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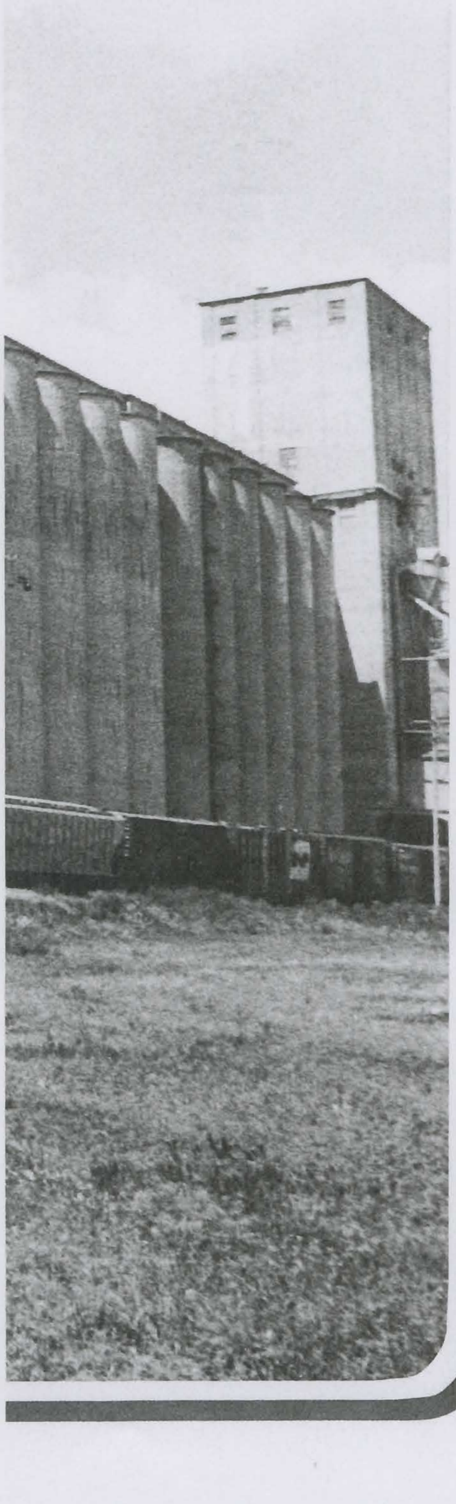

SOCIAL COSTS OF REGULATING RAILROAD GRAIN RATES IN THE UPPER MIDWEST

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SOCIAL COSTS OF REGULATING RAILROAD GRAIN RATES IN THE UPPER MIDWEST*

by Michael V. Martin and Reynold P. Dahl**

Introduction

Increasing Importance of Transportation Policy

Transportation is a primary component in the marketing process for most agricultural commodities. Farmers and shippers are served by a complex of transportation modes—trucks, railroads, and water carriers—which combine to form America's transportation system. This system links producing and consuming regions. Agricultural products flow from surplus to deficit areas, and price differentials induce the flow. Agricultural prices are lower in producing areas than in consuming areas by the amount of the transportation and handling costs.

Changes in transportation costs have a direct impact on prices paid to farmers. This price formation linkage has long been recognized by the Interstate Commerce Commission, which found in 1930:

> The producer's country price is generally said to be the market cash price minus the freight and handling charges into the market. On such a basis, it follows that a reduction in the inbound rate to the market would benefit the producer, if the market price remained stationary.

Therefore, improvements in the efficiency of the transportation system will benefit farmers.

Because transportation is of such significance to agricultural, as well as other, sectors of the economy, transportation policy has received a high public priority. Several recent events have further stimulated interest in transportation policy.

Numerous changes in agriculture and the general economy have placed new stresses on the transportation system. Rapid expansion in grain production and exports over the last five years has increased the demand

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for transportation service. Questions have been raised concerning the ability of the system to respond to these new needs.

Increased production and exports have been accompanied by shifts in marketing patterns. Routing, scheduling, and equipment acquisition have been affected. The "energy crisis" has focused additional attention on transportation operations. The railroads are both heavy users and major carriers of energy and have received special consideration.

Many railroads have also suffered from continuing operating losses. While there are many financially healthy railroads, there are a number in or near bankruptcy. The long-term financial viability of the rail network is threatened by the possible failure of the key regional carriers.

Finally, there has been considerable discussion of the need for a reevaluation of the role of government regulation of the railroad industry, particularly railroad rate regulation.

One specific railroad regulatory change which has received considerable attention is a proposed shift in the rules for ratemaking. For many years, railroad rates have been based more on value-of-service than on cost-of-service principles. Several transportation experts have argued that such a rate scheme encourages transportation system inefficiency and thus imposes certain costs on society. They suggest that a redefinition of regulatory ratemaking rules which focuses on cost-of-service considerations would favorably affect transportation system performance.

Purpose and Objectives of the Study

The purpose of this bulletin is to report the results of research aimed at evaluating the impact of a change to cost-of-service rates on grain. The focus is on grain shipments in the Upper Midwest region, including the states of Montana, North Dakota, South Dakota, and Minnesota. Wheat and barley transportation within and from this region are analyzed. Wheat is chosen because its transportation and marketing characteristics are typical of most other grains produced in the region. Barley is an atypical grain. Results will have implications for other grains and commodities.

The objectives of the study are as follows:

1. To establish a model for analyzing optimal efficiency in the intermodal distribution of grain traffic.
2. To determine actual grain flows and the modal distribution of traffic under current rates for comparison with the optimal distribution.
3. To estimate the social costs of suboptimal system efficiency.
4. To identify benefits to society from regulation in general and rate regulation in particular.
5. To evaluate proposed regulatory reform alternatives to improve the utilization of the grain transportation system and to assess the impact of these reforms on interregional grain shipments and markets.

It is hoped the results will provide answers to the following questions:

1. Does the current method of making and changing rail rates create a misallocation of wheat and barley traffic between rail and truck?
2. What are the social costs associated with utilization of the transportation system resulting from misallocation of traffic between modes?
3. Can the social costs be reduced through deregulation of railroad grain rates or through some reform in regulatory policies and/or procedures?
4. What are the ramifications on grain flow and interregional trade associated with deregulation or regulatory reform?

Railroad Regulation and Problems of the Railroads

History and Role of Railroad Regulation

Government regulation of railroads dates back to 1887 with passage of the Act to Regulate Commerce and the creation of the Interstate Commerce Commission. At that time railroads had a virtual monopoly on transportation in the U.S. and as such were conspicuously prosperous. Their market power allowed them to pursue a wide range of questionable business practices.

Regulation was designed to protect the public and to insure the availability of reliable, efficient transport services. The ICC was charged with protecting the public interest. Among other things, the Commission was directed to promote rates that were "just and reasonable" and to prevent "undue preference and prejudice." While discrimination between persons is specifically outlawed, this ratemaking directive has been interpreted so as to allow, in some instances, discrimination in rates between places and types of traffic. That is, the value-of-service rates which existed prior to imposition of regulation were, for the most part, permitted to continue.

There is strong general agreement that Congress took the appropriate action in 1887, given the structure and conduct of the transportation industry. However, there is a growing feeling that the ICC in its present form and with its present procedures is no longer a viable instrument for pursuing a socially sensitive transportation policy.

Conditions which originally justified regulation of railroads have changed significantly since 1887. Today, rather than dominating transportation, railroads are faced with stiff intermodal competition from trucks, water carriers, and pipelines. Many once wealthy railroads have fallen on hard times. While several railroads remain economically sound, the overall financial performance of the railroad industry has lagged well behind other major U.S. industries. In 1974 the rate of return on net worth for railroads, as a group, was 4.3 percent. This compares with a rate of return of 6.4 percent for the transportation sector as a whole and 12.7 percent for all industries, manufacturing and financial. In 1975 the railroads' return was .8 percent while all other transportation earned 2.3 percent and all industries experienced an 11.1 percent rate of return.

This poor performance in 1975 in a large part reflects the huge losses suffered by the Penn Central and a few other bankrupt northeastern lines. Still, the problem is not confined to the Northeast. The Rock Island Line and the Milwaukee Road, which serve the Midwest, are currently undergoing financial reorganization under bankrupt status. Further, it is worth noting that relatively low rates of return have been the rule rather than the exception in railroading. Between 1966 and 1972 the rates of return were consistently below 3 percent. In 1973 it was 3.08 percent.[1]

Critics of government regulation argue that many of the current problems in U.S. railroading are, at least in part, attributable to the failure of regulatory policy to keep pace with changing market conditions in the transportation sector. They contend that both railroads and the public are disadvantaged by out-dated regulatory policies regarding rail rates, branchline abandonments, and cross-modal regulatory differentials.

The Antiquated Railroad Rate Structure

The rate structure is as old as the railroads themselves. The foundation of the rail rate structure was set under the "value-of-service" pricing concept. In "value-of-service" pricing, rates were set at "what the market will bear" levels. High value freight was carried under higher rates than lower priced freight. Traffic over routes which railroads monopolized tended to move under relatively high rates.

Costs of service considerations were secondary, at best, in the development of the rail rate structure. Because they faced little effective competition at the turn of the century, demand factors were the primary criteria for rate setting, but competitive conditions have changed appreciably over the last 75 years. Motor trucks have grown into a highly competitive mode. Also, water carriers on both the inland rivers and the Great Lakes now vie for freight traffic. These changes in the competitive conditions facing railroads have not been accompanied by changes in the rail rate structure.

Using value-of-service and competition-oriented pricing techniques, railroads have created a complicated and often contradictory rate structure. The rate structure is replete with cases of effective cross subsidy between commodities and regions. The test of "reasonable" and "nonprejudiced," as outlined in law, has been interpreted so as to overlook many instances that would be defined as discriminatory from a strictly economic standpoint.

Continuing to operate under this pricing system, railroads have often found themselves noncompetitive on traffic which carries high rates relative to the actual cost of providing the transportation service when faced with competition from trucks. At the same time, railroads have found that their rates on certain low valued freight may not cover costs. As a result, much of their most profitable business has shifted to other modes, particularly trucks. In many cases, railroads have been left with the traffic where rates are low relative to costs.

While the rate structure was originally created by the rail carriers themselves, regulatory procedures and policies have effectively frozen that structure in place. Railroads have been unable, and in some cases unwilling, to respond to changing market conditions with new methods for setting rates. The rigidity built into the regulated rate structure has clearly contributed to the financial dilemma of U.S. railroads, but other regulatory problems have also had an impact.

Railroad Grain Rates: Structure and Characteristics

The ratebreak system is an important feature of the railroad grain rate structure. Instead of providing a system of through-rates from origin to final destination, this system provides for gathering rates from country origin to the first market to which is added a system of special rates to final destinations. Rates from the country origin to the first market are referred to as "flat" rates, and rates beyond the markets are designated as "proportional" rates. "Flat" rates are higher than "proportional" rates for comparable distances. The reason is that proportional rates were designed to be added to the gathering rates as portions of reasonable "through" rates from the country all the way through to distant consuming points.

The ratebreak system developed out of the transit privilege which was introduced in the late 1800s on western grain inbound to Omaha and later shipped to Chicago. At that time, the Union Pacific monopolized grain traffic from the west into Omaha. However, several carriers had routes from Omaha to Chicago. To hold the traffic for the second movement, Omaha to Chicago, the Union Pacific introduced the transit privilege. When the shipper shipped grain from Omaha to Chicago, he had to

[1] *Monthly Economic Letter*, CitiBank, New York, New York, April 1976.

Figure 1. Illustration of railroad rate-break system on barley

pay only the balance of the through-rate from country origin to Chicago provided it had been shipped into Omaha on the Union Pacific. The transit balance was lower than the Omaha to Chicago flat rate. The transit privilege applied even if grain was unloaded, stored, and/or processed in Omaha. The other carriers responded by offering proportional rates on Omaha-to-Chicago grain which were competitive with the Union Pacific's transit balances. The only stipulation was that the first movement was by rail, but the particular carrier did not matter.

Proportional rates were subsequently extended to many other markets which became ratebreak points. Thus, grain could be shipped into any one of these markets, stopped, unloaded, processed, and reshipped under a rate combination which was equivalent to a through-rate shipment.

The application of these rates at a ratebreak point is illustrated in figure 1. Assume a maltster in Minneapolis purchases a carload of barley from an elevator in Hallock, Minnesota. The car is shipped to Minneapolis at the flat rate of 66 cents per hundredweight. The car is unloaded, and the barley is processed into malt, reloaded, and shipped to Chicago. The Minneapolis to Chicago flat rate is 79 cents per hundredweight, but this does not apply since the first shipment was by rail. The lower proportional rate, 55 cents per hundredweight, applies to the malt from Minneapolis to Chicago. Hence, the total rate from Hallock to Chicago is $1.21 per hundredweight even though the barley was stopped and processed into malt at Minneapolis.

Processing or storage in-transit is also permitted under flat rates and proportional rates so that grain can be stored or milled at any point on the route from Hallock to Chicago and the total rail rate will be equivalent to the through-rate, $1.21 per hundredweight.

The economic effect of the ratebreak system and the transit privilege is to make transportation expense a neutral factor in location decisions for grain processors and handlers. Under a flat-rate-in, flat-rate-out structure, there would be an incentive for many grain processors to locate close to final markets because costs of service and rates on processed products are higher than those on raw commodities.

Another unique feature of the grain rate structure is market equalization. Market equalizing rates were introduced as a method of equalizing competition between various cities in grain processing and handling. Rates are equalized through several "gateways" to a specific destination.

Figure 2 may help in illustrating how market equalization works. Assume that grain originating in Kansas City is to be processed at some intermediate location and then shipped to Chicago, the final market. St Louis may be the location for processing on the most direct route to Chicago. However, under rate equalization, the rate for grain and the processed product from Kansas City through Minneapolis to Chicago is the same as the rate through St. Louis even though the distance via Minneapolis is considerably longer. Minneapolis can compete for the processing business even though it is not as well located as St. Louis from a transportation standpoint. The cost to the carrier for shipping through Minneapolis exceeds the cost through St. Louis, yet the rate is the same. Again, this rate structure eliminates transportation considerations from location decisions.

Rates for grain are subject to legislatively set criteria of "reasonableness and nonprejudice." As long as they pass this test, they are acceptable. By applicable definitions established over time by the ICC, the ratebreak system, the transit privilege, and market equalizing rates are "reasonable and nonprejudicial."

Figure 2. Illustration of market equalization in rail rates

Finally, there are numerous instances of rate discrimination between types of grain and directional flows. The law does not hold commodity discrimination to be illegal. It does hold place discrimination to be illegal when unjust or unreasonable.

The railroad rate structure on grain is an excellent illustration of ratemaking based on considerations other than the costs of providing the transportation service.

Branchline Abandonment

An issue of great concern, particularly in rural areas, is branchline abandonment. Because trucks can more effectively move freight over short distances, many short-haul rail branchlines have lost their economic viability. A recent study done at Iowa State University examined the benefits and costs of operations over 71 Iowa branchlines. The study found that only 13 have a benefit-to-cost ratio of over 1.00. Fifty-six have ratios of less than .25. Even though costs of operating over these low ratio lines greatly exceed revenues, service must be maintained until ICC permission to abandon is granted.

The process of approving abandonment applications is slow and imprecise. Cases may drag on for months and sometimes years. While the ICC hearing and decision process plods along, these branchlines are net loss operations for the rail company involved.

Certainly not all branchlines should be abandoned. Some generate sufficient traffic to justify continued operations. There are also cases where improved roadbed and service would stimulate new traffic and likely return them to profitability. However, in cases where current branchline utilization is low and the prospects for future improved utilization is poor, forcing the railroads to operate these lines only weakens the overall system. The majority of railroad abandonment requests eventually receive ICC approval. The basic problem is delay.

Truck and Barge Agricultural Rates Unregulated

Beyond the problems associated with direct regulation of railroads are problems created by the unequal regulation of competing modes. The ICC regulates rates and operations of all railroad traffic. However, trucks and barges may carry agricultural commodities exempt from ICC regulation.

Trucks hauling raw or partially processed agricultural output over interstate routes are free from any ICC regulation. As a result, they can respond quickly to changing market conditions. When demand for transportation services is high, rates will rise, increasing carrier revenue. When demand is low, rates will fall. To be efficient and profitable, railroads need consistent traffic so as to optimize utilization of high investment equipment. The competitive flexibility allowed trucks in pursuing agricultural traffic often prevents railroads from gaining and holding business over the long run.

Barge traffic in bulk commodities, such as grain, is also exempt from regulation. Bulk commodities make up over 90 percent of total barge freight. The bulk commodity exemption gives the barges a strong position on movements where they compete directly with railroads. In agricultural freight, the ability to lower rates to avoid empty backhauls gives barges a sizeable advantage by optimizing equipment utilization. For example, upriver movements of coal, petroleum, and fertilizer to Minneapolis are the primary barge shipments in the spring. To avoid sending their equipment south empty, they lower rates on grain traffic. This draws traffic from the railroads, who are unable to respond with lower rates themselves. When demand increases for southbound transportation in the fall, barges can increase rates on grain and lower rates on northbound products. In both instances, barges can avoid empty movements, while railroads cannot.

It would be grossly unfair to suggest that **all** the blame for the difficulties facing railroads is related to regulation. Along with rate regulation, branchline abandonment, and regulatory inequity problems, railroads face difficulties due to the nature of the cost structure of the service they provide. Because railroads own, construct, and maintain their own roadbed, and because railroad equipment is very expensive, a substantial portion of their costs are fixed. Truck and barge costs are much more variable in nature. In the case of barges, the roadbed—that is, the river—has been developed and maintained at no cost to the commercial users. Congress is currently considering a bill that would impose a system of user charges on the Mississippi River system. While trucks already pay user charges for highways through fuel and excise taxes, the amount charged each user varies with their traffic. Also, large investments in the highway system come from public rather than private funds.

Where costs are largely fixed, optimal utilization of plant and equipment is essential. The higher the traffic volume the more widely these costs can be spread. Empty backhauls, uneven annual transportation demand, and poor logistical management all contribute to suboptimal utilization. Railroads whose utilization is poor are likely to be railroads in critical economic shape since their fixed cost burden tends to create a heavy financial drag.

The stiff price competition given railroads by trucks and barges makes maximum utilization extremely difficult. Many railroad companies have abandoned certain types of freight traffic to other modes so as to concentrate on attracting better volume on freight for which they have an advantage.

The problem of utilization of equipment is further complicated by antiquated railroad operations. Many rail switching yards are outdated and inefficient. As a result, rail cars are frequently tied up by long delays and, upon occasion, completely lost. This problem is particularly acute when freight has to be transferred between two rail lines. Often a car belonging to one rail company will be switched to tracks belonging to another en route to its final destination. The car may not return to the owner line for months. If one line is using a car belonging to another, they are required to pay a per diem charge to the owner. These charges are frequently not adequate to compensate the owner firm for its loss from service.

Finally, railroading in many areas of the country has suffered from excess capacity. National enthusiasm for railroad expansion during the last half of the nineteenth century was responsible for this problem. Federal encouragement and assistance stimulated construction of a vast rail network during a period when it appeared that this would be the only mode for high volume transportation well into the future.

Railroad planners and government officials cannot be faulted for failing to foresee the rapid development of truck, barge, pipeline, and air transportation. Still, much of the track built during these railroad heydays is now redundant. This leaves the railroads to compete with one another while also trying to compete with trucks, barges, and pipelines. A number of the weaker lines have barely been able to generate enough traffic to survive. Government policy is now supportive of rail company mergers, which will eliminate duplication while still maintaining service. However, strong lines are reluctant to absorb their weaker sisters, especially when they believe they will be prevented from abandoning the net loss branchlines they would acquire in a merger.

Analytical Framework: the Social Costs of Transportation Regulation

Other Studies Estimating Social Costs of Railroad Regulation

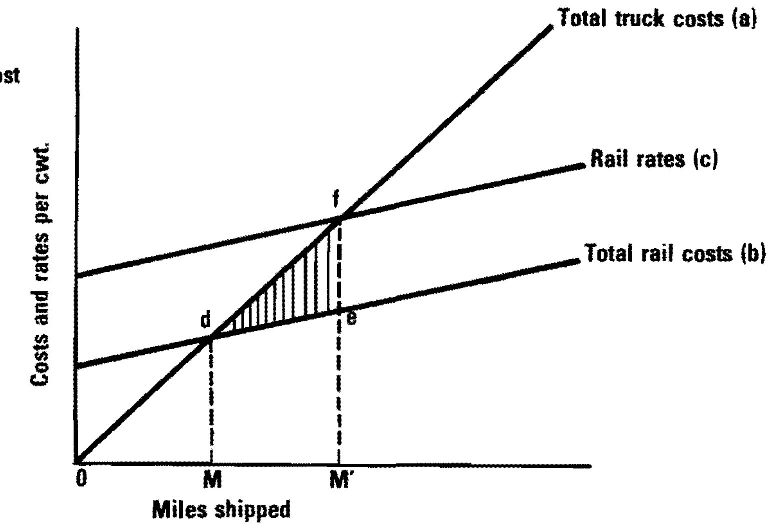
While many research projects have focused some attention on regulatory issues, four recent efforts deserve mention. Studies by Moore, Peck, Harbeson, and Friedlaender all attempt to put some monetary measure on the net social cost of government regulation under existing policy directives.[2] Each takes an aggregative approach to the problem. That is, these studies are general in terms of mode, commodity, and region.

While specific estimates of social cost vary over a wide range, these studies reach two common conclusions. First, the cost to society of regulation is substantial, between $3.8 billion and $8.9 billion for the decade of the 1960s.

Second, a substantial share of this social cost results from a misallocation of freight traffic between modes induced by value-of-service rail rates. Friedlaender

[2] Thomas Gale Moore, "Deregulating Surface Freight Transportation," *Promoting Competition in Regulated Markets*, Almarin Phillips, ed., Brookings Institution, Washington, D.C., 1975, pp. 55-98; Merton J. Peck, "Competitive Policy for Transportation?" *Perspectives on Antitrust Policy*, ed. Almarin Phillips, Princeton University Press, Princeton, N.J., 1965, pp. 244-73; Robert W. Harbeson, "Toward Better Resource Allocation in Transport," *Journal of Law and Economics*, Vol. 12, October 1969, pp. 321-38; and Ann F. Friedlaender, *The Dilemma of Freight Transport Regulation*, Brookings Institution, Washington, D.C., 1969.

Figure 3. Model for identifying the social cost of value-of-service pricing in rail transportation of wheat and barley



terms this a "deadweight loss" for society. To a large extent this loss occurs because value-of-service rates shift traffic from rail to truck. Moore estimates that 26 percent of the approximately 100 billion ton miles of traffic hauled by trucks during the 1960s would have been more economically moved by rail.

Peck concludes:

> A major source of the misallocation of traffic between modes is the high degree of economic price discrimination in transportation rates. Economists generally define price discrimination as price differences that do not reflect cost differences. Price discrimination so defined is a long-standing characteristic of railroad rates, though it is better known as value-of-service ratemaking.[3]

Harbeson summarizes his findings in this way:

> ...it is essential to recognize and remove the underlying causes of the existing uneconomical allocation of traffic. The principle underlying cause, in the writer's opinion, is not difficult to diagnose. It is the persistence of rail and motor rate structures still heavily influenced by so-called value of service, that is, discriminatory, pricing principles.[4]

The assumptions, methodology, and results of each study provide strong support for the conclusion and policy implications suggested by the authors. However, studies of this nature have certain limitations in terms of applicability. Because they are so broad in scope, they are subject to imprecision in estimation and contradiction when basic assumptions are altered. This study attempts to avoid some of these problems by reducing the scope of analysis to a specific type of traffic in a specific region.

[3] Peck, op. cit., p. 247.

[4] Harbeson, op. cit., p. 335.

Analytical Framework and Basic Assumptions of This Research

Much of this analysis hinges on two assumptions drawn from basic economic theory. First, perfectly competitive markets serve to optimize efficiency in allocating resources and forming prices. Thus, opportunity costs of production and income redistribution effects are minimized for society under such a market structure. Recognizing that no existing market is "perfectly" competitive, one can still argue that any move toward more effective competition or any move that serves to stimulate competition will have positive social benefits.

Second, if perfect competition existed, prices charged by producers would settle at levels which equal costs of production plus a "normal" return to capital. This is to say, no excess profits would be taken in the long run when such a market structure exists. This argument can also be used in a converse fashion: If economic profits are being taken, then it can be assumed that imperfect competition exists.

These two basic assumptions are used in formulating a model for measuring the social cost of regulated value-of-service rail grain rates. This model is presented in Figure 3. Here we assume rail cost, rail rates, and truck rates per hundredweight of grain shipped are approximately linear functions of the miles from origin to destination. As shall be demonstrated, reality tends to validate these assumptions. Further, it is assumed, and confirmed with empirical data, that grain trucking is a highly competitive industry, and thus truck rates tend to approach truck costs. Finally, this model assumes that shippers of grain make their selection of mode so as to minimize the transport bill. On each shipment, they choose the lowest rate mode.

Line (a) in figure 3 represents the cost function for trucking grain. It also represents the truck rate function. Line (b) represents the rail cost function (including a "normal" return). If the rail industry were as competitive as grain trucking, the rail rate function would be the same as the rail cost function. Under such circumstances, shippers would choose the truck mode for shipments of less than M miles and rail for shipments greater than M miles. Actual rail rates, at value-of-service levels, however, often exceed costs. Thus, one can determine a rate function, as indicated by line (c). Now it is clear that shippers would utilize trucks for shipments up to M' miles in length. Therefore, triangle (dfe) represents a cost to society due to the shifting of traffic to the relatively inefficient mode. This social cost is analogous to Friedlaender's "deadweight loss." Further, the area between lines (c) and (b) to the right of segment (fe) represents an income transfer from shippers to the railroads since rates exceed costs (including a "normal" return).

Figure 3 shows that the truck cost function has a steeper slope than the railroad cost function. This is because truck costs increase more rapidly with distance shipped than do rail costs. Also, the truck cost function starts at the origin since all truck costs are annualized and considered as variable costs. Truckers do not own terminal facilities or the roadbed. The cost of the roadbed to truckers accrues on a variable basis through the tax on fuel and the annual vehicle registration fee.

The railroad cost function, on the other hand, includes a sizeable fixed cost component. This is because railroads own and operate their own roadbed and terminal facilities. These costs do not vary with distance shipped. Hence, the railroad cost function intercepts the y axis in figure 3 at the level of fixed costs per hundredweight shipped.

Railroad and Truck Cost Functions

General Assumptions on Upper Midwest Grain Transport

To determine whether unnecessary costs are imposed on society by maintenance of value-of-service rail grain rates, it must be determined whether or not grain traffic is currently being carried under a suboptimal modal traffic distribution. Thus, a comparison of the current modal traffic distribution with a distribution implied by a set of rates consistent with a perfectly competitive sector will provide evidence of resource misallocation. Then, a comparison of the current transportation bill for grain transport services in the region with a hypothetical bill, given an optimal traffic distribution, will provide an estimate of the dollar cost of any existing resource misallocation.

A set of rates which reflects costs of service can be used to approximate perfect competition. Then, an optimal grain traffic distribution between truck and rail can be determined. This will allow an estimation of a transportation bill under hypothetical optimal conditions.

Because this study focuses on wheat and barley shipments in the Upper Midwest, certain assumptions are necessary to facilitate the estimates. These assumptions are as follows:

1. Flows of grain have been identified from 27 crop reporting districts in Minnesota, North Dakota, South Dakota, and Montana. Central shipping locations in each district have been selected for grain moving from the district. For simplicity, it is assumed that all grain shipped to Minneapolis and Duluth-Superior from districts originates at the representative central location (Appendix tables A-2 and A-3).
2. The production year 1975 serves as the base or representative year for volumes and flows of wheat and barley eastbound. A further assumption is that the total volume shipped to each destination, Minneapolis and Duluth-Superior, will not change with changes in transport rates in the short run. In other words, rail rates designed to optimally allocate grain traffic will be multiplied times the volume of grain shipped to each destination in 1975, where rail is the efficient mode, to determine rail shipping expense. The same will be done for trucked grain. A total transportation bill will be the sum of the two.
3. There is sufficient additional rail capacity to handle any reasonable increases in demand for rail grain transport. In 1973, when export sales of grain rose sharply, railroads were caught short of equipment. However, since that time, carriers serving this region have acquired additional railroad cars. But severe grain transportation problems and equipment shortages have reoccurred in 1978. Questions are again being raised as to the ability of railroads to handle increased quantities of grain for export.

   The trucking industry is capable of expanding or contracting capacity as demand dictates. The industry has low fixed costs and is fluid. Entry and exit may occur in the very short run.

Cost-of-service functions, including a "normal" return, for rail and truck grain transport can now be estimated. The functions estimate the costs for shipping grain on a per hundredweight and distance basis by motortruck and by rail car. These cost functions represent the cost of basic shipping services only. If a particular type of grain freight requires some assessorial service, either at the terminal or in transit, the costs of these services are considered in addition to those estimated by the cost functions.

Railroad Cost Functions

Estimating railroad cost functions is a difficult task. Railroads perform a large number of transportation services for an equally large number of commodities. Assigning the large fixed cost burden in railroading to each service and commodity is a nearly impossible task. As an alternative to continual reestimation of rail cost functions for each shipping circumstance, the Interstate Commerce Commission has developed a set of cost coefficients for major component functions required in any transport service. This set of coefficients is referred to as Rail Form A. In combination they provide a cost of service function for most commodity types by region.[5]

Form A costs are used here. The coefficients have been adjusted to reflect price changes between 1974 and 1977. Coefficients for rail costs in the western truck region[6] are presented and applied for this analysis.

This rail cost functions for the western region serve to estimate costs for all lines operating in this region. While it is recognized that different rail companies face different costs, it is assumed that the costs for any single type of freight traffic are approximately equal.

Along with the assumption of cost homogeneity between lines for grain shipping, a number of other assumptions were required:

1. All grain moving within and from the region is carried in jumbo hopper cars. In reality, grain is moved by boxcar as well as by jumbo hopper, but the hopper car has become increasingly prevalent in recent years. It is the preferred container for grain by all criteria. Boxcars, in general, serve as backup equipment. When evaluating efficiency, it seems reasonable to focus on the most efficient and most widely utilized type of equipment.
2. The average jumbo hopper car carries 1,701.35 hundredweight (cwt.) per laden movement. Maximum payload capacity of a hopper is 100 tons (200,000 lbs.) or 2,000 cwt. However, waybill sample statistics indicate that the average load weight for western region cars in 1975 was 170,135 pounds.[7]
3. The empty backhaul ratio is 1.988. That is to say, 98.8 percent of the grain cars returning to the western trunk region and to country elevators within the region are moved empty.[8] The implication here is that equipment used to move grain out of the region can find very little return haul traffic. From a cost estimating standpoint, this means that expenses incurred in returning empty cars to country origins must be allocated to the previous grain shipment. Rail Form A cost coefficients are calculated with empty backhaul expenses included.
4. Costs estimated for this study are for single car shipments from origins with train assembly at the nearest assembly yard.
5. In computing mileage for any given shipment, a circuity factor of 18 percent was included.[9] This is included as an estimate of additional mileage required for train assembly.
6. The basic cost function computed here assumes that no transit stops are made. However, certain grains are processed or stored at points between their origin and final destination. A sizeable share of such shipments move under transit rates. Barley shipping is heavily influenced by transit. Almost all barley malted in this region is either shipped under a combination of flat and proportional rates or utilizes the transit privilege. The railroad incurs a cost in providing transit. Thus, a charge of 9.4 cents per hundredweight is included on grain which will be transitted.[10] The transit expense includes costs associated with switching, handling, less car utilization due to time delays, billing, and general clerical activities.

The Rail Cost Function of Upper Midwest Grain

The cost functions for rail service on intraregional movements of grain take the following form:

$$TC = C + VC(X).$$

where

TC = total cost per hundredweight of grain shipped within the region;

C =terminal and fixed costs per hundredweight for handling grain (includes switching, train assembly costs, allied clerical services, and basic physical plant expense);

VC = variable cost per hundredweight per mile of actual train operation on a per hundredweight basis; and

X = miles shipped within the western trunk region.

Thus, using Rail Form A adjusted coefficients and the previously stated operation assumptions, the rail cost function for intraregional shipments of wheat and barley in cents per hundredweight is as follows:

$$TC_G = 11.69017 + .07198X.$$

Total rail costs and "full" rail costs are synonymous. Railroads commonly use the term "full cost" while total cost is the comparable economic term.

Truck Cost Functions

Because truck operations and costing are relatively simple, it is possible to build up truck costs by aggregating annualized expense components. It is necessary to

[5] ICC, *Rail Carload Cost Scales, 1974*, Bureau of Accounts Statement 1C1-74, Washington, D.C.

[6] States west of the Mississippi, but including rail connections to Chicago.

[7] U.S. Department of Transportation, *1975 Carload Waybill Statistics*, FRA, Office of Rail Systems Analysis and Program Development, Statement TD-1, Washington, D.C., July 1976.

[8] Burlington Northern, Inc., Tariff 3, ICC 3, Gene C. Griffin, *North Dakota Barley Rail Costs*, Verified Statement B.4., submitted to ICC, ExParte 270 Sub. 9 by the Upper Great Plains Transportation Institute, Fargo, North Dakota, February 1976, p. 11.

[9] ICC, *op. cit.*, p. 131.

[10] Robert Tosterud, *North Dakota Barley Transportation Characteristics*, Verified Statement B.4, submitted to ICC ExParte 270 Sub. 9 by the Upper Great Plains Transportation Institute, Fargo, North Dakota, February 1976, p. 44.

make a number of assumptions regarding a representative grain trucking operation. These assumptions are discussed with each component estimate.

Total costs of operations per year equal fixed costs plus variable costs per mile times annual running miles:

$$TC = FC + VC \cdot M.$$

$$FC = D + L + I + A + R,$$

where

D = depreciation and annual interest expenses;

L = annual license and other user charges (not including fuel taxes);

I = annual insurance expense;

A = annual administrative costs per truck; and

R = annual repair and maintenance per truck.

Assumptions:

1. The purchase price of a 10-wheel, diesel power tractor is $40,000. The price of an 8-wheel semitrailer used in grain hauling is $10,000. Thus, total equipment costs are $50,000.
2. The average tractor and trailer unit is depreciated over a five-year period and has salvage value of $15,000. The owner must pay a simple annual interest rate of 10 percent for capital. Then, annual depreciation and interest expense are

$$\frac{\$35{,}000}{3.791} + \$15{,}000(.10) = \$10{,}732.$$ [11]

3. Other costs per truck are

   L = $1,200 per year ($1,070 Minnesota + $130 interstate permits);

   I = $2,400 per year ($1,000 deductible);

   A = $2,000 per year; and

   R = $1,900 per year.

Single Trip Variable Costs:

$$STVC = O + T + W,$$

where

O = oil and filter costs per mile;

T = tire costs per mile; and

W = driver's wages per mile.

Assumptions:

1. The average truck gets 4.5 miles per gallon of diesel fuel, and fuel sells for an average price of 52 cents per gallon. Thus, fuel costs are 11.56 cents per mile.
2. A truck holds 5 gallons of oil which must be changed along with the filter every 10,000 miles. Oil sells for $2.60 per gallon and filters are $6.00 apiece. Thus, oil costs are .19 cent per mile.
3. A tractor and trailer unit requires tire changes every 90,000 miles. There are 18 tires on a unit which sell for an average of $300 each. Tire expense is 6 cents per mile.
4. While drivers are paid under a variety of schemes, it is assumed that, on the average, a driver receives 15 cents per running mile in pay.

[11] Present value of a $1 annuity five years hence at a 10 percent rate of interest. This method computes the required annual recovery rate when both depreciation and interest on capital are involved. In other words, the operator must realize $10,732 per year to recover vehicle costs ($9,232 + $1,500 = $10,732).

Assumptions on Annual Grain Hauling Operations

The average truck operates 260 days per year, 6.25 hours per day of running time, and 1.25 hours of terminal time. It operates at an average speed of 50 miles per hour, so that total annual running miles per truck are 87,750. In grain hauling, the truck returns empty 95 percent of the time. Consequently, the annual laden mileage is 46,069 miles; it operates empty over 41,681 miles.

In moving grain, the gross weight limit per unit is 73,000 pounds. Assuming a 48,000 pound payload, a grain truck can move 800 bushels of wheat or 1,000 bushels of barley (wheat at 60 pounds per bushel; barley at 48 pounds per bushel).

By annualizing the cost components in terms of assumed average annual operations, it is possible to turn all costs to variable costs. Then, a cost per laden mile of operation can be computed. This cost is 104.384 cents (assuming 95 percent empty backhaul).[12] Total truck cost per hundredweight for shipments of different distances are computed as follows:

$$\text{Total truck cost/cwt.} = \frac{\text{cost per laden mile} \times \text{miles shipped}}{\text{cwt. capacity of truck}}$$

or

$$\text{TTC/cwt.} = \frac{104.384 \text{ cents} \times \text{miles.}}{480}$$

Rail and Truck Cost Functions Compared

The relationship between truck and rail costs-of-service for wheat are shown graphically in figure 4. Note that trucks have a cost of service advantage out to 80 miles. For hauls longer than 80 miles railroads are the least cost mode. If the foregoing estimates of rail and truck costs fairly represent real costs, then it can be argued that where trucks haul grain in excess of 80 miles and sufficient rail service is present, a misallocation of grain traffic occurs. If either rail costs are actually higher then estimated or truck costs are lower than estimated, this mileage break point would increase.

Often times truckers suggest they set their rates at below levels suggested here. They do this by effectively absorbing some costs assumed in this analysis. Likewise, railroads often suggest the Form A cost estimates are too low. To attract capital, returns must be higher than those assumed by the ICC. To acknowledge these arguments, the modal traffic distributions under rates set at single trip variable truck costs and 120 percent of total rail costs are analyzed in Appendix figure A-1.

[12] A complete cost component breakdown is provided in the Appendix.

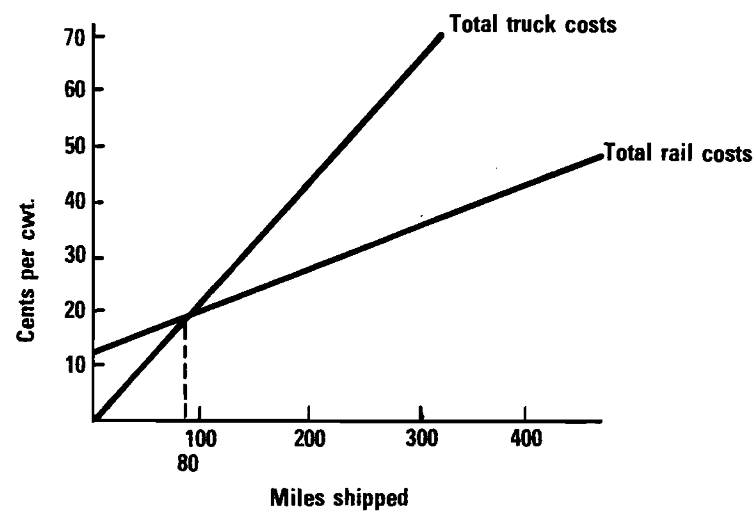


Figure 4. Cost functions for wheat shipped via truck and rail on intraregional hauls

Optimal Modal Distribution of Grain Traffic

Distribution of Wheat Traffic

Under total rail and truck cost assumptions, rail is the economic mode for wheat shipments in excess of 80 miles. The degree to which rail is preferable to truck can be seen in table 1, which shows the ratio of rail costs to trucks costs from each of 27 representative country origins.[13] Where the ratio exceeds 1, truck is the cost efficient mode. For values less than 1, rail is less costly than trucks. The smaller the ratio, the more cost efficient rail is relative to truck (and vice versa).

The only two origins from which trucks should be used are Minnesota districts 5 and 9. In all other cases, railroads hold the cost advantage in moving wheat to Minneapolis-St. Paul and Duluth-Superior.

Total Wheat Transport Expense under Optimal Traffic Distribution

If one assumes that rail and truck costs for rate determination under least expense mode selection, the expense of shipping wheat from 27 country locations is summarized in table 2. The expense is computed by multiplying the cost-based rates times estimated flow volumes from each origin to each destination.[14] The total expense for all regional shipments would be approximately $77 million. With full cost-based rates, rail

[13] The actual origins and their highway and rail mileages to Minneapolis-St. Paul and Duluth-Superior are shown in Appendix tables A-2 and A-3.

[14] Estimated from several sources, including *Agricultural Statistics* for North Dakota, South Dakota, Montana, and Minnesota; North Dakota Public Service Commission Grain Movement Statistics; U.S. DOT and Minnesota DOT *One Percent Waybill Sample; Minneapolis Grain Exchange Annual Report, 1976*; and shipping records of the Burlington Northern Railroad. Volumes shipped in 1975 are used here.

Table 1. Ratio of total rail costs to total truck costs per hundredweight for wheat shipped from 27 representative origins to Minneapolis and Duluth-Superior

State and district	Station	Minneapolis	Duluth-Superior
North Dakota			
1	Powers Lake	.4543	.4641
2	Rugby	.4687	.5346
3	Langdon	.4836	.5344
4	Killdeer	.4110	.4774
5	Woodworth	.5154	.5253
6	Hope	.5705	.5685
7	New England	.3793	.4768
8	Moffit	.4804	.5370
9	Forman	.4563	.5254
South Dakota			
1	Isabel	.4814	.4900
2	Roscoe	.5142	.5635
3	Webster	.6479	.4807
4	Sturgis	.4337	.4460
5	Ree Heights	.5411	.4740
6	Madison	.8243	.4919
8	Murdo	.5008	.4985
9	Menno	.6668	.5814
Minnesota			
1	Crookston	.5757	.6529
4	Morris	.7568	.6149
5	St. Cloud	1.2191	.7462
7	Lake Wilson	.7813	.6613
9	Rochester	1.1422	.7114
Montana			
2	Havre	.4170	.4489
3	Poplar	.4244	.4727
4	Lewiston	.5017	.5025
6	Billings	.4625	.4637
7	Miles City	.4741	.4752

Table 2. Shipping expense for wheat to Minneapolis and Duluth-Superior assuming distribution of traffic based on rates reflecting total rail costs and total truck costs per hundredweight from 27 representative country origins, 1975 shipment volumes

Origin	Station	Minneapolis	Duluth-Superior	
		Total costs ($ in 1,000s)		
North Dakota				
1	Powers Lake	3,160	6,873	
2	Rugby	1,279	3,432	
3	Langdon	2,640	6,012	
4	Killdeer	801	1,488	
5	Woodworth	1,440	2,191	
6	Hope	1,524	2,890	
7	New England	1,728	1,540	
8	Moffit	548	946	
9	Forman	1,554	1,956	
Total		14,679	27,331	42,010
South Dakota				
1	Isabel	1,288	734	
2	Roscoe	2,902	1,579	
3	Webster	1,165	713	
4	Sturgis	2,204	—	
5	Ree Heights	1,219	680	
6	Madison	283	—	
8	Murdo	1,840	—	
9	Menno	214	—	
Total		11,118	3,708	14,826
Minnesota				
1	Crookston	4,078	5,237	
4	Morris	1,509	2,482	
5	St. Cloud	218	477	
7	Lake Wilson	228	—	
9	Rochester	124	—	
Total		6,159	8,197	14,257
Montana				
2	Havre	228	232	
3	Poplar	1,453	1,492	
4	Lewiston	109	111	
6	Billings	50	51	
7	Miles City	1,062	1,088	
Total		2,904	2,976	5,881
Regional Total		34,861	42,214	77,076

carriers would dominate inbound wheat shipments. Trucks would handle only a very small portion of wheat shipments.

Of the total expense for shipping wheat, the largest share would accrue as revenue to rail carriers. Railroad revenues would be $76.7 million while truckers would receive $.3 million.

Optimal Barley Traffic Distribution

Barley shipping inbound, particularly to Minneapolis maltsters, differs from wheat. Maltsters require additional assessorial services from rail shipping on inbound barley. Because official barley grades do not completely indicate malting quality, maltsters generally buy on the basis of graded, submitted samples. Official reinspection and regrading are usually required. This involves switching and siding the car and thus reduces car utilization. On occasion, a car of barley will be found to be of a grade below malting standards. The car must then be picked up and switched, and the barley reshipped. Also, contamination of barley is a major concern of barley shippers and maltsters. Railroads report that their best equipment is used in shipping malting barley.

Nearly 100 percent of Minneapolis-destination barley is shipped via rail. Truckers contend that this is due to the transit privilege-proportional rail rates, which effectively capture all first movement malting barley traffic. This analysis will assume away the transit requirements for first movement barley to determine the economic viability of truckers for malting barley hauling under cost-based rates. However, maltsters believe that trucked barley imposes several costs on them not created under rail shipments.

First, trucks do not afford maltsters the opportunity to side and regrade the shipment. It is unlikely that a trucker will park his vehicle and wait 24 to 36 hours for regrading before unloading. Thus, to handle large volumes of trucked barley, maltsters would need substantial short-term, small-unit (1,000 bushels) storage facilities. Such temporary storage increases handling and raises costs.

Second, maltsters argue that the process of dumping trucked barley creates a problem in dust control. To handle barley inbound by truck, these maltsters would have to install additional dust control equipment.

Third, large-volume truck receiving requires considerable parking and staging space and easy access from major highways.

Finally, because a rail car carries about three times the volume of grain a truck does, maltsters feel that paperwork involved in receiving trucked barley would be greatly increased if large volumes of barley were trucked in.

Estimates of the additional cost of trucking in barley vary with the maltster involved. Officials of Rahr Malting, the area's largest maltster, estimate that their costs would increase approximately 11 cents per hundredweight. This estimate will be used for analysis and will be added to truck costs to reflect the total cost in moving barley via truck to Minneapolis.

The relative advantage of each mode for barley shipping can be identified when this additional truck cost on malting barley shipments and rail assessorial service costs are included. Table 3 shows the ratio of rail to truck costs. Again, a ratio greater than 1 indicates trucks are the least cost mode. Trucks would move barley to Minneapolis on hauls of up to about 70 miles when total truck costs are compared to total rail costs. Railroads will pick up all shipments of greater length. On barley shipped to Duluth-Superior, truck costs do not include the 11 cents per hundredweight for Minneapolis barley. Thus, the truck advantage to Duluth-Superior is greater than for Minneapolis. With total rail and truck costs, trucks are the lower cost mode on hauls of 145 miles or less to Duluth-Superior.

Table 3. Ratio of total rail costs to total truck costs per hundredweight for barley shipped from representative origins to Minneapolis and Duluth-Superior, R_2

State and district	Station	Minneapolis	Duluth-Superior
North Dakota			
1	Powers Lake	.4867	.5376
2	Rugby	.5061	.6395
3	Langdon	.5230	.6496
4	Killdeer	.4437	.5528
5	Woodworth	.5558	.6365
6	Hope	.6129	.7111
7	New England	.4149	.5534
8	Moffit	.5212	.6380
9	Forman	.5098	.6514
South Dakota			
1	Isabel	.5174	.5630
2	Roscoe	.5569	.6635
3	Webster	.6858	.5808
4	Sturgis	.4628	.4996
5	Ree Heights	.5805	.5543
6	Madison	.8300	.5824
8	Murdo	.5316	.5651
9	Menno	.6938	.6783
Minnesota			
1	Crookston	.6176	.8337
4	Morris	.7817	.7980
5	St. Cloud	1.0596	1.0403
7	Lake Wilson	.7987	.8109
9	Rochester	1.0333	.9043
Montana			
2	Havre	.4388	.4961
3	Poplar	.4552	.5440
4	Lewiston	.5202	.5489
6	Billings	.4847	.5140
7	Miles City	.4996	.5355

Total Barley Transport Expense under Optimal Traffic Distribution

Table 4 shows the estimated transportation bill for shipping barley when traffic is allocated to the least cost mode. The total expense is $24 million for shipments from 27 representative origins to Minneapolis and Duluth-Superior. As in the case of wheat, most barley traffic and thus most revenue from shipping barley will accrue to rail carriers. Of the $24.1 million total bill, $24 million will be railroad revenue while only $100 thousand will be truck revenue.

Table 4. Shipping expense for barley to Minneapolis and Duluth-Superior assuming distribution of traffic based on rates reflecting total rail costs and total truck costs per hundredweight from 27 representative country origins, 1975 shipment volumes

Origin	Station	Minneapolis	Duluth-Superior	
		Total costs ($ in 1,000s)		
North Dakota				
1	Powers Lake	790	215	
2	Rugby	1,078	227	
3	Langdon	3,524	998	
4	Killdeer	73	24	
5	Woodworth	533	159	
6	Hope	2,265	469	
7	New England	130	28	
8	Moffit	25	2	
9	Forman	824	215	
Total		9,245	1,941	
South Dakota				
1	Isabel	166	111	
2	Roscoe	629	442	
3	Webster	386	282	
4	Sturgis	55	36	
5	Ree Heights	277	194	
6	Madison	475	—	
8	Murdo	145	—	
9	Menno	157	—	
Total		2,293	1,067	
Minnesota				
1	Crookston	3,625	1639	
4	Morris	1,273	241	
5	St. Cloud	36	13	
7	Lake Wilson	40	—	
9	Rochester	31	—	
Total		5,007	895	
Montana				
2	Havre	790	362	
3	Poplar	569	262	
4	Lewiston	460	210	
6	Billings	317	145	
7	Miles City	344	158	
Total		2,482	1,139	
Regional total		19,028	5,043	24,071

Value-of-Service Rail Grain Rates and the Actual Grain Transport Expense

Current Rail Rate Functions

Having proposed an optimal distribution for wheat and barley traffic under cost-based rail rates, a comparison can now be made with the actual distribution under the existing rate structure. First, it is necessary to determine rate functions for wheat and barley rail transport services.

By fitting a simple OLS regression to X-336 rates with miles as the independent variable, the following rate functions are obtained:

Wheat rates eastbound under X-336:

$$\text{Rate/cwt.} = \underset{(3.40)}{17.3031} + \underset{(18.10)}{.1383}\,(\text{miles}) \quad R^2 = .92$$

Barley rates eastbound under X-336:

$$\text{Rate/cwt.} = \underset{(2.22)}{49.188} + \underset{(12.47)}{.095}\,(\text{miles}) \quad R^2 = .91$$

The t statistic values are in parentheses.

As the estimated equations and accompanying statistics indicate, rates are approximately linear over miles for eastbound grain. This close linear relationship is the result of three factors. First, in longer hauls, rail carriers have less truck competition and thus can charge higher absolute rates. This is essentially a value-of-service characteristic in grain rates.

Second, general rate structures of this nature are more easily defended when challenged before the ICC. For example, rates directly related to distances shipped cannot be challenged under section 4 of the Interstate Commerce Act, which requires that long hauls not carry lower rates than short hauls over the same routes. Also, accusations of price discrimination are more easily rejected with this type of rate function.

Third, rail costs increase with the distance shipped, and rates reflect these cost increases. However, as can be seen from the functions, the rates on both wheat and barley increase more rapidly with distance than costs. The slope of the wheat rate function is .1383. The slope of the barley rate function is .095. The cost functions have a slope of .072. Figure 5 shows rate functions and the corresponding cost-of-service functions. Costs increase with distance shipped, but rates rise even faster with distance. Table 5 shows the ratio of X-336 rail rates to estimated rail costs for shipping wheat and barley from country origins. Note that in only one instance is the ratio less than 1. In many instances the ratio exceeds 1.5.

Actual Distribution of Wheat and Barley Traffic

The result of rate levels set under value-of-service conditions is that trucks are given a competitive advantage in rates which exceed their competitive advantage implicit in costs. That is to say, rail rates which exceed cost-of-service levels tend to shift wheat and barley traffic toward trucks to a greater degree than economic considerations would dictate.

Table 6 shows the mileage advantage of trucks when rates are considered. As the table indicates, the truck mileage advantage increases substantially when rail rates replace rail costs. These relationships are shown graphically in figures 6, 7, and 8. Shippers wishing to minimize transportation expense would opt for truck over rail in cases where the actual expense of shipping is less than for rail. This of course, imposes a cost on society due to the misallocation of grain traffic toward the higher cost carrier.

Rail rates under X-336 for wheat and barley are set at a level which more than doubles the length of haul advantage of trucks in every situation. In the case of barley bound to Minneapolis, existing rail rates more than quadruple the truck haul radius. Rail carriers have managed to hold virtually all Minneapolis barley traffic even under these rates because maltsters can only realize the lower outbound proportional rates on malt if the inbound barley movement is by rail. This analysis would seem to suggest that if the transit privilege-proportional rate structure were eliminated and barley rates stayed at current levels, some Minneapolis barley would shift to truck.

Table 5. Ratio of X-336 wheat and barley rail rates to total rail costs from 27 representative origins to Minneapolis and Duluth-Superior

State and district	Station	Wheat Minneapolis	Wheat Duluth-Superior	Barley Minneapolis	Barley Duluth-Superior
North Dakota					
1	Powers Lake	1.59	1.53	1.68	1.61
2	Rugby	1.44	1.45	1.67	1.68
3	Langdon	1.42	1.46	1.73	1.76
4	Killdeer	1.53	1.46	1.68	1.61
5	Woodworth	1.61	1.41	1.76	1.68
6	Hope	1.46	1.39	1.75	1.69
7	New England	1.53	1.59	1.82	1.63
8	Moffit	1.58	1.37	1.83	1.61
9	Forman	1.50	1.33	1.75	1.59
South Dakota					
1	Isabel	1.67	1.38	1.55	1.56
2	Roscoe	1.58	1.25	1.30	1.37
3	Webster	1.45	1.25	1.16	1.26
4	Sturgis	1.54	1.54	1.34	1.37
5	Ree Heights	1.59	1.52	1.30	1.30
6	Madison	1.39	1.47	1.16	1.25
8	Murdo	1.27	1.36	1.10	1.20
9	Menno	1.52	1.58	1.26	1.15
Minnesota					
1	Crookston	1.45	1.43	1.71	1.78
4	Morris	1.40	1.54	1.70	1.78
5	St. Cloud	1.42	1.32	1.73	1.65
7	Lake Wilson	1.56	1.56	1.16	1.27
9	Rochester	1.07	1.26	.73	.99
Montana					
2	Havre	1.86	1.83	1.48	1.45
3	Poplar	1.79	1.74	1.92	1.88
4	Lewiston	1.64	1.61	1.34	1.32
6	Billings	1.93	1.89	1.53	1.49
7	Miles City	1.51	1.48	1.76	1.72

Table 6. Truck advantage in miles from Minneapolis and Duluth-Superior destinations under total cost and rate comparisons

	Total rail cost-total truck cost	X-336 rates-total truck cost
Wheat to Minneapolis and Duluth-Superior	80	218
Barley to Minneapolis	70	304
Barley to Duluth-Superior	145	402

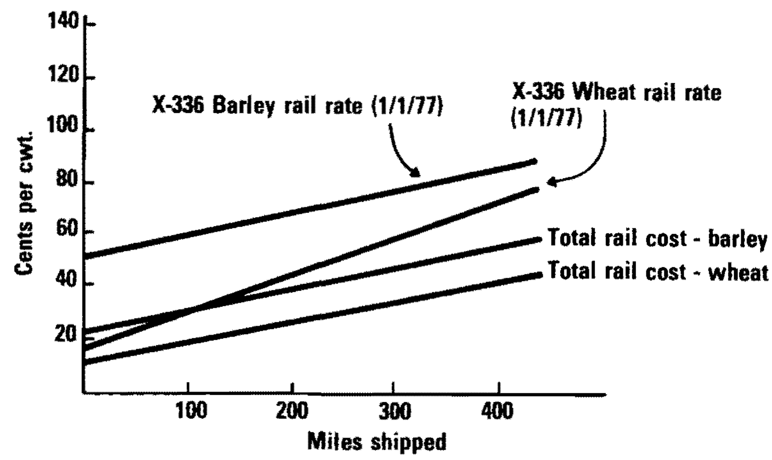


Figure 5. Barley and wheat rail rate functions at X-336 and rail cost-of-service functions

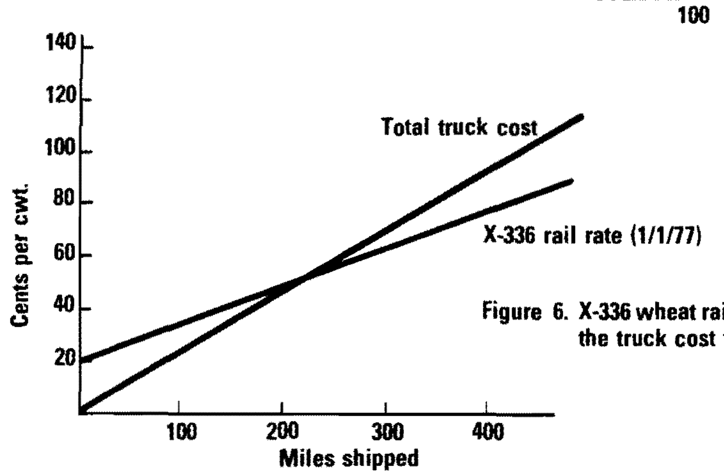


Figure 6. X-336 wheat rail rate function for eastbound shipments, and the truck cost function

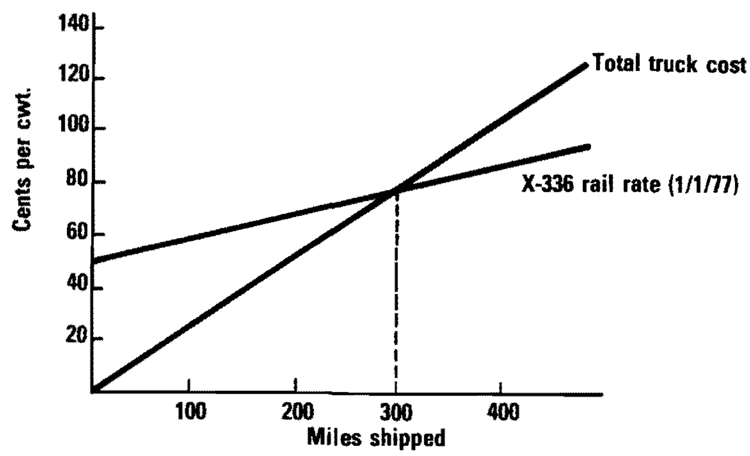


Figure 7. X-336 barley rail rate function to Minneapolis, and the full truck cost function

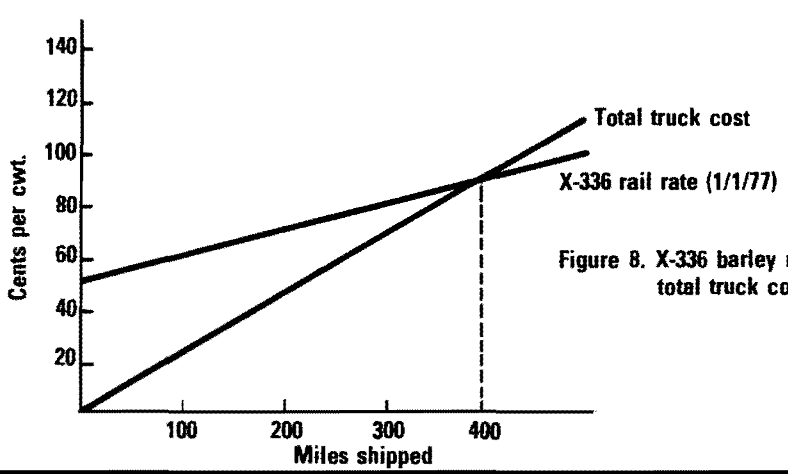


Figure 8. X-336 barley rail rate function to Duluth-Superior and the total truck cost function

Social Costs of the Current Rate Structure

The Actual Transport Bill and the Associated Social Costs

Measuring the social costs of the current rate structure involves comparing the estimated actual transportation bill with a hypothetical transportation bill that would occur under competitive cost-based rates. Thus,

Total social cost = actual transportation bill — (minus) optimal distribution cost-based transportation bill.

Once the total social cost is estimated, it can be allocated between the two causes. The social cost of traffic misallocation can be estimated by first identifying the volume of traffic from each origin moving via the inefficient mode. The resource cost of moving grain by truck where rail is the preferable mode is computed as follows:

$$\text{Social cost of traffic misallocation} = \sum_{j=1}^{2} \sum_{i=1}^{27} (\text{TTC} \times \text{cwts.} - \text{TRC} \times \text{cwts.})_{ij}$$

i = origin, j = destination

where

TTC = total truck cost per hundredweight from each origin to Minneapolis and Duluth-Superior;

cwts. = hundredweights shipped from each origin via truck; and

TRC = total rail cost per hundredweight from each origin to Minneapolis and Duluth-Superior.

The social cost effect resulting from monopoly pricing, i.e., the income redistribution, is then the residual social cost remaining when misallocation costs have been substracted from total social cost.

The total actual transportation bill estimate is made by multiplying actual shipments from each origin by each mode, by the appropriate modal rate. The actual bill of inbound wheat transport totals $123.2 million, of which $39.8 million accrues to trucks and $83.4 million accrues to railroads. The actual transportation expense for barley totals $39.7 million. Trucks realize $2.8 million; railroads realize $36.9 million. Thus, the sum of inbound transportation bills for these two grains under X-336 rail rates, truck rates equal to truck costs and 1975 shipment volumes, is $162.9 million, with railroads realizing $120.3 million and trucks $42.6 million.

If the optimal distribution of wheat and barley traffic is defined using total rail costs, then the total social effect of value-of-service rates is $46.1 million on wheat transport and $15.6 million on barley. The summary of these costs is shown in table 7. Total social cost arising from misallocation of wheat and barley traffic is $18.9 million. This is primarily the result of trucks hauling grain over distances for which railroads are more efficient.

The remaining social effect, $42.8 million, occurs because value-of-service rail rates exceed total rail costs. This represents an income redistribution in that resources committed to rail service realize returns which more than cover the value of those resources and a normal return on investment.

Table 7. Summary of social costs resulting from value-of-service rail rates on eastbound wheat and barley, assuming total rail cost rates to Minneapolis and Duluth-Superior

		dollars in millions
Wheat:		
Actual expense of shipping 1975 volumes under X-336 rail rates and total truck costs		123.2
Expense under rates reflecting full rail costs and total truck costs (least expense modal distribution)		77.1
Total social cost on wheat		46.1
Cost resulting from misallocation of traffic	18.0	
Cost resulting from monopoly pricing by railroads	28.1	
Barley:		
Actual expense of shipping 1975 volumes under X-336 rail and total truck costs		39.7
Expense under rates reflecting full rail costs and total truck costs (least expense modal distribution)		24.1
Total social cost on barley		15.6
Cost resulting from misallocation of traffic	.9	
Cost resulting from monopoly pricing by railroads	14.7	
Total social cost		61.7
Total resulting from misallocation of traffic	18.9	
Total resulting from monopoly pricing by railroads	42.8	

At first glance, one might be surprised at the relative distribution of total social effect between the effects of misallocation of traffic and that of monopoly pricing. The effect from monopoly pricing is much larger than that accruing due to traffic misallocation. This is, in part, due to the fact that areas in which railroads hold a monopoly position are also areas of high grain density. Thus, these high rates are applied to a fairly high volume of grain shipments.

Value-of-service rates elevate the total transportation bill faced by shippers of wheat and barley to a level substantially above what it would be if rates reflected the full cost of transportation resources. It can be concluded that this excess transportation expense results in lowered prices paid to farmers. Depending upon relative elasticities of supply and demand, consumer price may be influenced upward as well.

Economic Effects of Flat Percentage Increases in Rail Rates

If value-of-service pricing for rail service encourages a maldistribution of wheat and barley traffic toward trucks, the current method used for increasing rail rates aggravates the problem. Rail rate levels have, over time, moved continually upward. These rate level increases have been applied mainly on an across-the-board, flat percentage basis.

The flat percentage rate increase method is used because it allows relatively easy computation of new rates and has been consistently accepted by the ICC. Where rates are a linear function of miles, a flat percentage increase will increase both the intercept and slope of the function. An appraisal of actual rates and recent rate increases reveals that this does indeed occur. Table 8 shows estimated rate functions for rail rates at six levels. Figure 9 shows these functions graphically.

Table 8. Estimated rail wheat rate functions for rate levels X-267B to X-336 (t statistics in parentheses)

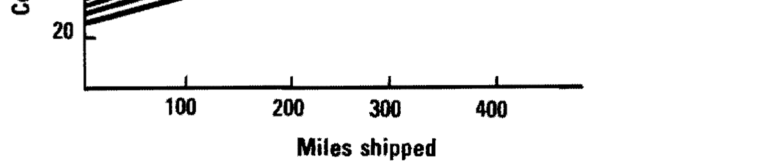
	R^2
X-267B, March 1, 1972	
Rate/cwt. = 10.6367 + .0858 (miles)	.93
(3.62) (19.50)	
X-281B, October 23, 1972	
Rate/cwt. = 10.8430 + .0885 (miles)	.93
(3.56) (19.46)	
X-305A, January 20, 1975	
Rate/cwt. = 10.7101 + .1129 (miles)	.94
(2.80) (19.72)	
X-313, October 11, 1975	
Rate/cwt. = 12.3926 + .1298 (miles)	.94
(2.79) (19.57)	
X-330, October 1, 1976	
Rate/cwt. = 13.1405 + .1363 (miles)	.94
(2.75) (19.07)	
X-336, January 1, 1977	
Rate/cwt. = 17.3031 + .1383 (miles)	.92
(3.40) (18.10)	

As these functions indicate, absolute rate increases are greatest on long-haul traffic. This is the traffic which railroads are best suited to handle. When rail rates increase during a period of relatively constant truck rates, this method serves to shift traffic toward trucks. Thus, one might argue that this type of rate increase serves to discourage the traffic for which railroads are the efficient mode. Not only may percentage rate changes further misallocate traffic toward trucks, they may also increase the social costs associated with monopoly pricing. In general, increases in rail service costs have risen less per unit per mile as mileage shipped increases. But again, it is on this traffic that rate increases are the greatest.

Finally, when rate levels are increased on a percentage basis, first movement grain shipments may carry a greater burden than second movements, where the proportional rate is applicable, because the rate per unit per mile is lower under proportional rates than under inbound flat rates by a greater absolute amount than outbound proportional rates. The absolute differential between the two rates is expanded under this scheme.

If regulation were reformed such that rates would be based on cost-of-service rather than value-of-service, an alteration in this rate adjustment method would also be required so that rate increases would more closely correspond to cost increases. If such a change does not occur, rates will be distorted under the flat percentage increases.

Figure 9. Rail rate functions at six levels where flat percentage rate increases were applied



Summary and Conclusions

Summary

The results of this research yield several conclusions with regard to existing rail grain rates under value-of-service pricing techniques and the impact of such rates on society. First, value-of-service rates create an incentive for some grain traffic, particularly on intermediate hauls, to shift toward inefficient trucks and away from the more efficient railroads. For example, trucks are the least **rate** mode on hauls of up to 218 miles for wheat to Minneapolis and Duluth-Superior and 304 miles on barley to Duluth-Superior. This occurs when cost-of-service implies that the truck advantage should only extend to 80 miles on wheat to each terminal and 145 miles on barley to Duluth-Superior.

While it cannot be argued that value-of-service rail rates are solely responsible for shifting intermediate length grain traffic to less efficient trucks, the evidence suggests that they are an important factor motivating this shift. This misallocation of traffic imposes a cost on society of between $14.9 and $19 million annually. This cost results from the "deadweight loss" associated with an overcommitment of resources to transportation that is necessitated by system inefficiency.

Second, the current method of increasing rates, that is, flat percentage rate increases, may serve to aggravate the situation. This is due to the fact that under this method the greatest absolute rate increase falls on long-haul traffic where absolute rates are highest. However, it is this traffic which rail carriers should be attracting. Also, cost-of-service increases are usually smallest on long-haul traffic since this is where railroads have their efficiency advantage. If truck rates remain constant, a flat percentage increase in rail rates would tend to increase the mileage rate advantage to trucks relatively more than other methods of adjusting rates.

Third, rates above costs on long-haul traffic cause an income transfer. Rail carrier revenues are subsidized at the expense of grain shippers and, ultimately, farmers. For the shipments examined in this study, the income transfer effect that results from these rate levels is estimated at between $27 and $43 million annually.

Conclusions and Policy Implications

The results of this research strongly suggest that a move toward cost-of-service ratemaking would reduce the total transportation bill for eastbound shipments of wheat and barley in the Upper Midwest. Cost-of-Service rates would result in the railroads recapturing traffic where they have a cost advantage. An efficient grain transportation system can be achieved if rate structures of all carriers are based on service costs. Transportation rate structures based on costs would result in each carrier — trucks, railroads, and barges — providing the services over distances where each has the lowest costs. This will minimize the total transportation bill for transportation services.

Railroads should be given more flexibility in ratemaking to enable them to adjust their rates in accordance with costs to meet the competition of unregulated trucks and barges. This is particularly applicable in areas such as the Midwest where intermodal competition is intense. In such areas, intermodal competition is probably the best regulator of transportation rates. Competition should assure that each mode will provide the transportation services where it has a cost advantage. Railroad rates in such competitive areas may not cover fully distributed costs but at least will cover variable costs.

The case for deregulation of rail rates is not as strong in areas such as the Great Plains which are far-removed from river corridors. Here, railroads are not confronted with truck-barge competition. The results of this study show that railroad rates above costs on long-haul traffic cause an income transfer. Hence, in areas where railroads have a monopoly on transportation services, railroad rates should continue to be monitored by the Interstate Commerce Commission. Even in these areas, however, railroads should be encouraged to offer new services and rates based on costs such as multiple-car shipments.

Intermodal competition has caused a gradual shift in the railroad rate structure to a cost-of-service basis over the past few years. Multiple-car rates, unit train rates, and special export rates which do not include transit privileges are examples. This trend should be accelerated.

If rates move toward costs, traffic shifts to the least cost mode, and rail capacity, where it is burdensome, is reduced; the policy goal as stated in the "inherent advantage" clause of the Transportation Act of 1940 can be achieved.

Appendix

Table A-1. Annualized cost for an average grain truck operation, per truck

Expense	Cents per running mile	Annual (dollars)
Depreciation	12.230	$10,732.00
License	1.368	1,200.00
Insurance	2.735	2,400.00
Administrative	2.279	2,000.00
Repairs	2.165	1,900.00
Fuel	11.560	10,143.90
Oil and filter	.190	166.73
Tires	6.000	5,265.00
Wages, driver-owner	15.000	13,162.50
TOTAL	53.530	$46,969.63

Single trip variable costs = 32.750¢/running mile (SVTC = F + O + T + W)
Total costs per laden mile (95 percent empty back haul) = 104.384
Single trip variable costs per laden mile = 63.863¢

Table A-2. Representative locations and truck mileages to Minneapolis and Duluth-Superior for grain shipping districts in North Dakota, South Dakota, Minnesota, and Montana

State and district	Location	Minneapolis	Duluth-Superior
North Dakota			
1	Powers Lake	573	588
2	Rugby	472	412
3	Langdon	426	375
4	Killdeer	635	573
5	Woodworth	374	389
6	Hope	288	303
7	New England	626	564
8	Moffit	413	428
9	Forman	326	343
South Dakota			
1	Isabel	474	592
2	Roscoe	353	432
3	Webster	225	432
4	Sturgis	681	807
5	Ree Heights	352	538
6	Madison	215	478
8	Murdo	531	649
9	Menno	302	446
Minnesota			
1	Crookston	286	239
4	Morris	148	236
5	St. Cloud	65	147
7	Lake Wilson	162	289
9	Rochester	83	224
Montana			
2	Havre	967	916
3	Poplar	657	606
4	Lewiston	916	931
6	Billings	844	859
7	Miles City	702	717

Table A-3. Representative stations and rail mileages* to Minneapolis and Duluth-Superior for grain shipping districts in North Dakota, South Dakota, Minnesota, and Montana

State and district	Station	Minneapolis	Duluth-Superior
North Dakota			
1	Powers Lake	624	662
2	Rugby	506	503
3	Langdon	460	443
4	Killdeer	626	664
5	Woodworth	420	455
6	Hope	334	358
7	New England	555	650
8	Moffit	437	532
9	Forman	287	382
South Dakota			
1	Isabel	527	714
2	Roscoe	386	573
3	Webster	278	456
4	Sturgis	730	925
5	Ree Heights	413	608
6	Madison	373	548
8	Murdo	641	815
9	Menno	446	621
Minnesota			
1	Crookston	335	309
4	Morris	176	276
5	St. Cloud	77	169
7	Lake Wilson	220	415
9	Rochester	124	319
Montana			
2	Havre	1,056	1,080
3	Poplar	680	703
4	Lewiston	1,226	1,251
6	Billings	1,017	1,041
7	Miles City	843	867

* Mileages include 18 percent allowance for single car and train circuity.

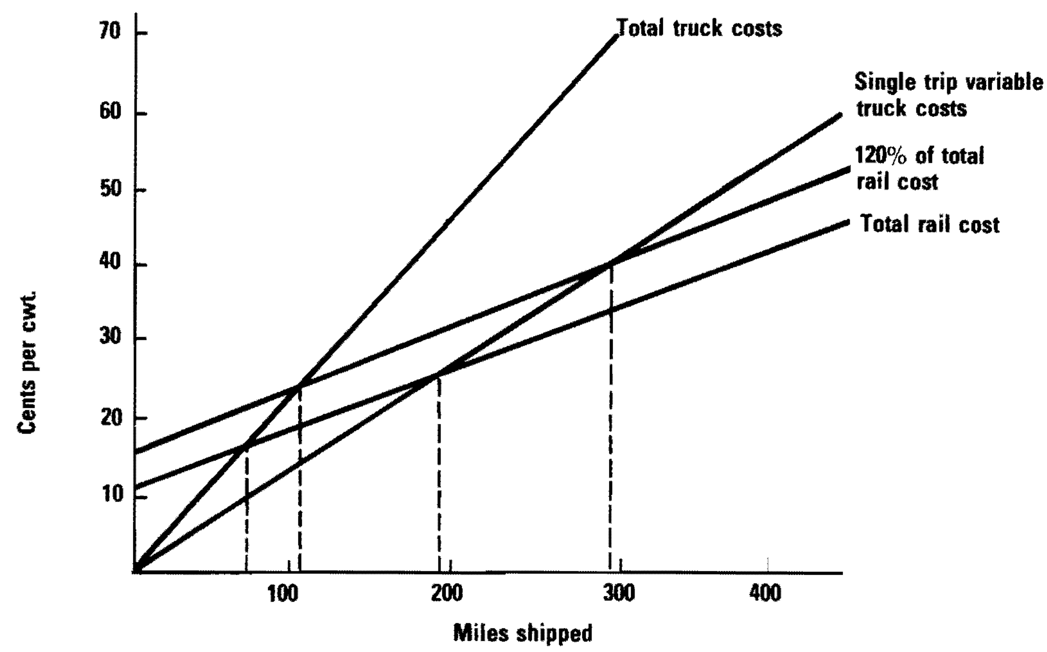


Figure A-1. Cost of services functions: Total truck costs, single trip variable truck costs, full rail cost and 120% of full rail costs

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