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Value of Overweighting to Intercity Truckers

D.S. PAXSON AND J.P. GLICKERT

An analysis of the problem of truck overweighting is presented. Legal and illegal overweighting and current enforcement procedures are discussed. The benefits to truckers of overweighting are shown by means of an incremental approach (decrease in transport cost per unit with increase in cargo weight) and by using specific cargo movements to calculate the incentives to overweight. The fine and penalty structures of various states are examined and are combined with the probability of being weighed to calculate the expected value of being weighed to the trucker. The net benefit of overweighting to the trucker is then shown by comparing the costs with the incentives. Finally, actual permit costs are examined in relation to the cost of additional pavement damage caused by overweight trucks. It is concluded that (a) economic incentives often exceed the expected costs of overweighting to the trucker, (b) current enforcement programs in some states are not effective, (c) fine structures should take account of both the amount of truck overweight and the number of miles traveled, and (d) the cost of overweight permits does not reflect the additional pavement damage caused by overweighting.

There is an ongoing controversy regarding the legal weight limits for trucks. An important part of this issue that is often overlooked is the problem of enforcement of weight limit laws. Enforcement programs are a critical part of efforts to control overweight trucks. Unless these programs are effective, truck weight limits are meaningless.

For any enforcement program to be effective, truckers must perceive the penalties for exceeding the weight limits as being greater than the economic benefits of overweighting. If truckers believe that the probability of being weighed is low and that the penalties for overweighting are low, they are more likely to run overweight. This situation will continue until effective disincentives are recognized by the trucker.

This paper demonstrates that in many cases there are economic incentives that far exceed the expected costs of overweighting. The analysis is performed by using a cost-benefit approach and specific examples.

The paper first discusses two types of overweighting: illegal and legal. Illegal overweighting subjects the driver to the possibility of fines and other penalties. Legal overweighting requires permits obtained from the individual states. The first section also deals with the enforcement process and the criteria required in order to assess the effectiveness of existing enforcement programs.

The second section presents an analysis of the benefits of overweighting. A general description of

these benefits shows how transport cost per unit of weight decreases as cargo weight increases. This demonstrates the incremental advantages of overweighting to truckers. A second, more in-depth approach uses specific cargo movements to calculate incentives for the trucker to overweight.

The next section deals with the cost of illegal overweighting. Fines from different states are examined and combined with the probability of being weighed to calculate the expected value of weighing to the trucker. The costs are then compared with the incentives in order to show the net benefit of overweighting to the trucker. Other penalties, such as forced unloading and suspension of driver's license, are also examined.

The last section describes legal overweighting by the use of state-issued permits. The different types of permits and their respective costs are presented for 10 states, and an effort is made to determine whether the permit costs reflect the additional pavement damage that is caused by an overweight truck. If the cost of a permit does not reflect this additional damage, then the trucker is not paying a fair share in regard to damage to highways and bridges.

ISSUE OF OVERWEIGHTING

This paper discusses two types of overweighting: legal and illegal. Truckers can load above the maximum weight limits legally by the use of specially granted permits. There are generally two types of permits--single trip and annual (multiple) trip. The prices and availability of these permits vary from state to state.

Illegal overweighting occurs when the cargo characteristics are such that the state will not issue a permit. The issuance of permits is controlled by the individual states; therefore, the availability of permits varies among the states. Illegal overweighting subjects the driver to the possibility of fines and other penalties, but the incentives for overweighting usually exceed the expected costs of the fines.

An evaluation of permits and fines is important in determining disincentives to overweight. Permits should reflect the additional pavement damage caused by an overweight truck. Fines should be high enough

to act as an effective deterrent to overweighting.

Effective enforcement programs are necessary to control the level of illegal overweighting. There are two basic components to the enforcement process: probability of detection and penalties for violation. Combined, these two make up the expected cost of overweighting to the trucker. The probability of detection is important as a deterrent. Truckers often have substantial experience to aid them in calculating the probability of being apprehended. Based on this probability, they can calculate the expected cost (in fines) of overweighting.

An effective weight enforcement program should make the avoidance of weight compliance checks difficult or impossible for the trucker. Given that a trucker is traveling a route with scale checkpoints, the probability of being weighed should be high enough to act as a deterrent.

Penalties (fines) are the second component of an effective enforcement program. If fines are levied for overweights, the fines must be a level higher than the economic benefit of overweighting. If the present fines are not sufficient deterrents, the fine system should be changed. This can be accomplished by (a) increasing the fine level and (b) introducing graduated fines where they do not already exist. Graduated fines take into account the amount of the overweight, rising incrementally as the amount of the overweight increases.

BENEFITS OF OVERWEIGHTING

The benefit a trucker receives from overweighting is increased financial returns. This results from decreasing costs per ton-mile as cargo weight increases. This decrease in cost is illustrated by the table below, which shows how costs per ton-mile decrease dramatically and costs per mile increase

only slightly as the weight of the load increases [based on the 1980 Association of American Railroads (AAR) model and data from the 1979-1980 National Motor Transport Data Base (NMTDB)]:

| Cargo Weight (tons) | Line-Haul Cost (\$) | |
|------------------------|---------------------|--------------|
| | Per Mile | Per Ton-Mile |
| 10 | 0.891 | 0.089 |
| 15 | 0.895 | 0.060 |
| 20 | 0.903 | 0.045 |
| 25 | 0.905 | 0.036 |

The example given is the average line-haul cost for a typical intercity trucker (an owner-operator leased to an irregular-route carrier). It should be noted that, while the cost per mile increases only 10 percent as the weight increases from 10 to 25 tons, the cost per ton-mile decreases 60 percent.

The more a truck is overweight, the greater the financial benefit that results. For example, a commodity with a rate of \$0.056/lb passing through a state with a limit of 73 280 lb will have the estimated incentives given in Table 1. The cash incentive to load 80 000 lb is \$390, and the incentives increase as cargo weight increases. This illustrates the incremental advantage that a trucker has as the amount of the overweight increases. This example was chosen in order to show that, once truckers choose to violate the weight limits, they have an incentive to overweight as much as the equipment will bear.

Some specific sample cases can illustrate how decreased ton-mile costs can offer the trucker real monetary benefits. Tennessee and Indiana are two examples of states where the maximum legal truck weight limit is 73 280 lb. Most of the bordering states have limits of 80 000 lb. Therefore, a trucker hauling 80 000 lb through these states is often in violation of state limits only in Tennessee and Indiana.

Sample truck rate data from a privately collected field survey (the NMTDB) were assembled to show how these weight increases would benefit the trucker. These data, given in Table 2, show that the benefit of overloading depends on (a) the rate of the commodity hauled and (b) the length of the trip. For example, the incentive to load 80 000 lb (as opposed to 73 280) through Tennessee on a machinery movement from Pennsylvania to Texas is \$300. The incentive to load 80 000 lb through Indiana on a movement of plastic products from Pennsylvania to California is \$360. Overweighting can offer the trucker real monetary benefits. The purpose of Table 2 is to show that there are high incentives to overload for a

Table 1. Incremental incentives to overweight.

| Vehicle Weight (lb) | Cargo Weight (lb) | Rate per Pound ^a (\$) | Resulting Rate (\$) | Incentive (\$) |
|---------------------|-------------------|----------------------------------|---------------------|----------------|
| 73 000 | 45 000 | 0.056 | 2520 | 0 |
| 75 000 | 47 000 | 0.054 | 2540 | 20 |
| 80 000 | 52 000 | 0.052 | 2700 | 180 |
| 90 000 | 62 000 | 0.050 | 3100 | 580 |
| 100 000 | 72 000 | 0.048 | 3460 | 940 |

Note: Calculated from NMTDB data.

^aA typical rate is \$0.056; the decreases in rate per pound are given in an attempt to account for the rate reduction that might be offered by a trucker planning to overweight.

Table 2. Incentives to overweight through three states.

| State | Gross Weight (lb) | Origin-Destination | Commodity | Rate per Pound (\$) | Incentive (\$) |
|-----------|-------------------|-------------------------|------------------|---------------------|----------------|
| Tennessee | 80 000 | Pennsylvania-Texas | Machinery | 0.046 | 300 |
| | | Florida-Michigan | Fruit | 0.041 | 275 |
| | | Mississippi-Illinois | Fish | 0.024 | 160 |
| | | Louisiana-New Jersey | Paper | 0.035 | 235 |
| | | Minnesota-New York | Meat | 0.038 | 255 |
| Indiana | 80 000 | Pennsylvania-California | Plastic products | 0.054 | 360 |
| | | Colorado-New York | Meat | 0.039 | 260 |
| | | New Jersey-California | Chemicals | 0.058 | 390 |
| | | Mississippi-Michigan | Lumber | 0.027 | 180 |
| | | Ohio-California | Glass | 0.064 | 430 |
| | | California-Illinois | Produce | 0.047 | 470 |
| Iowa | 90 000 | Wisconsin-California | Dairy products | 0.041 | 410 |
| | | Michigan-Idaho | Automobile parts | 0.036 | 360 |
| | | Ohio-Washington | Steel | 0.045 | 450 |
| | | Illinois-California | Chemicals | 0.043 | 430 |

Note: Calculated from NMTDB data.

Table 3. Fine structures for overweight trucks for 10 selected states.

| State | Fine | State | Fine |
|------------|------------------------------------|-------------|----------------------------------|
| Tennessee | \$25 min, \$50 max | Colorado | \$15 + \$5/1000 lb OW |
| Indiana | 2¢/lb for 1000-2000 lb OW | Connecticut | \$2/100 lb for 2-5 percent OW |
| | 4¢/lb for 2000-3000 lb OW | | \$3/100 lb for 5-10 percent OW |
| | 6¢/lb for 3000-4000 lb OW | | \$4/1000 lb for 10-15 percent OW |
| | 8¢/lb for 4000-5000 lb OW | | \$6/1000 lb for 15-20 percent OW |
| Iowa | 10¢/lb for ≥ 5000 lb OW | Maryland | \$8/1000 lb for 20-25 percent OW |
| | \$10 + 0.5¢/lb for ≤ 1000 lb OW | | \$10/1000 lb for >25 percent OW |
| | \$15 + 0.5¢/lb for 1000-2000 lb OW | | \$20 min |
| | \$80 + 3¢/lb for 2000-3000 lb OW | | 2¢/lb for ≤ 5000 lb OW |
| Arizona | \$150 + 5¢/lb for 3000-4000 lb OW | Minnesota | 6¢/lb for >5000 lb OW |
| | \$200 + 7¢/lb for 5000-6000 lb OW | | \$50 for 1000-2999 lb OW |
| | \$200 + 10¢/lb for ≥ 6000 lb OW | | \$100 for 3000-3999 lb OW |
| | From \$30 for 1000 lb OW to | | \$200 for 4000-4999 lb OW |
| California | \$280 for ≥ 6000 lb OW | Texas | \$300 for 5000-5999 lb OW |
| | \$300 max | | \$400 for 6000-6999 lb OW |
| | From \$10 for 1000 lb OW to | | \$500 for ≥ 7000 lb OW |
| | \$1000 for > 12 500 lb | | \$25 min, \$200 max |

Note: OW = overweight.

wide variety of commodities and origin-destination pairs.

The incentive to overweight increases as cargo weight increases. Iowa is used as a sample state to demonstrate the economic effects of a load greater than 80 000 lb, which is the maximum legal limit in Iowa. Table 2 gives some sample incentives to load 90 000 lb in Iowa. For example, the incentive to load 90 000 lb on a produce movement from California to Illinois is \$470.

In a competitive marketplace, some of these financial benefits might have to be passed on to shippers. This would be done through rate reductions offered to shippers for heavier loads. Table 1 demonstrates how a trucker could offer reduced rates and still increase revenues.

COST OF ILLEGAL OVERWEIGHTING

There are several components that combine to make up the cost of overweighting to the trucker. The primary cost of overweighting is fines. Table 3 (1) gives the fine structures for 10 selected states and indicates the variation in fines that exists. A truck traveling 10 000 lb overweight through Tennessee is subject to a maximum fine of \$50 if apprehended. A truck traveling 10 000 lb overweight through Iowa, however, is subject to a fine of \$1200. This inconsistency among fine structures is typical.

An examination of the effectiveness of fines must take into account the probability of being caught. The expected cost of the fines to truckers is a function of the truckers' ability to avoid routes that have weigh stations or, if they travel such routes, the chance of the weigh stations being in operation. Portable scales are sometimes used, but their use is nominal at best and usually accounts for less than 1 percent of total truck weighings. This is illustrated by the following FY 1979/80 data for three states:

| State | No. of Truck Weighings | Truck Weighings with Portable Scales | |
|------------|------------------------|--------------------------------------|---------|
| | | No. | Percent |
| Iowa | 67 000 | 3200 | 0.005 |
| Virginia | 7 500 000 | 7500 | 0.001 |
| California | 4 350 000 | 3400 | 0.008 |

A comparison of the probable costs and benefits of overweighting can be made for the Tennessee, Indiana, and Iowa cases already discussed. Enforcement officials from each of these three states were contacted and asked to give an estimate of the probability of an overweight truck being weighed in the

state, assuming the trucker was using avoidance measures. These estimates were used to calculate expected costs of the fines, which are presented in Table 4.

The expected cost of the fines can be subtracted from the incentives calculated in Table 2 to indicate that the trucker has high incentives to overweight even when the expected costs of the fines are taken into account:

| State | Expected Benefit (\$) | Expected Cost of Fine (\$) | Net Incentive to Overweight (\$) |
|-----------|-----------------------|----------------------------|----------------------------------|
| Tennessee | 245 | 3 | 240 |
| Indiana | 325 | 134 | 190 |
| Iowa | 425 | 180 | 245 |

Although many states have provisions for increasing the severity of the fine for subsequent offenses, inadequate record systems reduce the likelihood of enforcing this statute (2, p. 1).

Penalties other than fines are also an effective deterrent to overweighting. Forced unloading of the overweight freight can inflict substantial inconvenience and time cost on the driver. Some of these costs include the cost of the truck being idle, the transportation cost to pick up the shipment at the point of unloading, and also the increased potential for loss and damage.

Unloading policies vary and can be either discretionary (up to the enforcement officer) or mandatory. Analysis of state statutes reveals that 21 states have mandatory unloading policies, 26 states have discretionary unloading, and 3 states have no unloading statutes (2, p. 10). Even though 21 states have mandatory unloading laws, interviews with 41 states revealed that only 6 states actually practiced mandatory unloading and 25 states had discretionary unloading practices (2, p. 10). Like many other states, the states that were used in the examples (Tennessee, Indiana, and Iowa) all have discretionary unloading policies that result in little or no forced unloading. The laws are often not enforced due to the lack of available storage space, the nature of the freight (if perishable), a concern for other motorists' safety, and the possibility of vandalism.

In those cases where the excess weight is not unloaded, the financial impact of the fines is not high enough to deter the trucker from overweighting. The financial incentives of overweighting in these cases exceed the expected costs. Unless the current systems are revised so that the disincentives to overweight are increased, the truckers may continue to overweight when it is in their economic interest. Although the difference between incen-

Table 4. Expected costs of fines for overweighting in three states.

| State | Amount of Overweight (lb) | Fine (\$) | Estimated Probability of Apprehension (%) | Expected Cost of Fine (\$) |
|-----------|---------------------------|-----------|---|----------------------------|
| Tennessee | 6 720 | 50 | 5 | 3 |
| Indiana | 6 720 | 670 | 20 | 134 |
| Iowa | 10 000 | 1200 | 15 | 180 |

Table 5. Permit costs for overweighting in 15 selected states.

| State | Cost | Maximum Permit Weight |
|-------------|--|--|
| Tennessee | Single trip, \$5; annual, \$300 | Single axle, 18 000 lb Tandem axle, 36 000 lb |
| Indiana | \$10 if <40 miles, 25¢ for each mile above 40, \$50 max | NA |
| Iowa | Single trip, \$5; annual, \$10 | NA |
| Arizona | Single trip, \$10; multiple (30 days), \$30 | NA |
| California | Single trip, \$3; annual, \$30 | No restriction |
| Colorado | Single and multiple, \$5 | No restriction |
| Connecticut | No fees | 5-axle vehicles, 122 000 lb gross |
| Maryland | Single, \$150 for book of 10; 30 days, \$40; annual, \$350 | 900 000 lb for single trips |
| Minnesota | Single, \$5; seasonal, \$25; annual, \$50 | NA |
| Texas | Single trip, \$5; 30-day permit, \$10; annual, \$50 and ton-mile | Single trip, 45 000-lb axle load |

tives and costs will be different for other states, the main point to be made is that the disincentives to overweight will be, to some degree, less than the incentives in nearly all states. Therefore, continued overweighting should be expected if enforcement programs are not changed.

COST OF LEGAL OVERWEIGHTING

A trucker overweights legally by the use of permits obtained from individual states. The states control the application procedure, criteria for availability, and the types and fees for overweight permits. The permit application can usually be made by mail, telegram, or telephone.

Most state statutes allow the issuance of overweight permits only for the movement of indivisible loads. These are loads that cannot be reduced to meet statutory weight limits. The issuance of permits for divisible (reduceable) loads is normally not allowed; however, in recent practice some states (e.g., Massachusetts, Montana, North Dakota, South Dakota, Utah, and Nevada) are issuing permits for divisible loads. Permits can be used as a method of circumventing maximum weight limits, particularly when annual or continuous permits are issued (2, p. ii).

The sample permit cost for overweight authority in 10 selected states is presented in Table 5. There are extreme variations in the cost of permits. Four states (North Carolina, Massachusetts, Connecticut, and Rhode Island) do not charge for single-trip permits. Tennessee charges \$5 for an annual trip permit. Indiana charges \$10 for movements of less than 40 miles, 25¢ for each mile above 40, and a maximum charge of \$50. Iowa charges \$5 for a single-trip permit and \$10 for an annual permit.

The main issue concerning these permits is whether the fees collected for the permits cover the additional road damage caused by an overweight

truck. Fees charged by some states barely cover the administrative cost of issuing the permits, much less the additional highway damage caused by the additional weight.

Higher weight limits translate directly into higher levels of stress on roads, which in turn require additional maintenance and rehabilitation expenditures in order to maintain road serviceability. A special study was conducted by the State of Tennessee in an attempt to quantify the road damage caused by overweight trucks in Tennessee. The study used a measure of pavement damage developed by the American Association of State Highway and Transportation Officials (AASHTO)—the equivalent 18 000-lb single-axle loading (ESAL). The study found that the additional pavement damage cost caused by overweight trucks was 3¢/ESAL mile.

This figure can be used to estimate additional pavement costs resulting from legally overweight vehicles. AASHTO equations indicate that an 80 000-lb five-axle vehicle does approximately 0.8 ESALs/mile more than a 73 280-lb vehicle with the same configuration. This translates into additional pavement costs of 2.4¢/mile. A 90 000-lb five-axle truck imposes approximately 1.6 ESALs/mile more than an 80 000-lb vehicle of the same configuration and 4.8¢/ESAL mile more in pavement costs.

These increased costs per mile can be used to determine the appropriate cost for overweight permits. By using a 90 000-lb, 250-mile haul through Iowa (80 000-lb limit) as an example, the single-trip permit cost can be calculated to be \$12 instead of the actual permit cost of \$5. An annual permit, however, assuming a weight of 90 000 lb and a total of 15 000 miles/year traveled in Iowa, should cost \$720. The actual cost is \$10. An 80 000-lb load passing 250 miles through Tennessee (73 280-lb limit) causes additional pavement damage cost of \$6 compared with the \$5 cost of a permit. An annual permit, assuming a 90 000-lb load and 15 000 miles traveled/year, should cost \$360. The actual cost is \$300. Indiana uses a fee structure for permits that takes into account miles traveled, so that the trucker is charged a more appropriate fee of 25¢/mile for all miles traveled.

It is apparent that in some cases, particularly in the case of annual or continuous permits, the fees charged for overweight permits do not reflect the additional pavement damage caused by the overweight truck. It is concluded that, in order to make the fees more appropriate, they should be changed to take into account the weight of the vehicles and the number of miles traveled.

SUMMARY AND CONCLUSIONS

In summary, the main points of this paper are the following:

1. There are economic incentives that often exceed the expected costs of overweighting to the trucker.
2. Current enforcement programs in some states are not effective as a deterrent to overweight trucks and are in need of revision.
3. Fine structures should be more realistic, taking into account the amount of the overweight in the truck and the number of miles traveled by the trucker.
4. The probability of being weighed should be increased to discourage truckers from overweighting.
5. In many cases the cost of overweight permits does not reflect the additional pavement damage caused by overweighting. This is significant because whenever permits are offered it is clearly in the economic interest of the trucker to obtain the permit.

Several major conclusions can be drawn from these points.

The first conclusion is that, in order for the amount of illegal truck overweighting to be reduced, the effectiveness of enforcement programs must be increased. The probability of being weighed and the expected cost of the fine should, when combined, be greater than the incentives to overweight. The analysis performed in this paper indicates that in most cases the present enforcement programs are inadequate and in need of revision. The fine structure should be more realistic and take into account the expected value of being caught, the value of the overweight, and the number of miles traveled. The probability of being weighed could most effectively be increased by making fixed scales difficult to avoid and by making greater use of portable scales.

The second major conclusion is that the cost of overweight permits does not reflect the additional pavement damage caused by overweighting. To provide a more appropriate permit fee, the cost of the permit should take into account the amount of the overweight and the number of miles traveled.

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Abridgment

Impact of Increased Truck Weights on Relative Costs of Motor Carriers and Railroads and Potential Modal Diversion

LANA R. BATTS, ROGER W. KOLINS, AND REGINA T. SELVA

The relative costs per ton-mile for rail boxcar, trailer-on-flatcar (TOFC), irregular-route motor carriers, and exempt owner-operators for the period 1977-1985 are examined. A specific rate of inflation was applied to each category of cost in 1977 for the four types of transportation service to determine the effect of inflation to 1985. The relative average freight costs per unit of output were then compared at truck gross vehicle weight limits of 73 280 and 80 000 lb. The principal finding of the study is that any shift in the average costs per ton-mile resulting from an increase in the truck weight limit is influenced by the impact of inflation on the various cost components. A comparison of the relative costs by type of service and mode suggests that inflation may have a more adverse impact on the railroads than on motor carriers of truckload freight. The analysis also indicates that, over the long term, the position of TOFC relative to truckload motor carriage could deteriorate because TOFC costs have been increasing faster than comparable truckload costs. Based on the economic factors specified and analyzed in this study, TOFC is not the preferred transport option over the 1981-1985 period.

There is a perception held by some people that the use of the more productive truck carrying dimensions would divert traffic from rail by lowering unit costs and thus upset the competitive truck-rail balance (1). However, since 1977 rapidly escalating prices for all factors of production have affected the unit costs of the modes differently. Liberalized truck size and weight limits, which allow greater productivity to occur (2), will dampen the influence of inflation on truck costs both for the motor carrier industry and for that segment of the rail industry that depends on truck service--i.e., trailer-on-flatcar (TOFC). Thus, such limits will benefit the shipping public by way of decreased costs without harm or prejudice to any mode.

STUDY METHODOLOGY

The analysis presented in this paper is based on a

cost model developed by the U.S. Department of Transportation (DOT). In a technical supplement (3), DOT estimated the values of the various functional cost inputs (such as labor and fuel) for several types of truck and rail service for the year 1977. The results of the cost model were then used by DOT to support its conclusions in its report, "An Investigation of Truck Size and Weight Limits" (4). (DOT did not account for the terminal and overhead costs of irregular-route carriers. Therefore, adjustments were made in the DOT line-haul expense and terminal expenses were created. DOT also did not analyze exempt owner-operator costs. Therefore, irregular-route truckload line-haul costs were used to approximate these costs. Although exempt owner-operators have overhead expenses, they act as if they have only line-haul expenses.)

To project the DOT 1977 costs through 1985, each functional cost is inflated at an individual economically and historically justified rate. The estimated relative average unit freight costs for 1981 and 1985 reflect the effect of inflation on truck and rail costs.

The projected unit costs reflect cost relations that exist under truck gross vehicle weight (GVW) limits of 73 280 lb. To complete the analysis, the projected DOT costs were then adjusted to an increased payload weight of 80 000 lb.

The analysis presented in this paper compares costs for the following types of service:

1. Motor carrier--Irregular-route, common carrier, full-truckload service using 45-ft tractor-semitrailers;
2. Owner-operator--Full-truckload service using 45-ft tractor-semitrailers;
3. Rail carrier--General box carload service; and