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16. Abstract

A complex web of government regulations in the United States establishes maximum weights for vehicles on public roads. The primary purpose is to ensure compatibility of roadway design and operations with vehicle weight and dimensions. Of particular concern are the roadway impacts of heavy trucks, which far exceed those of passenger cars. As a rule of thumb, an "eighteen-wheeler" truck that weighs 80,000 lb has the same pavement impact as about 9,200 cars traveling the same distance. The use of heavier vehicles often produces savings in transportation costs. As load capacity increases, a truck can make the same number of deliveries in fewer trips; this produces savings in driver labor, in vehicle wear and tear, and in other inputs.

The challenge in vehicle weight regulation is finding the right balance between allowing these savings in transportation costs and preserving the roads and bridges. The trend has been toward higher limits, with a significant jump in 1974 when the maximum gross vehicle weight (GVW) allowed on interstate highways rose from 73,280 lb to the current 80,000 lb. Such reforms have gained momentum from various studies that have found the benefits to exceed the costs.

In 1989, the Texas legislature passed HB 2060 creating an annual permit for a vehicle to operate above the general legal weight limits. The name "2060" has stuck to the permit, despite later amendments under HB 1547 (enacted in 1995). This report examines this controversial permit and makes recommendations for modifying current truck weight regulations in Texas.

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ALTERNATIVES TO WEIGHT TOLERANCE PERMITS

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TEXAS WEIGHT TOLERANCE PERMITS: CURRENT PRACTICE AND OPTIONS

In 1989, the Texas legislature passed HB 2060 creating an annual permit for a vehicle to operate above the general legal weight limits. The name "2060" has stuck to the permit, despite later amendments under HB 1547 (enacted in 1995). To evaluate this controversial permit requires an understanding of the broader context of truck weight regulation.

REGULATION OF TRUCK WEIGHTS

A complex web of government regulations in the United States establishes maximum weights for vehicles on public roads. The primary purpose is to ensure compatibility of roadway design and operations with vehicle weight and dimensions. Of particular concern are the roadway impacts of heavy trucks, which far exceed those of passenger cars. As a rule of thumb, an "eighteen-wheeler" truck that weighs 80,000 lb has the same pavement impact as about 9,200 cars traveling the same distance.[1]

The use of heavier vehicles often produces savings in transportation costs. As load capacity increases, a truck can make the same number of deliveries in fewer trips; this produces savings in such inputs as driver labor and vehicle wear and tear.

The challenge in vehicle weight regulation is finding the right balance between allowing these savings in transportation costs and preserving the roads and bridges. The trend has been toward higher limits, with a significant jump in 1974 when the maximum gross vehicle weight (GVW) allowed on Interstate highways rose from 73,280 lb to the current 80,000 lb. Such reforms have gained momentum from various studies that have found the benefits to exceed the costs.[2]

Texas has extended to other public roads in the state the same limits that the federal government applies to the Interstate highway system. The state allows up to 80,000 lb gross vehicle weight, 20,000 lb on a single axle, and 34,000 lb on a tandem axle. In addition, vehicles must conform to Federal Bridge Formula-B, which protects bridges from excessive strain by restricting the weight of each of a vehicle's axle groupings. The weight limit for a grouping depends on the number of axles it contains and increases with the distance between them [Federal Highway Administration (FHWA) 1994]. Since one of the groupings to which the formula applies consists of all axles on

[1] The Texas Department of Transportation (TxDOT) derived this estimate from load equivalency tables prepared by the American Association of State Highway Transportation Officials. An eighteen-wheeler truck consists of a truck-tractor hitched to a semi-trailer. In TxDOT's calculation, the steering axle weighs 12,000 lb and each tandem axle weighs 34,000 lb. The passenger car was assumed to weigh 2,000 lb on each of its two axles. Mr. Gary Graham of TxDOT's Design Division explained the basis for the calculation.

[2] TRB (1990, p. 14) observed: "The impact analyses conducted for this study support findings from previous truck size and weight studies mandated by Congress. It has been found that increasing truck weight limits can significantly reduce the cost of goods movement and that the cost savings due to more efficient trucks generally exceed the additional pavement and bridge costs incurred by highway agencies."

the truck — the "outer bridge group" — the formula also restricts gross vehicle weight. (The sum of all axle weights equals gross vehicle weight.)

For many trucks, the limits under the bridge formula are redundant, being no more stringent than the general limits on gross and axle weights. However, the bridge formula does constrain the weights of the many specialized hauling vehicles that have short wheelbases, such as dump and garbage trucks. For these vehicles, the bridge formula keeps the legal gross weight to less than 80,000 lb. A further complication is that many states, including Texas, relax the bridge formula (or other weight limits) for classes of special hauling vehicles on non-interstate travel.

LOAD-POSTED LIMITS

Portions of the road and bridge network in Texas have posted weight limits that are less than the general ones described above. These limits may be imposed where "heavier maximum weight vehicles would rapidly deteriorate or destroy the road or a bridge." [3]

State and county governments in Texas must base their load postings on an engineering and traffic investigation that conforms to certain procedures. The procedures for determining the appropriate limits are more complicated for axle weight than for gross vehicle weight. Partly for this reason, load postings are almost always for GVW rather than axle weight, even though the consensus among engineers is that pavement deterioration is much less a function of GVW than of axle weight. (Strictly speaking, the deterioration is a function of tire pressure, of which axle weight is an indicator.[4]) For bridges, the posted limits on GVW make more sense because the engineering consensus is that deterioration depends mainly on GVW and axle spacing rather than axle weight.

On the state-maintained network, the load-posted stretches lie almost entirely on the network of farm-to-market (FM) roads. The FM roads were mainly constructed in the 1940s and 1950s to accommodate gross vehicle weights of up to 58,420 lb, the then-prevailing limit on Texas roads. Although some of these roads have since been upgraded, 58,420 lb restrictions remain on two-fifths of the nearly 41,000 centerline miles of FM roads.

County roads remain mostly at a standard of 58,420 lb or less, but only some are load-zoned. The establishment of load-zoned limits requires public hearings as well as an engineering study. Some county officials consider the process too troublesome to be worthwhile, particularly with holders of 2060 permits being exempt from load-posted limits (see below). Information on the proportion of county roads that are load-zoned is not readily available. In Panola County, none of the roads are load-zoned, although few can sustain even 60,000 lb trucks with any regularity.

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[3] Texas Transportation Code, Sec. 621.102 and Sec. 621.301. See http://capitol.tlc.state.tx.us/statutes/codes.

[4] "The fundamental cause of pavement failure is the application of a *tire contact pressure* that exceeds the *load carrying capacity* of the pavement. The *tire contact pressure* (or the next best indicator, axle load) is important to the minimization of damage. To the trucking industry, this means that the *gross vehicle weight* is almost unlimited by the pavement structure (within reason of course)… The reason gross vehicle weight is almost unlimited by pavement structure is that tire contact pressure can be reduced by increasing the number of axles, the number of tires, or by using low inflation pressure tires." (Crawford 1993)

In addition, there are many load-zoned bridges in Texas, including some 4,000 that were built to standards of less than 58,420 lb. (Brazoria County has some bridges built for only 5,000 lb loads.) Federal law requires an inspection of each bridge every two years as part of the Bridge Replacement and Rehabilitation Program established in 1970. A bridge that receives a rating of "structurally deficient" is unsafe for legal weights and therefore must be posted and restricted. The Texas Department of Transportation (TxDOT) has advised that some stretches of pavement on the FM system are load-zoned because they lead up to load-zoned bridges, not because the pavement is structurally deficient.

PERMITS FOR NONDIVISIBLE LOADS

All states issue permits for vehicles carrying loads that are impossible or extremely difficult to dismantle. Such a "nondivisible" load might be a large machine, for example.

In Texas, the large majority of nondivisible-load permits are issued for single trips, the others being valid for thirty days, ninety days, or a year. To obtain a single-trip permit, an applicant must propose a route for TxDOT to review and possibly modify and pay a fee of $30 or more. The thirty- and ninety-day permits cost $60 and $120 per vehicle and allow increases in width or length only. The annual permits allow trucks up to 12 feet wide, 14 feet high, 110 feet long, and 120,000 lb in gross weight. Unlike the permits evaluated in this study, nondivisible-load permits do not allow travel on load-posted stretches or off the state-maintained network. To haul overweight on local roads, holders of nondivisible-load permits must seek local government approval.

PERMITS FOR DIVISIBLE LOADS

Although the law simply refers to "vehicles," the demand for the 2060 permit has come almost exclusively from trucks. The permit does not require that loads be divisible, but the vast majority of loads actually carried appear to be highly divisible, such as shipments of gravel or crude oil. It is, in this respect, a "divisible-load permit."

The permit allows an additional 5 percent gross weight and 10 percent axle weight above the maximum allowable weights that would otherwise apply to the vehicle. As interpreted by the attorney general and later by the courts, the maximum allowable weight should be calculated without regard to load-posted limits. So, for a vehicle unaffected by the bridge formula, the permit provides an additional 5 percent gross weight above 80,000 lb. Because most vehicles using the 2060 permit are unaffected by the bridge formula, the gross weight limit under the permit is usually 84,000 lb.

The courts also upheld the attorney general's opinion that a key provision of HB 2060, which preempts the authority of the counties, is constitutional. County governments cannot regulate or restrict the weights of vehicles with 2060 permits; they cannot require the owners of the vehicles to obtain county permits to operate at these weights over county roads. Moreover, the counties' authority to designate routes for 2060 traffic is so circumscribed as to be useless. The counties cannot simply declare a road to be off-limits to 2060 traffic; they can only designate the route for an individual trip, and to do so they must know in advance that the trip will be made. Thus, to avoid route restrictions, a permit-holder must merely not volunteer information about a planned trip. Because permit-holders have this easy out, county governments are unable to designate routes.

Only somewhat more useful is the legal liability placed on permit-holders who damage roads or bridges when operating at the permit-authorized weights. Much of this damage is not traceable to the operations of individual companies. Exceptions occur when a single company places an army of 2060 trucks on a road that carries little other traffic, for such operations as road construction or harvesting a stand of trees. Roads have been known to start to come apart in the midst of such operations. However, while the culprit may be obvious to government and the damage assessable, proving culpability in court is another matter. The defendant can always claim that some other, less conspicuous, truck traffic contributed to the damage. Then, too, the trucks involved in an intensive operation may belong to several different companies, each of which may attempt to shift responsibility to the others.

If this were not enough to dissuade a government from suing, the law requires only $15,000 from a permit-holder as security against damage. The amount of security, which can be a bond or letter of credit, is slight compared to the cost of road damage that can result from a heavy truck operation. The average cost of resurfacing a light-duty county road in North and East Texas is approximately $45,000 per mile, according to evidence submitted by the County Judges and Commissioners Association of Texas (CJCAT).[5] Although companies are fully liable for road damage they cause, to collect above the amount of the security can be difficult. Partly because the amount of the security is so small, there are no cases known to TxDOT of a government agency collecting any portion.

Before the 2060 permits, some county governments allowed travel on their roads at weights above load-posted limits, but under arrangements often frustrating to industry. In 1987, the Texas Tank Truck Carriers Association (TTTCA) warned of the "problem" of county authority to "implement fees and issue permits for overweight or overlength vehicles." It informed its members:

> Several counties in Texas currently impose a fee schedule for traversing their highways. The fees range from $20.00 to $40.00 per truck per month. However, the idea is spreading and one county in particular, Smith County, is considering fees of up to $120.00 per day per truck. This proposal would apply to all trucks with an axle load over 15,000 pounds. (TTTCA 1987, p. 2)

The TTTCA further reported that industry representatives were lobbying for state regulation of county permits: a minimum allowable weight and a maximum fee. However, the association noted that even with such limits, "the danger remains that counties that weren't thinking about charging for permits will do so once they see a law permitting a maximum fee."

Industry descriptions of the pre-2060 permit system emphasize the administrative burden on the applicants, who sometimes had to contact several different counties. There were even cases where travel in different precincts within the same county necessitated separate permits. Reportedly, the counties issued many of their permits on a single-trip

[5] Testimony of Jim Alison before the Senate Committee on State Affairs on June 12, 2000. The estimate pertains to a 20-inch asphalt road built to support 50,000 lb loads.

basis, even where divisible loads were concerned. For a company hauling, say, many truckloads of aggregates to a construction site, obtaining a permit for each and every trip could indeed be burdensome. In addition, the Texas Aggregates and Concrete Association has maintained that counties had discriminated unfairly in the issuance of permits. By way of example, it alleged that a county north of Dallas had denied overweight permits to trucks servicing a quarry because the county, responding to residents' complaints about this traffic, had wanted to force the quarry to close.

The 2060 permit system has largely satisfied the industry associations. Heavy trucks have gained hassle-free movement over roads zoned to much lower weights, plus a modest increase in weight on other roads. Moreover, the permit is cheap: an annual fee of $205 allows travel in any twenty counties that the applicant designates. Permits that are valid in more than twenty counties carry higher fees, all the way up to $2,080 for more than 100 counties (Table 1). However, the average fee was only $238 in FY 1999 because the vast majority of applicants select the basic option. Demand for the permits declined by about 8 percent during the 2 years following a fee increase in 1995, but has since resumed its previous growth (Fig 1).

Table 1: Distribution of Permits, Fees, and Revenues by County Option; "2060" permits, FY 1999

# of counties in which permit is valid	# of permits	% of permits	permit fee ($)	permit revenue ($)
1 to 20	14,050	88.0%	205.00	2,800,250
21 to 40	1612	10.1%	425.00	685,100
41 to 60	224	1.4%	645.00	144,480
61 to 80	46	0.3%	865.00	39,790
81 to 100	27	0.2%	1,085.00	29,295
101 to 254	11	0.1%	2,080.00	22,880
Total:	15,970	100%		3,801,795
Average Fee:			238.05855	

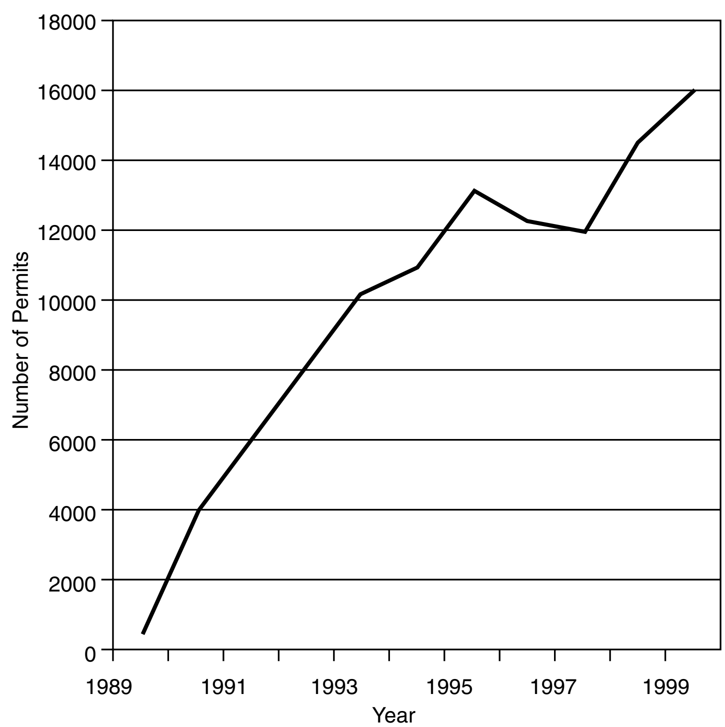
Source: TxDOT, Motor Carrier Division

The 2060 permit system has also had its share of critics, particularly among county officials. The foremost concern is that the heavy truck traffic under permit is degrading roads and bridges, especially those that are load-zoned. Trucks weighing up to 84,000 lb can now roam legally over roads and bridges designed to a standard of 58,420 lb or less. The impact on some roads, according to anecdotes, has been severe. In recent hearings, Texas legislators heard that a road built to the 58,420 lb standard will last for 10 years with its design traffic, but will require resurfacing every 2 years with traffic from 84,000 lb trucks (testimony from CJCAT).

As well as increasing the need for expenditure on 3R (reconstruction, resurfacing, and rehabilitation), deterioration in roads and bridges can compromise safety. Ruts in the pavement can become pools during wet weather, sometimes causing vehicles to hydroplane—a dangerous situation in which tires lose contact with the pavement. In addition, deterioration can take the form of a road crumbling at the sides, sometimes causing trucks to run off the road when attempting to avoid opposing traffic.

But most of the discussion about safety and 2060 permits has pertained to the risk of catastrophic failure of load-posted bridges. When a vehicle weighing far over the posted limit stresses a bridge, there is a risk that the bridge will collapse, either immediately or when subsequent traffic traverses the weakened structure. Although quite rare, such a failure reportedly occurred in Milam County, where a bridge collapsed from under a tanker truck with a state-issued permit.

Figure 1: Growth in "2060" Permits, FY 1989–FY 1999



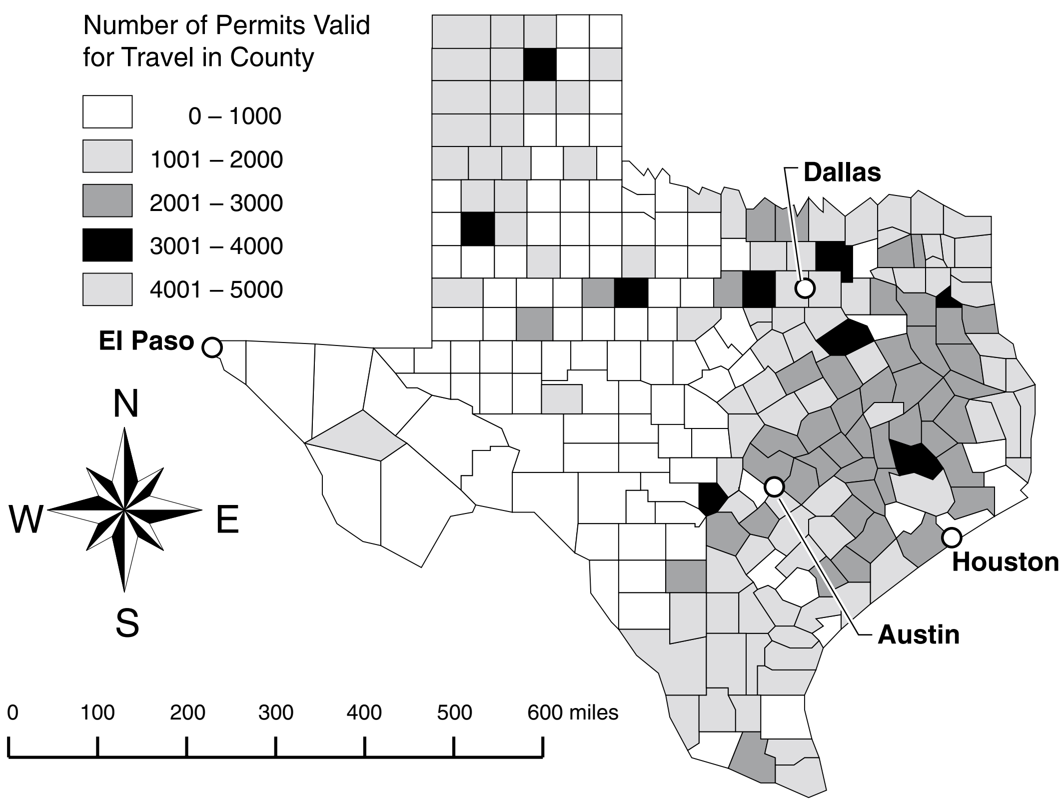
The concerns about deterioration have pertained mainly to the roads and bridges of East, North, and South Texas, where the permits are mainly used.[6] One indicator of usage is the number of permits that are valid for travel in a county. In FY 1999, the counties ranking highest on this indicator were within or near the metropolitan areas of Houston and Dallas/Fort Worth (Fig 2 and Table 2).

[6] The explanations we have heard for the permit being less used in West Texas are that the region has fewer bridges, and that fewer of its roads are load-posted. The exemption from load-posted limits on roads and bridges is one of the permit's appeals. Another possible explanation is simply that population and economic activity are concentrated in other regions of Texas.

A broadly similar geographic picture of usage emerged from this study's telephone survey of permit-holders (Appendix A). The interviewers asked 239 companies to specify in rank order the three counties where their 2060 trucks travel the most. Among the five regions in Figure 3, the North Central and East Texas regions account for about 80 percent of the respondents' mentions of counties, after weighting each company by the number of trucks it represents (Fig 4). The top-ranking counties are again near Houston and Dallas/Fort Worth (Table 3). The survey sample was too small to provide reliable estimates for lower-ranking counties, though Appendix A reports the estimates for all counties for readers who are interested.

Over 60 percent of trucks with permits are in companies for which the main commodities are aggregates, cement, and asphalt (Fig 5). Agricultural products account for another 10 percent; of the remainder, most is accounted for by forestry products, crude oil and related equipment, and petroleum and chemicals.

Figure 2: Overweight ("2060") Permits by Texas County



Source: TxDOT, Motor Carrier Division

Table 2: Top-Ranking Counties by 2060 Permit Authorizations, FY 1999

County	% of Authorizations
Tarrant	28.63
Dallas	28.17
Harris	27.87
Ellis	27.55
Denton	25.15
Wise	25.09
Kaufman	24.54
Collin	23.80
Parker	23.30
Johnson	22.89

Source: TxDOT, Motor Carrier Division

Table 3: Counties Most Traveled by Trucks with 2060 Permits, Survey Estimates

County	% of Trucks[a]
Dallas	9.28
Tarrant	9.04
Wise	7.79
Harris	5.01
Denton	3.96
Fort Bend	3.13
Collin	3.08
Brazoria	1.95
Brazos	1.69
Travis	1.56

[a] Estimates are based on responses to survey question: "What are, in order of most mileage driven, the three main counties in which your trucks with 2060 permits travel?" The estimates are of the percent of trucks held by companies for which a county is one of the three most traveled.

Source: CTR survey of permit-holding companies conducted in July 2000.

Figure 3: Texas Regions

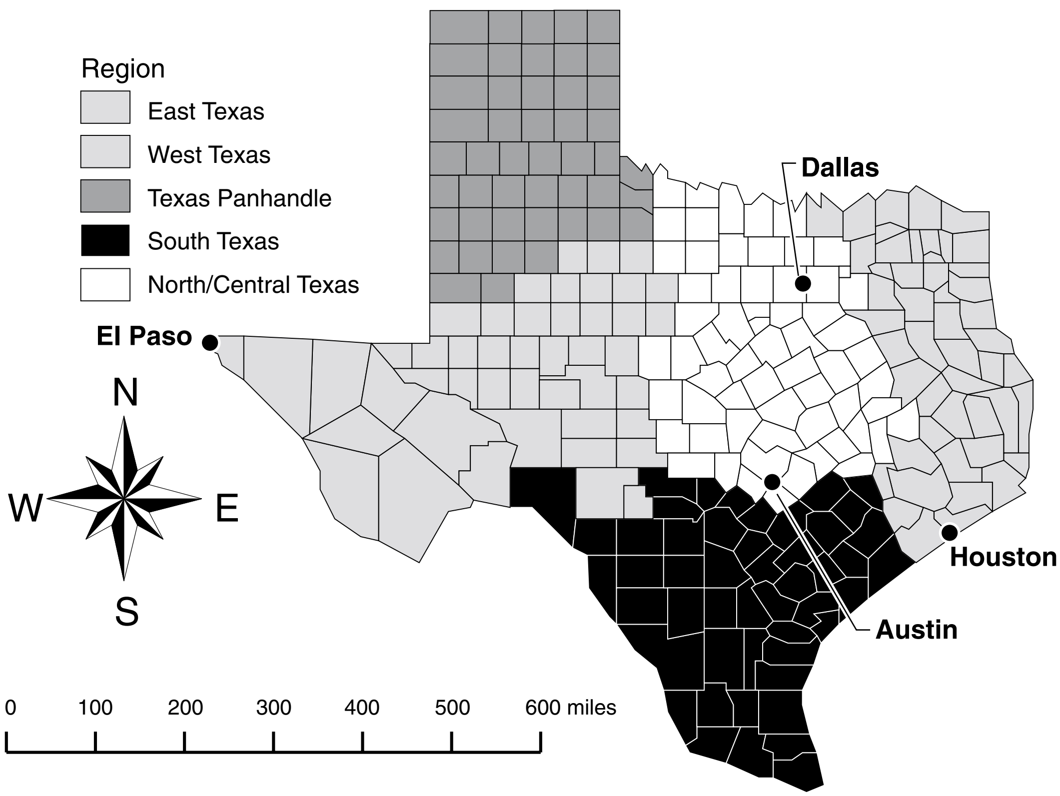
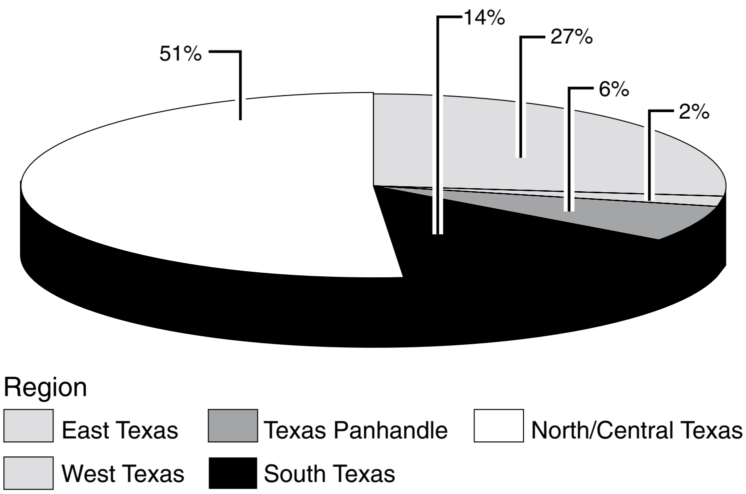


Figure 4: Regional Patterns of 2060 Truck Travel[a, b]

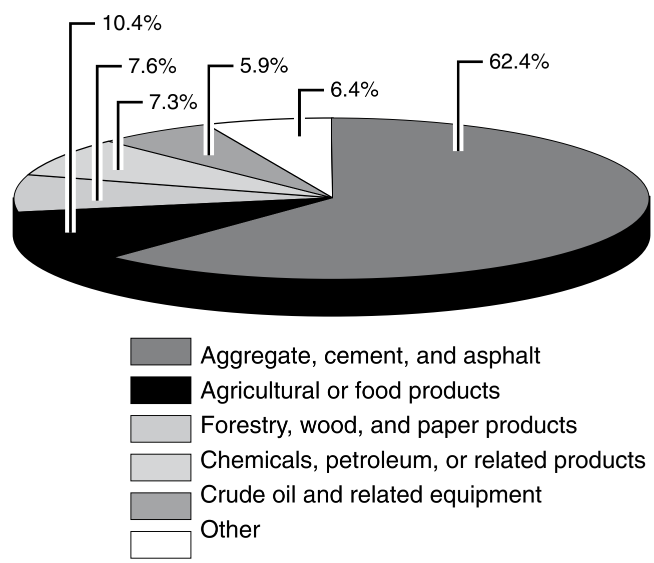


[a] Refer to Figure 3 for location of regions.

[b] Percentages are based on responses to survey question: "What are, in order of most mileage driven, the three main counties in which your trucks with 2060 permits travel?" For each county, we estimated the number of trucks held by companies for which that county is one of the three most traveled. All county totals were then aggregated by region.

Source: CTR survey of permit-holding companies conducted in July 2000.

Figure 5: Commodities Carried by Permitted Trucks[a]



[a] Percentages are based on responses to survey question Q5; see Appendix A. For each commodity category, we estimated the number of trucks with permits that are held by companies for which that category best describes the commodities carried.

Source: CTR survey of permit-holding companies conducted in July 2000.

FRAMEWORK FOR EVALUATING ALTERNATIVE WEIGHT TOLERANCE PERMITS

The concerns about the 2060 permit system led TxDOT to commission the present research project to evaluate and recommend alternatives that take account of all stakeholders' interests. Whether Texas would be better off without overweight permits for divisible loads is not the most relevant question for this study. TxDOT emphasized in its project statement that the permit is bound to continue in some form. Moreover, to perform a cost-benefit analysis of the 2060 permit system relative to the no-permit alternative would require more time than was allowed for this study.

A rare example of such a cost-benefit is a study of the divisible-load permit system in New York State (Meyburg, Saphores, and Schuler 1998). The study relied on three seasonal mail surveys conducted in 1990–1991, requesting permit-holders to provide detailed information on the characteristics of a specific truck and its usage on a randomly chosen day of the week. Other questions elicited information on the characteristics of the respondent's company. The permit system operating at the time of the surveys allowed generous weight tolerances: for example, gross weights of up to 120,000 lb and tandem axles up to 69,000 lb. According to the study's estimates, the system yielded savings in trucking costs on the order of seventeen times larger than the increase in pavement consumption costs. The study omitted the costs of bridge deterioration and, apparently, the costs of administering the permit system. Yet, as the study noted, such costs would have to be many times the pavement damage costs to overturn the study's finding of a high benefit-cost ratio for the permit system. (A more significant limitation of the study was that only about one-third of the companies receiving the surveys responded.)

Although the findings of particular studies are open to challenge, there can be little doubt of the *potential* benefits from a divisible-load permit system (or some similar arrangement). Whenever the law imposes absolute limits on vehicle weights, there are almost bound to be *some* cases where the benefits from exceeding those limits would exceed the costs. Whether a permit system will prove beneficial on balance will depend crucially on its success in granting weight tolerances to these particular cases, and not to others for which the benefits of overweight operation would fall short of the costs. The key to this success is economically efficient pricing of the permit, one of several criteria for evaluating a permit system.

ECONOMICALLY EFFICIENT PRICING OF PERMITS

Motor vehicle travel produces several types of external costs. Pollution from vehicle emissions is largely an "external" cost in that the adverse effects impinge mainly on people other than the motorist. Likewise, a motorist who enters congested traffic reduces travel speed for other motorists, producing an external cost in lost time. The other clearly external cost of vehicle travel is the weakening of pavements and bridges. The costs of crashes, on the other hand, are only partly external to the motorist, who himself may suffer injury and damage to his property.

A popular view among economists is that governments should charge motorists for these external costs. The theoretical ideal is a charge for each trip that matches the external costs created by that trip—the "marginal external cost." Such charges are only secondarily a means of raising government revenue. Their primary purpose is to discourage people from taking trips that are not worthwhile from a whole-of-society perspective: trips for which the private benefits fall short of the costs imposed on the rest of society. The charges *internalize* the external costs into private decisions on use of the roads.

Economically efficient charges for road use should ideally be trip-specific, since the marginal external cost will depend on the distance traveled, characteristics of the vehicle and the road, plus other factors such as the time of travel. In practice, calculations of marginal external cost will average among trips to some extent because separate calculations for each and every trip are not feasible.

Many existing taxes and charges on motorists connect only loosely to marginal external cost. For example, fuel taxes are often rationalized as pollution control measures because they discourage consumption of fuel. But the costs of a vehicle's emissions depend crucially on factors other than fuel consumption. The emissions will cause greater health problems when they pour into a smoggy city rather than a lightly populated, rural area with clean air. In addition, older cars are often much more polluting than newer ones. The ideal would be a location-variable tax on vehicle emissions rather than on fuel, although this may not yet be practical.

Conceivably, taxes and charges on motorists should even exceed the marginal external costs of their trips. After all, the government imposes taxes on all manner of economic activity well in excess of any marginal external cost involved—for example, taxes on sales of food and clothing—simply to raise revenue. The extent to which pure taxes like these should apply to road use is a difficult question and, to keep the analysis within bounds, the assumption in this report is that road users should merely pay for marginal external costs.

A comprehensive package of reform would overhaul the entire system of taxes and charges on motorists, bringing them into line with marginal external costs. But reform generally proceeds in a more piecemeal fashion. So we are faced with the formidable task of analyzing the economically efficient charges for overweight permits when other taxes and charges on motorists remain distorted.

Optimal Permit Fees in a "Second-Best" Environment: An Illustration

The analysis of the optimal policy for one element of an economic system, when other elements stay suboptimal, is what economists call an analysis of the "second-best." Many considerations enter the analysis, and clear-cut answers are elusive (see, for example, Small and Yan 1999). To explain the complexities in relation to permit fees, we draw on FHWA estimates of the typical external costs from truck travel (Table 4) — specifically, on the estimates for a five-axle combination truck on a rural Interstate.

According to these estimates, pavement consumption cost per mile increases from 3.3 cents at 60,000 lb gross weight to 12.7 cents at 80,000 lb. The increase in cost is proportionally much larger than the one-third increase in gross weight, consistent with the well-known fourth-power "rule." The rule—an approximation, really—is that each percent increase in axle weight will typically increase pavement consumption by about 4 percent. In the present comparison, the number of axles stays constant at five, so the increase in gross vehicle weight simply means heavier axles.

Table 4: 2000 Pavement, Congestion, Crash, Air Pollution, and Noise Costs for Illustrative Vehicles under Specific Conditions

Vehicle Class/Highway Class	Cents per Mile					
	Pavement	Congestion	Crash	Air Pollution[a]	Noise	Total
Autos/Rural Interstate		0.78	0.98	1.14	0.01	2.91
Autos/Urban Interstate	0.1	7.70	1.19	1.33	0.09	10.41
40 kip 4-axle S.U. Truck/Rural Interstate	1.0	2.45	0.47	3.85	0.09	7.86
40 kip 4-axle S.U. Truck/Urban Interstate	3.1	24.48	0.86	4.49	1.50	34.43
60 kip 4-axle S.U. Truck/Rural Interstate	5.6	3.27	0.47	3.85	0.11	13.3
60 kip 4-axle S.U. Truck/Urban Interstate	18.1	32.64	0.86	4.49	1.68	57.77
60 kip 5-axle Comb/Rural Interstate	3.3	1.88	0.88	3.85	0.17	10.08
60 kip 5-axle Comb/Urban Interstate	10.5	18.39	1.15	4.49	2.75	37.28
80 kip 5-axle Comb/Rural Interstate	12.7	2.23	0.88	3.85	0.19	19.85
80 kip 5-axle Comb/Urban Interstate	40.9	20.06	1.15	4.49	3.04	69.64

NOTE: S.U. = Single Unit, Comb. = Combination

[a] "Air pollution costs are averages of costs of travel on all rural and urban highway classes, not just Interstate. Available data do not allow differences in air pollution costs for heavy truck classes to be distinguished."

Source: FHWA (2000, Table 13)

The increase in gross weight also adds to the estimated per mile costs of congestion and noise pollution, but these effects are much smaller than the additional costs in pavement consumption. The estimated total cost per vehicle-mile on rural Interstates increases by about 9.8 cents as gross weight rises from 60,000 lb to 80,000 lb.

Now suppose that on some rural Interstate, the marginal external costs of a five-axle combination conformed exactly to the estimates in Table 4. Suppose, too, that the normal legal maximum for vehicle weight were 60,000 lb, so operation at 80,000 lb would require a permit, and that there were no costs to administering or enforcing the permit or other weight regulations. In the hypothetical situation being analyzed, these specific vehicle weights are the only alternatives.

The choice of permit fee would influence the relative use of the heavier (80,000 lb) versus lighter (60,000 lb) trucks; a lower fee would encourage a switch toward the heavier trucks. The permit fee would also affect the total amount of freight being trucked. Some businesses would react to a permit fee increase by reducing their use of road freight—for example, by switching to rail freight.

With respect to both of these outcomes, the choice of permit fee should be geared toward promoting economic efficiency. The mix between heavier and lighter truck traffic should be at an economically efficient level: one that minimizes the total cost to society of achieving the road freight task. Unfortunately, in a second-best world, there are trade-offs between this objective and ensuring that the size of the road freight task is also economically efficient.

Objective: An Economically Efficient Mix between Heavier and Lighter Trucks. To focus first on the mix of trucks, let us imagine for the moment that the permit fee has no effect on the total amount of road freight.

Returning to our numerical illustration, one option is to set the permit fee to ensure that the heavier truck pays 9.8 cents per mile more than the lighter truck, the difference in marginal external cost. The permit fee itself might not be equal to this amount: if other taxes and charges, such as registration fees, are also higher at the heavier weight, the permit fee per mile would equal 9.8 cents per mile *minus* the increase per mile in these other taxes and charges. However, to avoid awkward phrases, it helps to imagine that the amounts of these other taxes and charges remain constant as the vehicle weight increases above the normal legal limit. One can then describe the option being floated as a permit fee of 9.8 cents per mile.

Other possible choices of permit fees emerge from considering the total vehicle-miles of travel. When a five-axle combination carries a larger load, the number of trips needed to perform a given freight task declines. Fewer trips, in turn, reduce the wear and tear on pavements and bridges, which partly offsets the increased deterioration due to heavier loads per truck. Although the reality approximated by the fourth-power rule means that the balance of these effects will be greater deterioration, the offsetting effect is nevertheless relevant to the calculation of the appropriate permit fee. So are the declines in congestion and pollution that also result from fewer trips being made. (Less relevant is the decline in the incidence of crashes, since the costs of crashes are only partly external.)

For further illustration, we shall assume payloads of 30,000 lb and 50,000 lb for the five-axle combinations having gross weights of 60,000 lb and 80,000 lb. This means that the same freight task would require 1.6 times as many miles from a fleet of the lighter trucks as from a fleet of the heavier trucks. Returning to the rural Interstate figures in Table 4, the avoidance of such additional travel through the use of heavy trucks reduces external costs by about 5.5 cents per heavy truck mile (≈ 0.6 x 9.2 cents, the sum of external costs per mile for the 60,000 lb trucks).

To get the overall effect on external costs of using the heavier trucks in place of lighter ones, one must sum the figures calculated above:

- the 5.5 cent reduction in external costs per heavy truck-mile, which reflects that heavier trucks can perform the same freight task in fewer miles;
- the 9.8 cent increase in external costs per mile, which reflects that external costs increase with vehicle weight.

The sum, 4.3 cents per mile, would be another option for the permit fee. Which option would be more economically efficient would depend on how the taxes and charges on the lighter vehicles compare with their external costs. If the taxes and charges cover these costs exactly, the optimal permit fee would be the full 9.8 cents per mile. True, lighter trucks will need to travel more miles than the heavier trucks to carry the same amount of freight, and the additional miles create costs in pavement consumption, congestion, and pollution. But, if the lighter vehicles attract taxes and charges that exactly cover their external costs, the owners of trucks will internalize such costs into their decisions on what type of truck to use—heavy or light.

If, on the other hand, the lighter trucks generate external costs exceeding the taxes and charges levied on them, the owners of trucks will only partly internalize these costs in their choices between heavier and lighter vehicles. As a consequence, their decisions will be biased in favor of the lighter vehicles. To correct this distortion, the optimal permit fee would be somewhat less than 9.8 cents per mile. Were there no taxes and charges on lighter trucks, the optimal fee would be the 4.3 cents per mile.

By the same reasoning, if taxes and charges on the lighter trucks were recovering more than external costs, the optimal permit fee would be greater than 9.8 cents per mile.

Objective: An Economically Efficient Amount of Road Freight. To illustrate the conflict between objectives, suppose for the moment that there were no taxes or charges related to use of the lighter trucks.

If the sole objective in setting the permit fee were an economically efficient mix between trucks of different weights, the optimal fee would then be the 4.3 cents per mile, as was just noted.

But such a fee would be much less than the 12.7 cents in external costs that result from each mile traveled by the heavier trucks. The permit would extend to heavier trucks what is effectively a subsidy for the lighter trucks to consume pavement and to encroach on both the environment and the time of other motorists. While the extension of the subsidy would help ensure the right mix between lighter and heavier trucks, it would also push the demand for road freight services beyond the economically efficient level. (Demand would go beyond the levels where the benefits from additional road freight outweigh the additional external costs.)

The optimal permit fee under these specific circumstances would go past 4.3 cents to a level that balances the twin objectives of an economically efficient mix of trucks and an economically efficient amount of road freight. Economists have theoretical frameworks for determining where the balance occurs in "second-best" situations like this. An important factor in these frameworks is the sensitivity of demand to changes on prices. In the present context, one would need to quantify the response of demand for road freight services to changes in their price. A strong response would shift priority toward ensuring an efficient level of road freight services away from the other objective of getting the right mix of trucks by weight. Likewise, one would need to quantify the response of this mix to changes in the cost differential between heavier and lighter trucks.

External Benefits of Road Freight Transport?

A popular argument from the road freight industry is that the external costs of their operations are offset by external benefits. A common version of this argument is that charging the industry in full for its external costs would lead to high prices for the industry's services, which would have adverse effects throughout the economy. The adverse effects are sometimes seen as foregone "external benefits" from road freight operations. This is equivalent to saying that subsidies for the road freight industry—subsidizing its pavement consumption and other negative externalities—are justified by the benefits the industry provides the rest of the economy. If this argument were valid, it would have a bearing on the appropriate permit fees for overweight trucks.

The flaw in this line of reasoning can be demonstrated with formal economic theory or simply by considering the implication. The same sort of "external benefits" could be claimed for just about any industry. So every industry could claim that it deserves a subsidy. Yet across-the-board subsidies for industry make little economic sense.

To subsidize the road freight industry would make sense only if the industry could lay valid claim to generating truly external benefits to a much greater extent than other industries. A possible basis for such a claim is the role of transportation in stimulating competition outside the transportation sector. Distance insulates against competition to some extent, but distance effectively shrinks as transportation improves. With transportation costs lower, producers in different locations compete more strongly and society benefits. However, this argument pertains to freight transportation generally, rather than road freight specifically and, more importantly, other industries outside transportation can also lay claims to genuine positive externalities. Indeed, the telecommunications industry, like transportation, stimulates competition by lessening the tyranny of distance. For more discussion of positive externalities from transportation, see Bureau of Transport Economics (BTE 1999).

In the 2060 permit context, a related argument is that a subsidy to intrastate road freight may benefit Texas by attracting industry to the state. Again, one would have to question the targeting of the subsidy: a subsidy for other components of the Texas economy could attract industry to the state as well. Although it is conceivable that subsidizing road freight is a particularly cost-effective means of drawing industry to Texas, one would want some evidence of this.

Estimating Economically Efficient Prices for Permits

Determining the economically efficient fee for a permit requires a sound theoretical framework, such as that sketched above, plus reliable estimates of the framework's parameters. Many of the parameters are very hard to estimate, which can make it difficult to evaluate the appropriateness of existing permit fees. (However, as we shall see, some existing permit fees are manifestly out of kilter with what economic efficiency dictates.)

Among the key parameters are the physical impacts of heavy vehicles on roads and bridges. For the present study, we have conducted only a limited review of the engineering literature on this subject, since TxDOT requested a study that would focus on socioeconomic issues. From this limited review, we have learned that the modeling of the physical impacts on infrastructure is far from settled, particularly when it comes to bridges.

An economic issue is how to translate physical impacts on roads and bridges into dollar costs. The economic cost of damage to road infrastructure is the associated reduction in the infrastructure's present value. By present value, we mean the present discounted value of the stream of benefits ($) that the infrastructure will generate, net of the costs of maintaining the infrastructure.

The cost of repairs is an important consideration in calculating the economic cost of damage to roads and bridges, but another consideration is that not all damage will necessarily warrant repair. In some instances, the cost of repair could exceed the benefits. Suppose, for example, that traffic levels on some road are expected to decline in the future due to the planned closure of a quarry. Without sufficient traffic in the future, restoring the road to its original standard may not be economically warranted.

For the other external costs of truck traffic, estimation is more difficult than that for damage to infrastructure. The costs of congestion depend on the value that travelers attach to their time. A range of studies have estimated this value by analyzing travelers actual choices—as between an expensive air trip and a cheaper one by car—or choices between hypothetical travel alternatives posed in surveys. The estimated values of time have varied widely and considerable uncertainty remains.

Far more uncertainty surrounds the cost of pollution from motor vehicles, even abstracting from the vexed questions about greenhouse gases. The effects of motor traffic on the levels of some atmospheric pollutants are not well understood, nor are the effects of some atmospheric pollutants on health.

Then, too, how can one put a money value on health, particularly when talking about premature deaths?

One approach is to estimate how much money people are willing to pay to reduce their risk of premature death. Many studies have done this by analyzing pay differences between similar workers whose jobs differ in the level of safety. Consider an estimate that workers are typically willing to accept $9 less in annual pay for a job that reduces their annual mortality risk by one in a million. In that case, a million workers would collectively be willing to sacrifice $9 million annually in exchange for working conditions that would, on average, result in one fewer death per year. In this sense, the implied "value of life" is $9 million. Estimates of the "value of a life" so construed vary enormously: the Environmental Protection Agency adopted a value of $4.6 million after reviewing twenty-six studies with estimates ranging from $0.6 million to $13.5 million (FHWA 2000a).

ALLOCATING PERMIT REVENUES APPROPRIATELY

Allocation between Governments

When a permit allows travel over roads owned by more than one government, the division of revenues between governments can be contentious. Reimbursement for administrative and enforcement costs can be fought over, but the thornier issue is how to allocate net revenues in excess of these costs.

One option is to prorate revenues according to the external costs that the permit system produces within each jurisdiction. If pavement damage were the only such cost, such an allocation would be proportional to the damage cost that occurs on each government's roads. Such an allocation would appeal to many people's notions of fairness.

Allocation between Road Spending and Other Uses

The U.S. has a tradition of earmarking for road spending the revenues from road-related taxes and charges. The apparent fairness of this arrangement helps to win popular acceptance of these taxes and charges.

However, such earmarking is not always economically efficient. To draw an analogy, should all revenues from taxes on cigarettes be earmarked for finding a cure for lung cancer? Not necessarily: The amount of public funding for research on lung cancer should depend on a range of cost-benefit considerations, including the likelihood that a cure will emerge.

To give an example within the road sector, a study of road congestion in Australia found that, in some cities, economically efficient congestion pricing would yield enough revenue to fund road expenditures for the entire state in which the city is located (BTE 1997). In other words, combined with revenues from other economically efficient charges on road users (such as charges for pavement consumption), such revenues would be more than enough to fund state road expenditures. If such charges were adopted, would it make sense for the states to increase their road expenditures by the same amount as road user revenues? Again, imposing such a rule would contradict the logic of cost-benefit analysis. Some of the revenue gain might be better spent outside the road network.

Nor is there compelling logic to the alternative argument that taxes and charges on road users should be set to equate revenues with the economically warranted road expenditures. Suppose that economically efficient taxes and charges on congestion and the other negative externalities from road use yield more revenue than needed to fund the road system (as the Australian evidence suggests is possible). To scale back these charges and taxes would result in a loss of government revenue that could be offset only by raising other taxes and charges. However, such substitution between revenue sources would have a serious drawback. Efficient taxes and charges on the negative externalities from road users improve societal welfare by deterring people from excessive generation of these externalities. In contrast, most other taxes and charges have adverse effects on taxpayer decisions—for example, taxes on income deter people from saving and working.

As with other forms of earmarking, the dedicating of net revenues from overweight permits to road spending is problematic. It might seem natural to dedicate such revenues to repairing the damage to road infrastructure that the overweight trucks cause. However, as was noted above, there can be instances where the damage is not worth repairing.

Moreover, earmarking may have only limited effect on the pattern of public expenditures, given that funding for a given program can come from various sources. By Texas law, the revenues that counties receive from the 2060 permit system must flow into the County Road and Bridge Fund, along with revenues from bigger sources (such as the optional county registration fee). But some counties supplement their road and bridge expenditures with discretionary funding out of local property taxes. Quite possibly, the amount of such discretionary funding is lower than it would be in the absence of the legal earmarking of 2060 revenues.

All that said, earmarking permit revenues for road spending can be warranted when roads are underfunded. As well as winning popular acceptance for the permit fees, it channels revenue to a sound use.

OFFERING THE RIGHT MENU OF WEIGHT TOLERANCES

A permit system for overweight divisible loads offers a menu of weight tolerances, sometimes with only one choice. The menu specifies the tolerances that are allowed in relation to the limits on gross weights and axle weights (including limits imposed through the bridge formula). The menu may be restricted to certain categories of road users defined by vehicle type or commodity or to certain categories of roads.

A survey undertaken for this study revealed that permit systems for overweight divisible loads vary significantly between states (see Appendix B). New York, for example, offers tolerances that are larger and more differentiated than those in Texas. The divisible-load permit in New York allows a five-axle combination truck to weigh up to 102,000 lb on upstate roads and 120,000 lb downstate (New York City and nearby counties). The permit also provides axle weight tolerances of generally about 25 percent. In contrast, Oregon holds the line on axle weights while allowing gross weights of up to 105,000 lb.

The question of what menu to offer ties in closely with the pricing of road use. When permit fees, along with other road-related taxes and charges, are set at economically efficient levels, the menu of weight tolerances should be driven by demand. If permit users want a particular tolerance and are willing to pay for the external costs that result, government should try to meet the request. When, on the other hand, permit fees are inappropriately priced, the government may need to take a firmer stance. In particular, when fees are well below economically efficient levels, use of the permit will be excessive, and adding new tolerances may make the problem worse.

EFFECTIVE ADMINISTRATION AND ENFORCEMENT

Another criterion for evaluating a permit system is administrative efficiency and cost. In addition to public agency costs, there are the administrative costs to permit users. The users must prepare and submit applications and may also face other burdens, such as maintaining required records.

In many states, an overweight divisible-load trip may require approval from more than one jurisdiction. In these circumstances, one-stop shops that can issue all the necessary permits reduce the administrative burden on applicants. Oregon has recently introduced a one-stop shop annual permit to obviate the need for companies to apply separately to counties and the state.

One must also consider the extent to which the provisions of a permit system are enforceable and at what cost. Where enforcement of vehicle weight regulations is lax, companies may have little incentive to obtain a permit, and companies that obtain one may have little incentive to abide by its rules.

FAIRNESS

Fairness is a subjective notion, making it a fuzzy criterion for evaluating a permit system. However, the perception of fairness is important for getting the public to support a permit system and comply with its provisions.

Major reforms to a permit system carry a risk of inequitable outcomes when they are abrupt and unanticipated. Suppose that the annual fee per truck for some overweight permit increases in this fashion from $200 to $10,000. In the past, industry had based its investment decisions on the assumption that the permit fee would remain modest, say, with adjustment for inflation. With the abrupt and unexpected increase in fee, producers such as a quarry owner dependant on overweight trucks suddenly see their assets fall in value along with their profits. Such a producer, particularly one who was just breaking even, might argue with some justice that the outcome is unfair.

One way of making economic reform more palatable is to somehow compensate the losers. By definition, a reform that is economically efficient will yield sufficient net benefits to enable the losers to be exactly compensated while leaving the rest of society better off. However, this definition is framed for an idealized economy, where it is possible to identify each winner and loser from a reform, to know the dollar equivalent of their gain or loss, and to provide monetary compensation without distorting the economy in new ways. Partly because real-world circumstances are quite different, most economic reforms are unaccompanied by compensation arrangements. Exceptions include trade liberalizations in the United States, which brought about a program to retrain workers displaced by increased imports (Trade Adjustment Assistance Act of 1974).

Although it may sound harsh, one can also question whether the losers from a reform deserve to be compensated. For one thing, the losers from a particular reform might be much more affluent than the winners. In that case, compensation would transfer wealth from the poor to the rich. For another thing, so many reforms take place that the losers from one are bound to be beneficiaries from another. For the broad package of reforms, dispensing with compensation arrangements in most cases may produce outcomes that are fairly equitable. Indeed, there are often opportunities to neutralize the adverse effect of a reform on a particular group by combining it with another reform that is also economically warranted. In any event, it is hardly feasible for governments to devise compensation schemes for each and every reform.

Questions of fairness also arise when different government policies are based on inconsistent principles. To base permit fees purely on economic efficiency would be arguably unfair when so many taxes and charges on road users are strongly influenced by other considerations. If economic efficiency were to dictate a huge increase in permit fees, would such an increase be fair when, for example, car travel does not attract the congestion charges that economic efficiency would also warrant?

Such questions underscore the desirability of comprehensive reform to taxes and charges on road users. A system in which these taxes and charges are all based on economic efficiency principles would be consistent with a central notion of fairness: People should pay for the damage and injury that their actions impose on others. Fees for overweight permits should ensure that overweight trucks are charged in full for their damage to public road property (roads and bridges).

Economically efficient charges for road use can conflict to some extent with another notion of fairness: People who benefit from public infrastructure should contribute to its cost. Imagine someone traveling exclusively in a solar-powered car on uncongested roads. The economically efficient charge for such travel would be negligible: Pollution and congestion costs would be absent and automobiles consume very little pavement. So the traveler would be benefiting from the road network while contributing next to nothing toward its costs. Unfair, some would say.

But this notion of fairness is narrow. The fairness of taxes and charges on road users should be judged within the broad picture of people's circumstances. In the preceding example, what if the user of the solar-powered car lived on a meager pension? To extract a contribution toward the road network from such a person, even though his travel imposes no costs on the network, might be more cruel than fair. If the user of the solar car were more affluent, such a contribution could seem fairer. However, to base road user charges on individual financial circumstances would be administratively unfeasible.

EFFICIENT DIVISION OF POWER AMONG GOVERNMENTS

A jurisdiction's power to authorize and regulate overweight truck travel is restricted by superior levels of governments. Federal law allows states to issue overweight permits that are valid on the Interstate highways only when they can establish a "grandfather" right. As the name suggests, a grandfather right is based on the state having allowed certain weights before federal adoption of lower limits (Department of Transportation [DOT] 1997). Texas has not sought to establish such rights, and so the 2060 permit is not valid for travel on Interstate highways. Some segments of industry have been pushing recently for expanded state rights to issue permits that are valid on the Interstate highways.

The appropriate division between state and federal governments of regulatory power over truck weights is not an issue for this research project, which considers only reforms that the State of Texas government could implement on its own. Within this scope, however, the division of such powers between state and local governments is an issue that is relevant and also very complex.

In relation to overweight permits, some sharing of power between state and local governments would seem optimal. State regulation may be necessary to ensure that the permitting arrangements of different local governments are administratively conformable, making the one-stop shop a possibility. Moreover, when local governments can dictate their terms for overweight travel on their roads, there is a possibility that they will abuse this "monopoly" power. For example, a county government may seek to raise revenue by setting a permit fee well above an economically efficient level. Truth to tell, we do not know to what extent such abuses would occur. However, *reasonable* state-imposed constraints on the local governments would be harmless, and could do much to reassure industry about the permit system. A possible ceiling on permit fees would be the cost of pavement damage.

Allocating some power to local governments helps tailor an overweight permit system to community values. For example, residents of some communities, particularly affluent ones, will tend to place a higher value on travel-time savings than residents elsewhere in the state. Such variation has a bearing on the appropriate permit fee, because the use of overweight trucks can affect traffic congestion, as was discussed above.

Another possible ground for granting some permitting power to local governments is to cater to local development objectives. To illustrate, suppose that the only external cost from truck traffic were pavement damage. For the welfare of the broader society that reaches beyond local government boundaries, the permit should recover the cost of the pavement damage. However, a local community may sometimes stand to gain from charging a lower permit fee in order to lure business from other communities. When many communities play this game, the outcome is likely to be detrimental for the whole society. Yet such games are already being played with a whole range of local government incentives to attract businesses. To exclude underpriced permits from the menu would seem arbitrary.

HOW DOES THE "2060" PERMIT RATE?

Along each of the above criteria, we rate the system of 2060 permits on a scale of 1 (poor) to 5 (excellent).

ECONOMICALLY EFFICIENT PRICING OF PERMITS

Rating: 1

The 2060 permit fee structure captures little of the variation between users in the marginal external cost of overweight operations. The fee increases stepwise with the number of counties for which a permit is valid, which would correlate positively with the amount of travel and external costs. However, the correlation is probably rather weak and, as was noted above, the vast majority of users select the basic twenty-county option. Among the users selecting each option, marginal external costs will vary substantially, depending on how much and where a truck travels, with what loads, and other factors.

Moreover, in average terms, the permit fee appears to be much smaller than the external costs resulting from the allowed increase in weight. In deriving ballpark figures for these external costs, we consider only pavement consumption. Congestion costs are highly location-specific and therefore resistant to the sort of generalization we are attempting, as are pollution costs, which to boot, are exceedingly hard to measure even for a given location. To supplement the FHWA estimates of pavement consumption costs, we draw on estimates from studies of divisible-load permit systems in other states.

Evidence on Pavement Consumption Costs

The concept of an equivalent single-axle load (ESAL) is widely used in the measurement of pavement consumption. The benchmark in this concept is an 18,000 lb single axle: A truck with three ESALs can be expected to cause the same pavement damage as three passes of the benchmark axle. Also widespread is reliance on the ESAL tables developed by the American Association of State Highway Transportation Officials (AASHTO). The AASHTO figures on ESALs vary between roads with different design parameters. The structural number (SN) is a parameter that measures pavement strength, while the pavement serviceability index (PSI) measures pavement performance (riding comfort).

Crockford (1993), in a previous study of the 2060 permit system, used the AASHTO tables for a road with an SN of 2.5 and a terminal PSI of 2.0. For roads in Texas built to the 58,420 lb standard, these design parameters would have been reasonable choices. Table 5 reproduces Crockford's table of ESALs for a five-axle combination of truck-tractor and semitrailer; this is the predominant configuration for trucks with 2060 permits (see appendix tables A8 and A9). For comparison, Table 6 presents AASHTO-based estimates that would be appropriate to an Interstate highway, for which typical parameters are an SN of 5.0 and a PSI of 2.5. In both tables, the effect of axle weights on ESALs conforms fairly well to the fourth-power rule. However, as one would expect, a substantial increase in gross vehicle weight, from 58,420 lb to 84,000 lb, has a more marked effect on the lower standard road (Table 5) than on the Interstate highway (Table 6).

The accuracy of the fourth-power rule and of the AASHTO figures for ESALs have attracted some debate. (For a succinct, though slightly dated, review of the literature, see Meyburg, Schuler, and Saphores 1994, Appendix C.) Crockford (1993, p. 10) conducted a field experiment on two county roads in Texas, from which he concluded that the AASHTO damage factors are sometimes too high and sometimes too low, but overall "reasonable for estimating damage impacts."

A study of divisible-load permits in Louisiana (Roberts and Djakfar 2000) analyzed the pavement impacts on Louisiana roadways of trucks carrying four agricultural commodities: sugarcane, rice, cotton, and timber. For a sample of roadways, the study estimated current and future traffic levels in ESALs for alternative weight limits under permit. Combining these estimates with the original design specifications of the roadways and estimates of past traffic levels, the authors predicted the date when the roadway would need rehabilitation. Higher weight limits bring the date forward (by subjecting the road to more ESALs), which means an increase in the present discounted cost of the rehabilitation work. This increase in cost served as the study's measure of the additional cost of pavement damage.

Table 5: ESALs Generated by a Five-Axle Combination Truck on a Light-Duty Road

	# of ESALs		
GVW (lb)	Steering Axle	Tandem Axles	Total
58,420	0.055	0.293	0.641
80,000	0.183	1.075	2.333
84,000	0.066	1.632	3.33

Note: The calculations are for a truck-tractor/semitrailer combination with two tandem axles. The road is assumed to have an SN=2.5 and PSI=2.0.

Source: AASHTO (1986)

Table 6: ESALs Generated by a Five-Axle Combination Truck on an Interstate Highway

	# of ESALs		
GVW (lb)	Steering Axle	Tandem Axles	Total
58,420	0.051	0.298	0.647
80,000	0.189	1.09	2.369
84,000	0.232	1.333	2.898

Note: The calculations are for a truck-tractor/semitrailer combination with two tandem axles. The road is assumed to have an SN=5.0 and PSI=2.5.

Source: Crockford (1993, p. D-3)

One of the authors of the study, Professor Freddy Roberts of Louisiana Tech University, provided the Center for Transportation Research (CTR) with estimates of the cost in pavement consumption per ESAL-mile of travel, based on the study (Table 7). Professor Roberts is familiar with the road network in Texas and considers the FM roads to be structurally similar to the state-numbered routes in Louisiana. He also perceives substantial similarity between these states in the standards of their U.S. and Interstate highways. The estimates for each Louisiana road category in Table 7 are averages among sampled roadways—four state-numbered routes, four U.S. highways, and two Interstate highways. Within the state-numbered category, there was an outlier with an estimated cost per ESAL-mile of $1.55. The outlier, according to Professor Roberts, resembles roads in Texas that are load-zoned to 58,420 lb.

The study of divisible-load permits in New York (discussed above) also reported estimates of pavement consumption cost per ESAL-mile, based on literature review and discussions with state highway officials (Meyburg, Schuler, and Saphores 1994). These are shown in Table 7, together with the costs per ESAL-mile based on FHWA estimates for Interstate highways.

Our survey of 2060 permit-users divided the Texas road network among three categories and obtained information on vehicle-miles of travel among trucks with permits. Table 8 presents both the mileage breakdown and our best-guess values for pavement damage cost per ESAL-mile, based on the evidence presented above. For FM roads (including the small network of ranch-to-market roads), we use the average value for state-numbered routes in Louisiana (Table 7). For local roads, the average cost per ESAL-mile would doubtless be higher, since they are typically designed to a lower standard than the FM roads. To err on the conservative side, we use a figure that is only moderately higher than that for FM roads. For non-FM state roads, we again choose a value that is on the low side relative to the estimates in Table 7. Some of these roads are non-Interstate highways, such as “U.S. highways,” which were built to a lower standard than the Interstates. Moreover, our chosen value is low even relative to the range of estimates for the Interstates.

For other reasons as well, our selected values may be conservative. Although it is hard to gauge the realism of the New York estimates given their basis in secondary sources, we know that the estimates from the other studies omit certain categories of cost. In line with the pavement design models in use in most states, the Louisiana study omitted the costs of pavement distress, such as rutting and cracking: It measured only the costs of increased surface roughness. Professor Roberts imparted to CTR his "gut feeling" that this omission resulted in underestimation on the order of 20 percent. Absent from the calculations of both the Louisiana and federal studies are the costs in travel time that arise when roadwork disrupts traffic; this omission represents another source of underestimation of pavement consumption costs.

Table 7: Estimates of Pavement Consumption Costs per ESAL-Mile, 1999–2000

Louisiana		New York[a]		U.S.[b]	
Road Category	Cents	Road Category	Cents	Road Category	Cents
State-Numbered Routes	48.9	Local	55.2		
U.S. Highways	16.2	State	18.3	Interstate-rural	5.0
Interstate	2.7	Interstate	2.8	Interstate-urban	15.9

[a] CTR has updated the New York study's estimates, which were at 1987 prices, to the first quarter of 2000 using a road construction price index (FHWA 2000b).

[b] FHWA (2000a) estimated typical costs of pavement consumption per vehicle-mile for a five-axle combination truck at gross vehicle weights of 60,000 and 80,000 lb (see Table 4 in this report). To convert these estimates to cost per ESAL-mile of travel, we divided them by appropriate figures for the total ESALs: 0.726 and 2.369 for gross weights of 60,000 and 80,000 lb. The figures reported in this table are the average of the results at these alternative gross weights.

Sources:
Louisiana: unpublished estimates provided to CTR by Professor Freddy Roberts of Louisiana Tech University, based on research conducted for Roberts and Djakfar (2000).

New York: Meyburg, Saphores, and Schuler (1998) and FHWA (2000b)

U.S.: FHWA (2000a), AASHTO (1986)

Table 8: Pavement Consumption Cost per ESAL-Mile and Annual VMT among Trucks with "2060" Permits—Estimates by Texas Road Category

Road Category	Annual VMT among Trucks with "2060" Permits		Estimated Cost per ESAL-Mile
	Million-Miles	Percent	Cents
Local	481.5	31.5%	60.0
FM	216.6	14.2%	48.9
Non-FM State	832.4	54.4%	3.0
Total	1,530.5	100.0%	

For our illustrative calculations of pavement consumption costs resulting from the 2060 permits, we consider two hypothetical extreme travel patterns for a five-axle combination operating under permit. The worst-case scenario for pavement damage is where a truck travels only on county-type roads, which are the most vulnerable to heavy weights. The best-case scenario is where a truck travels only on non-FM state roads, which are the least vulnerable. For each scenario, our calculations combine the following assumptions with our best guesses of pavement consumption per ESAL-mile:

- Each truck travels 80,000 miles annually, approximately the median suggested by responses to our survey.
- The truck is fully loaded for half of these miles and empty for the other half.
- The tare weight of the vehicle is 29,000 lb (a typical weight for a five-axle combination)
- Each truck has a loaded GVW of 84,000 lb under permit.
- Without the permit, the loaded GVW would be 58,420 lb for the truck that travels only on county-type roads, and 80,000 lb for the truck that travels only on non-FM state roads.

Our assumptions about the gross vehicle weights reinforce the extreme nature of our two travel scenarios. County-type roads are the most vulnerable to damage from heavy trucks, and the jump from 58,420 to 84,000 lb is about the maximum that would result from the permit. Conversely, non-FM state roads are the least vulnerable, and the jump from 80,000 to 84,000 lb is about the minimum that would result from the permit. For comparison, our survey findings are that the loaded miles among 2060 trucks are driven mainly at GVWs of between 80,000 and 84,000 lb, and only 8 percent at fewer than 70,000 lb (Table 9). Our survey did not ask for weight breakdowns within the 80,000 to 84,000 lb interval, but we have learned that some grain trucks exceed 80,000 lb and that logging trucks typically operate at 84,000 lb.

Table 9: Percent Distribution of Annual Vehicle-Miles Traveled among "2060" Trucks by Gross Vehicle Weight

GVW	% of VMT
under 70,000 lb	8.3
70,000 – 79,000 lb	31.5
80,000 – 84,000 lb	58.0
over 84,000 lb	2.0
	100

For each scenario, we compare the annual pavement consumption cost that results from the operation of one truck, at the loads that would be carried with and without the permit (Table 10). For the worst-case scenario, the increase in load due to the permit causes an awesome increase in pavement consumption cost of over $64,000. For the best-case scenario, the corresponding figure is an increase of somewhat over $600, still well in excess of the average permit fee of $238 in FY 1999. Even after adjusting for the facts that heavier trucks require fewer trips to carry the same amount of freight, and that fewer trips mean less pavement consumption, the increased damage due to the permit exceeds the average permit fee. The net increase in pavement consumption cost per permitted truck, after making this adjustment, amounts to about $51,000 in the worst-case scenario and to about $500 in the best-case scenario.

The range between the best- and worst-case estimates is vast and could expand further were one to incorporate external costs other than pavement damage, such as the costs of pollution, congestion and bridge damage, and perhaps the external component of road accident costs. To venture an estimate within this broad range would require more information than is currently available.

That said, reality contains a significant element of our worst-case scenario. The trucks with 2060 permits travel over a quarter of their miles on local roads, and another 19 percent on FM roads (Table 8), many of which were built to the same standard as a typical county road and have not been upgraded. In addition, the responses to our survey indicate that a third of the permitted trucks are in companies that travel load-zoned roads on at least 20 percent of their trips (Table A14). Although such usage of load-zoned roads may not sound particularly high, one has to remember that the proportion of county roads that are load-zoned would likely be higher in the absence of the 2060 permit.[7] (At present, the permit's exemption from the load-zone restrictions discourages county governments from undertaking the time-consuming process for establishing load-zone limits.) Furthermore, reality would not have to resemble our worst-case scenario all that

[7] In particular industry sectors, the reliance on load-zoned roads could be much higher than these figures indicate. Mr. Bob Currie, of the Texas Logging Council, reported to CTR that about 95 percent of travel in his sector occurs on load-posted state roads and 5 percent on county roads, of which about one-fourth are load-posted.

much for our estimates to imply that the pavement consumption costs due to 2060 permits far exceed permit revenues.

In rating the 2060 permit system poorly on the criterion of "economically efficient pricing," our benchmark is what would make sense, not the general practice among other states with divisible-load permits. Our survey of practices in seventeen states found that permit fees are generally set to recover administrative costs only, although in a few states they partially recover pavement consumption costs. (An earlier survey of arrangements for overdimensional permits in fourteen states found the same patterns; DOT 1997, p. VII-9.)

Voluntary Contributions to Road Repairs

Our impression that permit fees are too low remains, even after considering the voluntary contributions that some companies make toward road repairs. Companies that cooperate this way reduce the risk of being sued and can hope to build good will with the county government. When a company expects to be using a road heavily in the future, another motivation for voluntary contributions is to induce the county to undertake the repairs soon.

Panola County is among the counties that have had some success in obtaining such contributions. The superintendent of the county's road and bridge department, Mr. John De Presca, has found that even when an operation involves several companies, he is fairly successful in getting the companies to agree on a division of contributions among them. Some companies approach his department to work out a voluntary agreement on road repairs before commencing work at a site. Under such agreements, the department assesses the condition of the road before, during, and after the operation, and companies pay for the materials needed for repair. In other cases, the department requests this sort of agreement upon learning of major trucking operations on county roads (through the surveillance of the department's foreman or the two constables carrying out weight enforcement). The responses to these requests are mixed, with some companies simply refusing.

The Panola County system, like the arrangements in other counties, recovers only a portion of the damage to county roads from heavy trucks. Only some of the damage is traceable to particular operations, and only some of the companies involved in such operations agree to participate in the system. Moreover, the companies that agree to participate pay only for the material inputs to repairs, leaving the county to pay for labor, equipment, and machinery. According to one of the county commissioners, Mr. Jimmy Davis, the road damage recovery agreements have yielded about $2 million over the last 10 to 12 years, but the true damage costs are higher.

Unlike Panola County, Brazoria County does not have any agreements with industry to recover the damage costs from heavy trucks. The permits coordinator for the county, Ms. Marvene Coles, said that 2060 trucks are tearing up the county roads, and the damage is being covered through increased property taxes. She mentioned that the county is currently trying to recover road damage costs arising from an operation under a 2060 permit, but that liability will be hard to prove.

Table 10: Illustrative Calculations of Pavement Consumption Costs of "2060" Permits

WORST CASE

				Pavement consumption cost ($)				
	GVW (lb)	payload (lb)	ESALs	per ESAL-mile	per vehicle-mile	per vehicle-year	savings from fewer trips	per vehicle-year, net of savings
No permit	58,420	29,420	0.641	$0.60	$0.38	$15,384		$15,384
With permit	84,000	55,000	3.33	$0.60	$2.00	$79,920		$66,544
Net effect of permit	25,580	86.9%	2.689			$64,536	$13,376	$51,160

BEST CASE

				Pavement consumption cost ($)				
	GVW (lb)	payload (lb)	ESALs	per ESAL-mile	per vehicle-mile	per vehicle-year	savings from fewer trips	per vehicle-year, net of savings
No permit	80,000	51,000	2.369	$0.03	$0.07	$2,843		$2,843
With permit	84,000	55,000	2.898	$0.03	$0.09	$3,478		$3,335
Net effect of permit	4,000	5.0%	0.529			$635	$142	$493

Additional Taxes Paid by Trucks with Permits

Nor does our impression change when we consider the effect of vehicle weight on registration fees and fuel taxes.

Trucks are assessed registration fees in Texas according to maximum loaded weight: tire weight plus net carrying capacity. The net carrying capacity is defined as either the manufacturer's rating of this capacity or the heaviest net load to be carried, whichever is greater. The registered weight cannot, however, exceed the 80,000 lb legal limit on gross vehicle weight. Even vehicles that can exceed this limit under permit are registered at 80,000 lb.

According to industry sources contacted for this study, the 2060 permit has led not to the usage of larger trucks in the industry but to standard trucks carrying heavier loads. For a standard truck, the manufacturer's rating would normally be close to 80,000 lb, the maximum registered weight. Any increase in registration fee resulting from heavier loads under 2060 permit would therefore be negligible.

The heavier loads would, on the other hand, affect fuel tax payments. Under the assumptions used for our worst-case scenario (Table 10), we have formed rough estimates of this effect, with and without allowing for changes in the number of trips. (The estimates are based on mileage per gallon data in the FHWA's Highway Revenue Forecasting Model and in *Highway Statistics, 1999*.) Heavier loads reduce fuel economy and, with the number of trips constant, the annual payment of fuel taxes increases by about $600 per vehicle. This pales into insignificance, however, beside the estimated worst-case increase in pavement damage cost (Table 10).

Recognizing that heavier loads also mean fewer trips changes the picture entirely. The net effect of the heavier loads is now a reduction in fuel consumption that saves about $5,000 per vehicle in fuel taxes. This effect reinforces our assessment that trucks with 2060 permits are not paying for the pavement damage they cause through overweight operation.

ALLOCATING PERMIT REVENUES APPROPRIATELY

Rating: 3

The revenues from 2060 permits are allocated among the state and county governments according to a complex formula. The fee for the permit comprises a basic fee of $80 and a county option fee, which increases with the number of counties for which the permit is valid. The county option fee generates about two-thirds of the revenue from the permit.

Of the basic fee, $5 goes to TxDOT and $25 to the state highway fund. The remaining $50 is distributed among all counties in Texas in proportion to the centerline road mileage maintained by counties. The county option fee is also distributed in proportion to county-road mileage, but only among the counties for which a permit is valid. All the revenues accruing to the counties are earmarked for the County Road and Bridge Fund.

The allocation of the revenues among counties bears only some relationship to the distribution of traffic from 2060 trucks. This is especially true of the $50 portion of the basic fee, the allocation of which depends on road mileage alone. For example, Tarrant County is one of the counties most traveled by 2060 trucks, having Fort Worth as its seat (Tables 2 and 3). Yet it has only 354 miles of county roads, compared with 579 miles in El Paso County, which is among the counties least traveled by 2060 trucks. In FY 1999, El Paso County ranked third from the bottom among the 254 counties in number of valid permits, with only 83.

Even when county road mileage is weighted by the number of permits valid for use in a county—as is done for allocation of the county option fee—the result is a loose proxy for 2060 traffic levels. The basic county option, which is selected for the vast majority of permits, authorizes travel in up to twenty counties. Applicants have nothing to lose, and possibly something to gain, by naming twenty counties, yet it is likely that many of the applicants travel in only a few. The evidence in Crockford (1993) is suggestive in this regard, although based on a mail survey of thirty trucking firms to which only nine firms responded. Of the respondents, five operated their trucks in less than 5 percent of the counties for which they were permitted. Then too, some applicants for permits may inadvertently select counties where they are unlikely to travel, due simply to confusion about county names—for example, thinking that Houston is in "Houston County" or that Austin is in "Austin County." In our survey of permit holders, we attempted to steer applicants away from such mistakes.

The upshot is that the 2060 permit system does not rate particularly well along one of the principles in our framework for evaluating permit systems, namely, that net revenues be allocated across jurisdictions in proportion to the external costs that the system imposes on each jurisdiction. Granted, to devise an allocation scheme that would adhere closely to this principle would be difficult or impossible with the information currently available, and to devote a great deal of effort toward this goal would be a waste of resources at present, with the total bucket of money being so small. In FY 1999, permit revenues amounted to only a few million dollars, or about $15,000 per county.

The earmarking of 2060 permit revenues for road and bridge spending strikes us as probably innocuous and possibly beneficial at present. The vast bulk of the revenues (87 percent in FY 1999) enters the road and bridge funds of the counties, and by all accounts the county roads are in dire need of additional funding. Indeed, the need for more funding results partly from the 2060 permit system, which has been hastening the deterioration of some light-duty roads and bridges.

OFFERING THE RIGHT MENU OF WEIGHT TOLERANCES

Rating: 2

To exempt trucks from the load restrictions on bridges, as the 2060 permit does, smacks of a recipe for disaster. If the load limits on bridges are too conservative—and we do not know that they are—a revision or partial relaxation under permit might be justifiable, but not a blanket exemption.

To some extent, self-interest deters drivers from exceeding the weight limits on bridges. Few drivers want to risk a bridge collapsing from under them. Yet prudence does not always prevail, and such collapses do occur. (To add to our earlier example, a crane weighing over 8 times the posted limit reportedly caused a bridge collapse in Mesquite.)[8]

Results of our survey suggest that almost half of the trucks with 2060 permits are in companies that cross load-zoned bridges on some of their trips. Of these trucks, an estimated two-fifths are in companies that cross load-zoned bridges on more than 20 percent of their trips. A possibility that we are unable to assess is that some respondents deliberately understated their crossings of load-zoned bridges for political reasons. Some companies may have reasoned that the more such travel our survey reveals, the greater the odds that the legislature will scale back the 2060 permit exemption from load-posted limits.

Bill Webb of the Texas Motor Transportation Association (TMTA) acknowledged that drivers of trucks with 2060 permits sometimes cross load-posted bridges. The most common circumstance in his estimation was when shippers give directions to a trucker without realizing (or caring) that the route includes a load-posted bridge. Mr. Webb's impression is that the trucker will generally not turn around when encountering the unexpected load-zoned bridge. Implicit in this scenario is that the trucker's route after collecting a load differs from the route that the trucker took to the shipper's premises. (Otherwise, the trucker would presumably have observed the load-zoned bridge before collecting the load.) Although this no doubt occurs, there would certainly be other occasions when truckers cross a load-zoned bridge that they know of beforehand.

The ill-advisedness of the exemption from bridge weight limits is evidenced by its general absence from permit systems in other states. The exemption featured nowhere in the permit systems of the seventeen other states whose weight regulation practices we surveyed. Nor, for that matter, did any of these states exempt permit-holders from load-posted restrictions on roads (Appendix B). Some of these states, such as Louisiana, have many load-posted bridges. If industry and rural communities in these other states can cope with these limits, surely those in Texas can too. Moreover, TxDOT research has shown that only about 1 percent of the communities in Texas are "landlocked" by load-zoned bridges, which suggests that removing the current exemption would have only a modest impact. Further evidence of the impact being modest was supplied to CTR by Mr. Bob Currie of the Texas Logging Council. His estimate was that removing the current exemption from load postings on bridges would make only between 3 and 4 percent of the timber in Texas "inaccessible."

A secondary reason for assigning a low rating to the 2060 permit menu of weight tolerances is its lack of choice. This contrasts with the divisible-load permits in some other states, which offer a range of tolerances varying in price. Montana, for example, offers a permit for an annual fee of $100 plus $46 for each authorized ton above the general limit on GVW of 80,000 lb (up to a maximum gross weight of 129,000 lb). A "one-size-fits-all" approach to overweight permits is generally suboptimal because it

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8 Senator Ogden mentioned this event at the joint hearings of the Texas State Senate Affairs and Border Affairs Committees, held in Houston on April 12.

ignores the variation between companies in their transportation needs. How the menu of tolerances in the 2060 permit might be enlarged is discussed in a later section of this report.

EFFECTIVE ADMINISTRATION AND ENFORCEMENT

Rating: 5, Administration

One of the major pluses of the 2060 permit system is its relatively light administrative burden. The administrative costs to TxDOT, which runs the system, are low. The permit fee includes $5 to cover the costs of issuing the permit sticker, distributing revenues among government agencies, and notifying the counties of the issuance of permits valid for use within their boundaries. The $5 administrative charge has been constant since its introduction in 1995 and does not cover other administrative costs of the system, such as maintaining the permit database or, for that matter, conducting studies such as this. But even allowing for some understatement, the administrative costs in proportion to revenues are relatively low. The administrative charge amounted to only about 2 percent of the average permit fee in FY 1999 ($238).

Administrative burdens on permit users have also been modest, the biggest probably being the provision of the $15,000 security. Among nine permit-holders surveyed in 1993, only one agreed that “the permit is too much trouble to get” (Crockford 1993).

In contrast, a study of Oregon’s weight-distance tax on trucks placed the costs in public administration at 4.8 percent, and industry compliance costs at 5.7 percent, of total revenue from the tax during 1993-95 (Weinblatt et al. 1998, p. 39). The estimate of public administration cost factored in collection, auditing, enforcement, and all associated overhead and support activities. The compliance burden on companies includes keeping track of and reporting the distance traveled at each declared weight. The estimate of 5.7 percent of total revenues was based on estimates of this burden supplied by tax-paying companies, and so must be taken with a grain of salt. As Weinblatt et al. observe, some companies may have been exaggerating for political reasons.

Rating: 2?, Enforcement

Our choice of rating on the enforcement dimension reflects general difficulties in enforcing the weight limits on Texas roads, rather than flaws specific to the 2060 permit system. A violator’s chances of going undetected significantly reduce the incentive to obtain a 2060 permit and to abide by its provisions. Anecdotal evidence suggests that the violations of weight limits are rampant on many low-volume roads. Repeatedly, we heard that many companies make little effort to comply, viewing overweight fines as simply a cost of doing business. According to Brazos County Commissioner Randy Sims, truckers receiving citations have even told enforcement officers that they have no intention of getting a 2060 permit because risking a fine is cheaper.

Whether the fines are high enough is questionable. A fine of between only $100 and $150 results from exceeding axle weight limits, regardless of by how much. Citations for GVW violations are written mostly to vehicles that are less than 5,000 lb overweight, to which the same fines apply. The maximum fine is between $500 and $1000 for exceeding the GVW limits by more than 10,000 lb. An exception is made for a repeat offense within twelve months, for which the fines are doubled.

These penalties are modest compared with those in some other states. Among the states surveyed for this study, penalties are most stringent in New York, where an axle weight violation can cost up to $4500 and a GVW violation up to $2700. New York also has automatic suspension of overweight permits for load-posting violations or exceeding weight limits by more than 10 percent, and a fee of $5000 to get a new permit after revocation. In contrast, violations of Texas weight standards do not result in any loss of permit privileges under the 2060 system.

Texas, like many other states, requires some vehicles cited for weight violations to reduce their weight before resuming their journey. Vehicles that are less than 5 percent overweight or within 5 miles of their destination are exempt from the requirement. A broad exemption also applies to vehicles carrying forestry and agricultural products (including livestock). Moreover, even for vehicles that are not exempt, having to immediately reduce weight is only sometimes a strong deterrent to weight violations. When gross weight is legal but an axle is overloaded, shifting the weight off the overloaded axle can be quite easy in some cases: for example, on a water truck, a simple adjustment to an internal valve will often suffice. When gross weight exceeds the limit, off-loading the excess may or may not be burdensome. DPS sometimes allows trucks carrying aggregates to dump their excess load into the ditch along the side of the road, where it is later smoothed. Since the product is generally of low value, the deterrent effect of this loss is limited.

CTR has also been informed that weight enforcement efforts in Texas are fairly limited off the state-maintained highway network. Department of Public Safety (DPS) troopers responsible for weight enforcement patrol county roads very lightly because of the low traffic volumes, and because many roads lack pullout areas where inspections can safely occur. By law, troopers cannot carry out inspections on municipal roads, and few municipalities are active in weight enforcement. Houston recently resumed weight enforcement after a lapse of 25 years. Both county and municipal governments are reportedly hampered in their weight enforcement efforts by difficulty in obtaining training, requests for which are turned down by DPS. More fundamentally perhaps, a serious effort at weight enforcement requires political will that may sometimes be lacking.

The question mark beside our rating for enforcement (2?) reflects a lack of data. Data collected by TxDOT from weigh-in-motion (WIM) devices are suggestive of high levels of compliance. But WIM devices are placed only on high-volume highways, where weight enforcement efforts are concentrated. Elsewhere on the network, overweight vehicles are less likely to be apprehended, and so the level of compliance is lower. Data on the proportion of inspected vehicles found to be overweight are not especially informative. Enforcement officers target for inspection vehicles that look overweight, so this proportion will far overstate the rate of noncompliance.

FAIRNESS

Rating: 2

The 2060 permit system rates poorly on the fairness criterion that people should pay for damaging public property. To repeat, the weight tolerances in the permit have costs in pavement damage that appear to significantly exceed the payments by permit-holders in fees and voluntary contributions.

Trucks with 2060 permits are, of course, not the only vehicles that pay less than their pavement damage cost. For one thing, the absence of load postings from many light-duty roads, particularly county roads, means that trucks up to 80,000 lb can operate legally on these roads, with a substantial pavement impact. Under the same set of assumptions used for Table 10, we estimate that an 80,000 lb truck traveling exclusively on roads designed for 58,420 lb vehicles would generate pavement damage costs of about $29,000 annually. In comparison, such a vehicle would be required to pay only about $9,000 annually in fuel taxes, registration fees, and other road-related taxes and charges.[9] In light of this disparity, industry has questioned the fairness of 2060 permit fees that would recover the pavement damage costs of overweight operation. The holders of permits would, in industry's view, be singled out.

Similarly, one could question the fairness of companies having to pay for 2060 permits when certain classes of vehicles receive generous dimensional tolerances at no cost or for a nominal fee (such as $5). The law in Texas, like that of other states, is replete with such special provisions. Concrete-mixer trucks are allowed tandem axle weights of up to 46,000 lb, whereas the general limit is 34,000 lb. The deal is even better when the gross vehicle weight is less than 69,000 lb; a concrete-mixer truck can then have a tandem axle weighing up to 50,600 lb. Other special tolerances include:

- An exemption from load-posted weight limits on state-maintained roads and bridges for vehicles delivering groceries, farm products, or liquefied petroleum gas.
- An exemption from load-posted weight limits on county roads and bridges for vehicles delivering groceries or farm products, provided that the delivery "requires" use of the road or bridge.
- An exemption from weight limits for vehicles transporting "fixed load oil field service equipment" for servicing an oil and gas well not more than 50 miles from the equipment's point of origin.
- A 12 percent tolerance on axle weights for vehicles hauling forestry or agricultural products in their natural state.

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[9] This estimate was derived from a database created for a Texas highway cost allocation study. For 1998, the year to which the database pertains, we estimated that the vehicle being considered would have been required to pay the following amounts in road-related taxes and charges: $7,030 in fuel taxes (a rough estimate that may be on the high side), $855 in registration fees, $806 in federal sales tax on trucks and trailers, plus $695 in other federal taxes (heavy vehicle use tax and tire sales tax). The study from which these data were taken is being conducted for TxDOT by the Center for Transportation Research (University of Texas at Austin) and by the Texas Transportation Institute (the Texas A&M University). A report on the study is expected to be published soon.

Conversely, one could question the fairness of restricting certain privileges to the 2060 permit. A major privilege is being able to travel at up to 84,000 lb GVW over load-zoned county roads without need of county approval. Such travel can easily cause more road damage than a truck moving at 90,000 lb over a county road built to an 80,000 lb standard. Yet to legally move the 90,000 lb truck, would require county permission as well as a nondivisible-load permit from the state.

EFFICIENT DIVISION OF POWERS AMONG GOVERNMENTS

Rating: 3

The appropriate division of powers in a permit system between state and local governments has already been acknowledged as a complex issue. For the reasons set out in our framework section, our sense is that some sharing of power is optimal.

The 2060 permit system, in contrast, relegates almost all power to the state government. County governments have no power to speak of. The permit is not valid on municipal roads, but few municipalities actively enforce vehicle weight limits, as was noted above. Houston is one of the exceptions, but its police department nevertheless accepts the 2060 permits as valid on city roads.

In the powerlessness of the counties, the 2060 system is unusual among systems of overweight vehicle permits. Among the other states whose practices were surveyed for this study, only Oklahoma issues permits that are valid off state-maintained roads. These permits are valid on both state and county roads for trucks hauling garbage and certain farm and forestry products.

Oregon's divisible-load permit system has a division of power from which Texas might borrow some ideas. The state government issues a permit known as the Continuous Operating Variance Permit (COVP), which is valid on state roads and on select roads in counties where the permit-holder wishes to operate. Each county government can designate which of its roads the permit is valid for, and can charge up to a maximum fee set by state law ($8 annual per vehicle). Counties are said to vary considerably in the portion of their road network that they designate, with some selecting only a few major freight routes.

OUR VISION: AN OVERWEIGHT PERMIT SYSTEM USING GPS TECHNOLOGY

The bad news in this report is that the 2060 permit system generally rates poorly against our evaluation criteria, with the notable exception of administrative efficiency.

The good news is that modern technology holds much promise for overcoming the current problems, given the political will. An electronic system of road pricing has at its core a global positioning system (GPS), which can pinpoint a vehicle's geographic coordinates. When linked to a geographic information system, it can determine a vehicle's position on a road network at any given time to a high degree of accuracy. Other components of a GPS-based system of road pricing include technologies for transmitting data, such as cellular telephones, and for data storage and analysis. A system could also include on-vehicle equipment that monitor axle weights and tire pressures, though not as accurately as the vehicle's position, given the current state of technology.

A GPS-based system can do much to overcome the informational obstacles to appropriate pricing of permits. Economically efficient pricing requires that each trip be charged according to the external costs in pavement consumption and in other externalities that may be relevant (pollution, congestion, and possibly accidents). Estimation of the external effects requires, in turn, detailed information on a vehicle's patterns of travel. One would want to know the trip's route, the weights on the various axles, the number and type of axles and their configuration, and perhaps tire pressures. The time of travel can also be relevant, as it can influence the effect on congestion or even on pavement consumption.[10]

Our vision of a divisible-load permit system also includes other features that the component technologies make possible. The net revenues from the permit would be allocated between state and local governments along the lines suggested earlier in this report. Each government would receive a share of net revenue equal to the share of external costs that the system produces within its jurisdiction. Enforcement of permit provisions would become vastly easier, because the system would monitor when vehicles exceed the allowed tolerances.

A GPS-based permitting system would also have some side benefits. It would yield traffic data that could guide government road spending; at present, lack of traffic data significantly impedes planning for many low-volume roads. In addition, while permit-users would have to equip their trucks to participate in the system, there is potential for customizing the system to provide commercial applications, such as near real-time vehicle tracking, dispatch, and communication. Because of these commercial applications, GPS has penetrated segments of the road freight industry, particularly where the cargo is time-sensitive. By choosing GPS technologies compatible with those already used by industry, governments could reduce the cost of participating in a GPS-based permit system.

Our vision of a permit system pertains to what is feasible in the reasonably near future. In fact, a system close to our vision has been tested over the past year in Saskatchewan and is scheduled to be fully operational in that province sometime this year. In Australia, Tasmania uses GPS to ensure that overweight-permitted vehicles adhere to designated roads, and other states are testing similar systems. The developments in Saskatchewan, Australia, and elsewhere around the globe are discussed in the next section of this report.

The main drawback to a GPS-based permit system is the expense, which would far exceed the cost of anything like the current 2060 permit system. However, with technological advances, the expense has come down to the levels that make feasible a system such as that being implemented in Saskatchewan. Eventually, some such system

[10] In areas with severe winters, roads are particularly vulnerable to pavement damage during the spring thaw, and some states have load restrictions that apply only during that season. In Texas, the impact of loads on pavements is less seasonally-sensitive than in colder-weather states, though the impact in some parts of the state increases during wet weather.

will almost certainly make sense for Texas, but it would take a thorough cost-benefit analysis to judge whether we have reached that stage yet. Such an analysis would have to consider lower-tech alternatives, such as a conventional weight-distance tax on overweight vehicles, or something like the current 2060 system but with revamped fees and options.

In the same cautious vein, what makes sense for Saskatchewan does not necessarily make sense for Texas. For one thing, Saskatchewan, along with the rest of Canada, allows much heavier vehicles on its roads than does Texas. With a permit, divisible loads can move across Saskatchewan in double-trailer trucks with gross weights up to 92,500 kg, or about 204,000 lb. If the weight limits and tolerances were the same as in Texas, the maximum GVW would be the 84,000 lb allowed by the 2060 permit, and many more trucks would be needed to haul the same amount of freight. The total cost of outfitting trucks to participate in a GPS-based permit system would therefore be much higher.

This leads to the important question of what would be the appropriate tolerances under a GPS-based permit system in Texas. We have already taken a stand in this report against blanket exemptions from load-posted limits on bridges; this, like anything else that seriously compromises safety, does not belong in a permit system. However, it is conceivable that some liberalization would be appropriate for some of the other tolerances contained in the current 2060 permit system. If permit-users are prepared to pay for the additional external costs entailed, there is a case for acceding to requests for liberalization. An exception is when these costs are so high as to pose major problems for collection.

The prospect of greater weight tolerances could influence industry to support the sort of system we envision. The inducement would be greater were Texas able to extend such tolerances to its Interstate highway system. Even so, some trucks with 2060 permits manage to travel at 84,000 lb gross weight, despite being legally limited to 80,000 lb on the Interstates.

As another sweetener for industry, the state and county governments might do well to channel net revenues from the permits into a special fund to be spent solely on roads with significant volumes of permitted traffic. Permit-holders would then have no grounds for complaint that they are paying for road repairs not performed.

To clinch the deal, the state and county governments might also want to commit to supplementing the special fund with contributions from general revenue. That way, the fund could be large enough to upgrade the roads that attract a lot of 2060 traffic, rather than simply repairing damage. As the roads are upgraded, there would be a double bonus for industry. The roads would become less vulnerable to pavement damage, so the economically efficient charges for trips under permit would decline. The other bonus would be decline in truck operating expenses, such as truck wear and tear, as the road surfaces become smoother.

The expenditures supported by the proposed fund would, we suspect, generally pass a cost-benefit test at present, given what we have heard about the condition of many of the roads used by 2060 traffic. However, to verify this we would need results from cost-benefit analyses of candidate road projects. Such analyses would need to be performed regularly as the upgrading program evolves, both to guide the allocation of funds and to determine the appropriate contribution from general revenue. To continue drawing on general revenue until every road serving 2060 traffic is upgraded to 80,000 lb or higher would not necessarily make economic sense. For some of these roads, the traffic volumes may well be too low to justify the required expenditures.

Without any added inducements, current users of the 2060 permit system would have little to gain from the system we envision and something to lose. Permit-users would incur some costs for the equipment and services needed to participate in the system, such as the cost of transmission of on-board data to a central administration unit. They would also lose their exemption from weight limits on bridges, and their total payments for overweight trips would likely be much higher than their current payments for 2060 permits. To cushion the impact, the increase in charges might be phased in over several years.

The only other way to make the envisioned system more palatable to industry is to directly compensate the segments of industry that would be significantly worse off than under the current permit system. Whether such compensation would be appropriate is hard to say. Some companies would suffer a windfall loss were the 2060 permit to be scaled back. But presumably many of these companies enjoyed a windfall gain when the permit came into being in 1989. Additional grounds for being cautious about the idea of compensation were adduced in our framework section.

Turning our vision into reality would require more than softening the opposition and applying GPS technology. A massive task would be estimating the economically efficient charges. As was explained in our framework section, the vast range of inefficiencies in the pricing of road use, such as the lack of congestion pricing, greatly complicate this task. That said, the sort of pricing for overweight permits that exists now is so inefficient that to improve on it substantially would not be hard.

The adoption of economically efficient prices for permit use would probably require some restriction of legal liability for road damage. At present, a 2060 permit-holder is fully liable for road damage resulting from operation of his trucks, notwithstanding the payment of a permit fee. If the charges for permit use were to increase enough to cover the costs of resulting road damage, a company could wind up paying for road damage twice—through the charges for the permit and through penalties assessed in court. The above-discussed obstacles to successful suits would make this outcome uncommon, but to further reduce its likelihood, a company's payments for permit use would have to count in some fashion toward payment of any court-imposed penalties.

Rounding off our vision, the setting of permit fees would entail some input from both state and local governments along the lines we have suggested. The state government would set fees for state-maintained roads and place limits on the fees charged by local governments to ensure that they do not exceed the economically efficient levels. Local governments would provide some input so that charges incorporate community attitudes toward traffic congestion and pollution. Reluctantly, we could also subscribe to allowing local governments to charge less than efficient prices for the sake of local economic development.

GLOBAL POSITIONING SYSTEMS

Global positioning system (GPS) technology is currently utilized by many industries. Trucking firms and taxi companies use GPS for routing and fleet logistics purposes. Rental car companies equip their cars with on-board GPS navigation systems, and in the near future, navigation systems with the ability to receive real-time traffic information will become standard on new cars. As the use of GPS has expanded, the technology has become both better and cheaper, and its applications for overweight vehicle tracking are spreading throughout the globe, with a number of countries in the testing or pre-implementation phase. Not only does GPS have many uses, but the transmissions sent from GPS satellites are free and open to anyone with a responder capable of receiving them.

GPS allows the monitoring of every truck on every road. Thus, GPS aids in the enforcement of overweight trucks on nonallowed routes. Additionally, route information can be used to appropriate road funds to those areas most traveled.

GPS can also be used for road user fees. A GPS-based system is viable for road pricing because it can:

- support continuous-pricing configurations. Continuous pricing allows road use fees to vary by weight, distance traveled, and type of road. This ties the road user's cost more closely to the cost of road damage.
- administer dynamic road-pricing schemes by altering the road use fees in near real-time and transmitting this information back to the road user.
- track the collection of fees by road or area, aiding in the allocation of funds for improvements on roads with the greatest demand and damage.
- handle multiple jurisdictions by applying the appropriate road user fees determined by each jurisdiction.

GPS Technology

GPS uses twenty-four U.S. Department of Defense satellites that transmit radio frequencies to a ground-based receiver. The transmissions note the time and positioning of the satellites. Using this information from two or more satellite transmissions, the receiver is able to pinpoint its location on the earth's surface.

The Department of Defense recently ceased introducing slight distortions to the satellite transmissions, which used to limit GPS accuracy. Inaccuracy owing to atmospheric conditions remains, but can be minimized with the use of combined GPS/GLONASS receivers. GLONASS is a Russian GPS satellite system. Additionally, the European Union plans to launch a GPS system called GALILEO, which may further enhance positioning accuracy.

Another possible source of limited accuracy is the "canyon effect." This effect occurs when signals cannot reach a vehicle traveling between large buildings. A GPS in this situation is backed up by a simple odometer, or "dead reckoning" system, until the signal can be restored.

A transponder or receiver is placed in the truck to receive the satellite signals. The data is then sent, via wireless cellular phone network or by low earth orbit (LEO) satellite services, to a central receiving station. LEO may become the preferred method of data transmission because it is not area constricted and is more cost effective. Constant "bursts" of location data can be sent to the central receiving station for continuous monitoring, or information can be sent at various time intervals. If real-time data are not needed, sending data at specific intervals, possibly every night, is the most cost-effective method owing to the reduced costs in wireless communications (see section on Saskatchewan for savings in wireless communications costs).

Once at the central receiving station, off-site personnel can retrieve data from remote query stations. Remote terminals can be programmed to run user-defined reports. Examples include exception reports that show violations on specific trucks and reports on road usage to adjust road use fees if necessary.

Certified Wide Area Road Use Monitoring

Automatic monitoring of road use raises concerns about privacy and, in the wrong hands, could be a technological tool for repression. Certified Wide Area Road Use Monitoring (CWARUM) is an option for addressing privacy concerns. CWARUM is a private-sector application of GPS, which departs from other road use monitoring systems because government owners of the roads do not fund and manage all aspects of the system. CWARUM leaves enforcement to the government, but assigns most other responsibilities to private, competing concessionaires.

The concessionaire acts as intermediary between road users (subscribers) and the road-owning agency. The agency publishes electronically the rates it charges for road use. The concessionaire monitors each subscriber's road use to calculate the amount owing the agency, collects this amount from the subscriber, and forwards it to the agency. As part of a certification process, the concessionaire agrees to abide by the agency's terms. For audit purposes, the agencies can cross-check the concessionaire's records with truck weight data collected with WIM or similar technology. Exception reports are issued to road agencies showing when trucks traveled on unauthorized roads. For its services as intermediary, the concessionaire can charge subscribers any price that the market will accept.

All the monitored data is the property of the subscriber to the service (the one being monitored). The subscriber authorizes the private concessionaire to provide only the data that are needed by the road agency for collection of road use fees and weight enforcement. The data can be aggregated with other subscribers' data and unitemized over time, leaving no trail of a particular subscriber's travel patterns. The security of the detailed information in the concessionaire's database is similar to that of many private firms, such as credit card, telephone, and utility companies. Faith in private trade practices with both legal and market sanctions provides substantial benefits over road agency promises.

CWARUM subscriptions can include services other than billing for road use. Transponders would probably be marketed like cellular phones with multiple styles, features, and prices. Features could include fleet logistics, two-way Internet communication, and real-time traffic data. Estimates of a typical monthly CWARUM subscription for a basic package of information and management services are around $15 to $25, similar to fees charged by many Internet providers.[11]

Global Applications of GPS-Based Transport Technologies

Several governments have tested or are planning GPS-based systems for road pricing and weight enforcement. Germany has trialed two systems, and Switzerland has developed the specifications for a heavy goods vehicle system to be implemented in 2001. The Technical University of Denmark is planning to demonstrate the feasibility of GPS distance-based road charging. In addition, the European Union (EU) plans to use GSP-based road pricing to eliminate the inequities resulting from different vehicle taxes between member countries. The EU system will cover travel in all member countries and replace country-specific tax schemes with a single road pricing system.

Outside Europe, trials in Hong Kong demonstrated that GPS combined with advanced dead-reckoning systems is effective in eliminating "concrete canyon" effects. However, the two trials most applicable to the 2060 permit system were conducted in Saskatchewan and Tasmania.

Saskatchewan*[12]*. The Canadian province of Saskatchewan is in the process of integrating GPS into its partnership haul agreements between commercial carriers and the Saskatchewan Department of Highways and Transportation (SDHT). Under these agreements, the SDHT allows participating commercial carriers to haul larger weights on select roads if road-friendly technologies, such as air-spring suspensions and central tire inflation, are employed. Roads are selected based on their capacity to support overweight vehicles. In return, carriers make a financial contribution toward funding highway construction and maintenance improvement projects.

The carrier contribution includes incremental pavement or bridge costs resulting from traveling over normal limits, plus half the net savings in trucking costs accruing to the carrier after deducting these pavement and bridge costs. Haul cost savings range from 20 percent to 50 percent, depending on truck configuration. This results in cost savings of $12,000 to $40,000 per truck. The contribution is based on loaded weight and kilometers traveled. The fee associated with a particular gross vehicle weight is multiplied by the total kilometers driven to determine the contribution. For municipal roads, the portion of revenue allocated to each participating municipality is also calculated.[13]

Currently, haul cost savings are manually calculated, which is labor-intensive and requires a well-developed automated accounting system. Thus, many medium- to small-sized carriers, rural cities, and municipalities are unable to participate in the partnership. To facilitate widespread implementation of the partnership program, International Road

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[11]For more information on CWARUM, see papers by Daniel F. Malick located at http://home.earthlink.net/~dmalick/CWARUM/.

[12]Information on Saskatchewan's overweight vehicle arrangements and the automated vehicle monitoring and audit system was obtained from Berthelot et al (n.d.). and from conversations with Norm Burns of the Saskatchewan Department of Transportation and Randy Hanson of International Road Dynamics, Inc.

[13] Municipalities have the option of participating in the partnership agreement or directly charging for the use of their roads.

Dynamics Inc. (IRD) has developed an automated vehicle monitoring and audit system that utilizes GPS technology and enables an electronic permit system.

The IRD system employs four primary systems for data collection and dispersion: an onboard vehicle data collection/storage system, a communications network system, a central administration system, and remote user query systems. The onboard data collection/storage system continuously monitors and samples data from the onboard systems—GPS, central tire inflation (CTI), and air-spring suspension weight sensors, which measure axle weights. The sampled data are stored on the onboard data storage system, and transmitted nightly to the central administration system over a circuit switch cellular network during off-peak hours to minimize transmission costs.

The central administration system creates and maintains a truck fleet database, performs compliance audits and billing, and summarizes data for user defined queries. The IRD system is designed to interface with a geographic information system (GIS) to provide road names and locations referenced by the GPS coordinates. This facilitates truck routing and the graphical display of road usage. With GIS, each trip is traced to specific routes for automatic assignment of road usage fees and revenue allocation.

Remote query systems allow the public road agencies and commercial carriers to generate reports from data gathered in the central administration system. Users may query reports for vehicle routing, noncompliance, and audit purposes. Privacy and confidentiality are protected by the use of a secured, restricted Internet link. In addition, commercial carriers are not able to query data on other carriers, and road authorities are not able to query the database of other road authorities.

The IRD system covers all roads in the province. The system monitors travel on and off the permit-allowable road network, which facilitates enforcement. For weight monitoring, the air-spring suspension weight sensors measure the pressure on the air bags while the vehicle is stationary. These readings have a 10 to 15 percent margin of error, so drivers must enter the GVW into an onboard keypad. The self-reported GVW is checked against the weight sensor measurements in field audits. The GVW limits are lower for trucks without air-spring suspensions.

Three road categories exist for pricing purposes: primary (Interstate), secondary (provincial paved), and other (gravel, county, and municipal roads). Different fees are assessed for each road type. On load-sensitive roads, higher GVW limits are allowed for trucks with low-pressure tires. For gravel roads, trucks are required to have central tire inflation and increase their tire pressure to limit damage.

Saskatchewan has tested the system on five demonstration trucks, each equipped with satellite hardware that enables the storing of data on travel. The data transmission costs $13.50 per month, as opposed to $9.50 per day for transmission of real-time data. Once implemented, the truck owner will pay monthly fees of $64 to lease the onboard hardware plus $54 for the transfer and processing of data. All dollar figures were converted from Canadian to U.S. dollars based on the July 31, 2000, exchange rate. The system should be fully operational by October 2000.

In addition to administering the partnership haul agreements, the IRD system can be readily customized for numerous other private- and public-sector applications. These applications include near real-time vehicle tracking, dispatch and communication, traffic generation/destination studies, road preservation management, and traffic data collection. Other possible applications include onboard system monitoring, fleet logistics administration, and cargo load tracking.

***Tasmania*[14].** Tasmania, a state in southern Australia, performed a technical trial of its GPS-based system using ten vehicles. The experiment is known as Phase 1 of Tasmania's Intelligent Vehicles Trial.

The trial proved that GPS is viable and feasible for overweight truck monitoring. However, the technology used in the trial was somewhat antiquated. Data could be processed only at a central receiving station, while new technology allows data to be processed inside the truck transponder.

Tasmania proposes using the CWARUM method to administer the GPS and is currently searching for a concessionaire. Once the system is fully implemented, multiple concessionaires will compete to offer the GPS service. Tasmania is planning on using the CWARUM method to save costs and to relieve the state of risks. The concessionaires and the customers, rather than the state, would bear the burden of rectifying any technological problems that arise.

The use of GPS is planned only for route monitoring and enforcement, although road use fees may be implemented in the future. Concessionaires will issue exception reports to the road authorities showing the trucks that traveled on unauthorized roads. Additionally, the GPS will be used to track weight and noise using special sensors attached to the truck.

Barry Moore of the Tasmanian National Road Transport Commission believes trucking companies will be responsive to the use of a GPS-tracking system because the in-truck transponders can provide the additional services discussed above. These services should improve transportation efficiency and become a cost-saving device for the participating companies.

Tasmania has joined with the states of Queensland, South Australia, and West Australia in a partnership to administer the GPS system. The partnership is led by a steering committee to address problems of legal coordination.

IN THE MEANTIME

A cost-benefit analysis of a GPS-based permitting system for Texas might reveal that to start on implementation now would be premature. Moreover, even with an immediate start, it would take a while to get the system up and running.

In the meantime, the system of overweight permits for divisible loads could be improved in various ways.

[14]Information on Tasmania's technical trial was obtained from the Intelligent Vehicles Trial papers presented by the Transport Division of the Tasmania Department of Infrastructure, Energy, and Resources, and from a conversation with Barry Moore of the National Road Transport Commission. The Intelligent Vehicles Trial papers are available at http://www.transport.tas.gov.au/tvt/.

One option is to structure the permit fees like a conventional weight-distance tax. Such a system would, in theory, improve fairness and result in more efficient patterns of road use. On the other hand, it would create significant administrative burdens for government and for operators, who have to report their weight-miles traveled by vehicle category. It would also leave room for evasion. In Oregon, industry opponents of the weight-distance tax maintain that evasion is rampant, although a study of the tax placed revenue loss from evasion at only 5 percent of total revenue, based on four sets of field data (Weinblatt et al. 1998, pp. 39-40).

Whether or not evasion is a major drawback, our suspicion is that conventional weight-distance pricing for overweight permits would be like a horse and carriage during the advent of the automotive age. GPS based pricing for permits is the clear wave of the future. Hence this study does not focus on the weight-distance pricing option, although a full-scale evaluation of GPS-based pricing would need to consider it as an alternative.

The following discussion of options for the near future highlights only the differences between these options and our vision of a GPS-based system.

COLLECTION OF ADDITIONAL DATA

State law should require that holders of the 2060 permit provide data to TxDOT on their travel patterns. Probably the best approach would be to require participation in a survey similar to that conducted of divisible-load permit-holders in New York (see above). For each 2060 truck within a random sample, TxDOT would request detailed information on the truck's operations on a particular day. The respondents would have to report some general information about the sampled truck, their company, and the commodities they haul. In addition, for each trip made on the designated day, the respondent would have to report such information as the route, the number of trailers and axles, and vehicle gross weight.

The data from such a survey would inform decision making on road spending and the allocation of permit net revenues among state and county governments. The data would also inform the design of a divisible-load permit: what tolerances the permit should offer and at what prices. From another perspective, the data collection effort would serve as something of a trial for conventional weight-distance pricing.

REVISING THE MENU OF OPTIONS AND PRICES

Pending the collection of the additional data on patterns of permit use, whether the fees for 2060 permits should increase much is arguable. Although far from definitive, our analysis suggests that current fees fail to recover a large portion of the pavement damage costs from overweight operation of the trucks with 2060 permits. This supports the case for increasing fees. On the other hand, these trucks are hardly alone in paying less than their contribution to pavement damage and other negative externalities from road use. To increase permit fees without also raising other taxes and charges on road users could therefore appear to be unfair. Then there is the issue of how an increase permit fees would affect the growth of industry in Texas.

Nevertheless, our assessment is that some increase in the 2060 permit fees is in order. Ideally, it would form part of a comprehensive overhaul of road-related taxes and charges, but even in the absence of sweeping change, some reform is better than none. True, a cheap 2060 permit makes Texas more attractive for certain industries, but so would all manner of industry subsidies. To justify a subsidy for consuming pavement — what a cheap 2060 permit amounts to — would require firm evidence that it is a particularly cost-effective way of drawing industry to Texas.

If the problems with pricing could be largely fixed, a productive direction for change would be to split the current package of tolerances into various options. When the fee for each option approximates the economically efficient charge, expanding the range of choice will normally benefit society.[15] If, however, fees for some options are at very inefficient levels—far out of line with considerations of external costs—expanding the range of choice can be risky.

The only real options at present are the numbers of counties for which a permit is valid: up to twenty counties in the basic option that nearly everyone takes, and then twenty-one to forty, forty-one to sixty, and so on up to the all-Texas option. In contrast, companies that hold Oregon's divisible-load permit (COVP) can choose the exact number of counties their vehicle is permitted for. The feasibility of offering similar flexibility to holders of the 2060 permit is worth exploring, as there appears to be a latent demand. Among the nine respondents to a small survey of 2060 permit-holders in 1993, five operated their vehicles in less than 5 percent of the counties for which they were permitted.

Likewise, there appears to be a latent demand for 2060 permits that would lack the exemption from road load postings. From our survey of permit-users, we estimate that 22 percent of the trucks are in companies that never use load-posted roads (or so they say). The corresponding estimate for load-posted bridges is 54 percent (Table A14). So there would be a demand for permits without the exemption from load-posted limits on bridges, if by some mischance that exemption were not removed altogether. Permit-holders who chose the no-exemption options would receive a suitable discount in their fee.

In the same spirit of consumer sovereignty, consideration should be given to 2060 permits that are valid for periods of less than a year.

In the past, there have been unsuccessful attempts to amend the 2060 permit system to apply the percentage tolerances to load-posted limits, where applicable. A truck on a road or bridge posted to 58,420 lb would then be allowed a gross weight of 61,341 lb (5 percent over the load-posted limit), rather than 84,000 lb (5 percent over the general limit on GVW). For bridges, we would go even further and provide no tolerance above load-posted limits because of safety concerns.

For roads, tolerances above load-postings compromise safety to a lesser extent, and only a cost-benefit analysis could reveal what tolerances, if any, would be appropriate. Cutting back the current tolerances would reduce pavement consumption costs, but increase road freight costs. Mike Stewart of the Texas Aggregates and Concrete

[15] In theory, some options might have such high overhead costs in administration as to preclude a positive net benefit. In that case, the economically efficient price for that option is one that is high enough to eliminate all demand for the option.

Association conveyed to CTR that without the 2060 permit, the trucks in his industry would be constrained by the 58,420 lb limit. The trucks would be the same size as now, but they would carry smaller loads. His rough estimate was that the trucking of aggregates would be on the order of 40 percent more expensive. Mr. Bob Currie of the Texas Logging Council estimated that without the 2060 permit, forestry trucking operations would become 8 percent more expensive.

Cost-benefit analysis would also help evaluate other possible curtailments of the tolerances in the 2060 permit. One option is to require combination trucks that exceed the posted load limits on roads to have a rear tridem axle. (Phasing in such a requirement might work best because heavy trucks in Texas currently rely on a fleet of trailers that overwhelmingly have a rear tandem axle.) The additional axle on the rear of the trailer would reduce pavement consumption, but would also increase the trailer's capital cost and tare weight. The increase in tare weight would add to road freight cost by reducing the vehicle payload (assuming no change in the permitted weight limits). A cost-benefit analysis would quantify both the increase in road freight costs and the savings in pavement consumption costs.

Likewise, some proposals to liberalize permit provisions could warrant a careful analysis of costs and benefits. The Texas Motor Transportation Association (TMTA) has proposed a company permit, which would be freely transferable among a company's trucks. TMTA's argument is that companies face logistic obstacles to confining overweight operations to certain trucks within their fleet. In this scenario, a company's permits go partly wasted because each permitted truck will need the weight tolerances for only some of its deliveries during a year.

The proposed company permit would have the side effect of increasing overweight truck traffic. Consider, for example, a law-abiding company whose trucks each need to travel a load-zoned road only on the odd occasion. The company presently manages without the 2060 permit because these occasions are so infrequent, even though it could reduce its trucking costs by exceeding the load-posted limits. Were the TMTA's proposal adopted, the company might well purchase a permit and start operating above the load-posted limits. As a result, pavement consumption costs would increase. These costs would presumably be outweighed by the savings in trucking costs, were the fees for the 2060 permit—both the company option and the existing package—set at economically efficient levels. However, there is no guarantee of this favorable outcome were the permit to remain underpriced. In that case, one would have to carefully weigh the costs and benefits of the proposal to determine whether it would benefit society or not.

In the absence of GPS-based pricing, one can attempt to eliminate some unproductive uses of a permit through regulation. Consider a 2060-permitted truck that takes a load-zoned road as a shortcut, in preference to a road built to a higher standard. In the process, the truck operator might be saving only a few minutes that are worth much less than the additional cost in pavement deterioration. In the course of this project, we heard reports from several sources that 2060-permitted trucks were tearing up light-duty roads that served as shortcuts.

One of these sources proposed that 2060-permitted trucks be allowed on a load-zoned road only when their origin or destination lies along it. North Carolina imposes this sort of restriction on trucks delivering supplies or equipment to agricultural establishments: trucks can exceed load-posted limits only on the road where the destination is located.

However, the proposed restriction would pose problems when it excludes a road that is essential to the truck's route. Evidence we obtained on the usage of county roads by 2060 trucks suggests that this might occur often enough to warrant concern. Mr. Bob Currie of the Texas Logging Council told us that about 75 percent of log loads require use of more than one county road to access a job, that about 25 percent of the county roads are load-posted, and that rarely, if ever, do these roads serve as shortcuts. Our survey of permit-users indicated that about half of the trucks are in companies that sometimes use county roads on which they are neither delivering nor picking up (Table A15). The survey responses also indicate that an important reason for such travel is that no alternative route is available.

A milder restriction would prohibit use of the permit on load-zoned roads not essential to a truck's route. Such a restriction applies to the exemption from county load postings for trucks delivering groceries or farm products. To qualify, these deliveries must "require" use of the load-posted road or bridge, a provision that Lt. Gary Albus of DPS deems to be unenforceable.

Restrictions that would effectively deal with the shortcut problem might emerge from further research, including a broader look at practices outside Texas. North Carolina, for example, exempts agricultural products and garbage from load-posted limits on roads, but only from a point of origin on a load-posted road to the nearest highway that is not load posted.

GREATER CONSISTENCY

The laws that govern truck weight, like so many other laws, treat some industries preferentially. We believe that a more evenhanded approach to truck weight regulation would serve both fairness and economic efficiency. For example, the current exemption from load-posted limits for farm products and groceries, which is free, should be folded into the 2060 permit, which people have to pay for. The same applies to the free 12 percent tolerance on axle weights for forestry or agricultural products in their natural state.

IMPROVING ENFORCEMENT

A significant increase in 2060 permit fees, such as appears to be warranted, would tempt some companies to forego the permit and operate overweight illegally. To limit this response, the deterrents to weight violations would need to increase, and one way of achieving this is to increase fines. Deterrents to exceeding weight limits on load-posted roads would need special attention, as evaders of the permit fee would probably be particularly prone to this violation.

RECOMMENDATIONS

(1) **Enforce load-posted limits on bridges for all vehicles, including those with "2060" permits.** The current exemption from these limits risks catastrophic failure of bridges.

(2) **Require permit-holders to participate in a survey of the travel patterns of permitted trucks.** The data collected would assist TxDOT and local governments in designing the permit system and in setting priorities for road spending.

(3) **Increase the permit fees.** The aim should be fees that are at economically efficient levels, taking into account the costs of pavement consumption and other relevant external effects.

(4) **Allocate to local governments a degree of control over the overweight permit system.** The counties should be able to set the fee for use of a 2060 permit on their roads subject to a maximum allowable fee set by the state government.

(5) **Dedicate net revenues from the permit to a special fund to be used for roads with significant volumes of "2060" traffic.** This is likely to be money well spent, given the poor condition of many of these roads and the growing volumes of freight traffic.

(6) **Revise other weight tolerances and exemptions for consistency with 2060 permit provisions.** For example, the special weight tolerances and exemptions for agricultural-related products (including forestry) should be incorporated into the 2060 permit. It is unfair and economically inefficient for these privileges to be provided at no cost when the 2060 permit-holders have to pay for much the same thing.

(7) **TxDOT should further investigate the costs and benefits of altering the tolerances and options in the permit.** The provisions for load-posted roads warrant particular attention.

(8) **The Texas government should investigate the adequacy of current fines for weight violations, with a view to possibly increasing them along with permit fees.**

(9) **The Texas government should review the various truck weight regulations to ensure consistency in the underlying principles.**

(10) **TxDOT should undertake an evaluation of the potential for a GPS-based system of overweight permits.**

APPENDIX A

A telephone survey of companies holding 2060 permits was conducted in July 2000 to obtain information on reasons for permit use, commodity characteristics, truck configurations, and travel and road use patterns.[a] CTR contracted with the Office of Survey Research at The University of Texas to administer the survey. An introductory letter explaining the project background and possibility of an interview was sent to the companies prior to the survey.

Survey Methodology

TXDOT provided a database of companies with 2060 permits for fiscal year 1999 containing the number of permits held and contact names and telephone numbers. For the survey, we divided the companies into four strata based on each company's number of permitted trucks (Table A1). Companies in the higher-numbered strata each had fewer permits than companies in lower numbered strata. The companies with the largest number of permits formed stratum 1: only 1.6 percent of all permit-holders, they held over 30 percent of the permits.

Eight hundred companies were selected for the initial sample. Companies from strata 3 and 4 were randomly selected, while strata 1 and 2 were "certainty samples"—all companies from these strata were selected. Stratum 3 was sampled at a higher rate than stratum 4. The sample thus overrepresented companies that have many permits.

A pilot survey of forty-seven randomly selected companies from strata 2, 3, and 4 of the initial sample were interviewed to test the response rates and clarity of the questions. Stratum 1 companies were eliminated from the pilot survey: the large number of trucks they held permits for made their inclusion in the final survey especially important, and the willingness of companies to participate in both the pilot and final surveys could not be taken for granted. The overall response rate was 51 percent, indicating that approximately half the true sample contacts would respond to the survey. A number of revisions were made to the interview questionnaire as a result of pilot testing. For example, questions asking for percentage breakdowns of mileage in the three main counties of travel were eliminated due to low response rates and uncertainty among the respondents. Also, questions were reworded for greater clarity and simplicity.

The pilot survey also revealed difficulty in reaching the person best able to answer the questions. Suggestions were sought from personnel of two companies on whom to speak with and how to reach them. One company in Georgetown suggested contacting the dispatcher or safety director. As a result of this suggestion, the interviewers were instructed to ask for the person best able to answer the types of

[a] Strictly speaking, some of the surveyed permit-holders were branches of a company ('establishments'). In these cases, the respondents were asked to consider only the trucks for which permits had been mailed to their branch address.

questions in the survey. If this person was unknown, the interviewers asked for the dispatcher, and if not available, the safety director.

Based on the pilot-testing response rate, 400 companies (15 percent of the population) were chosen from the initial sample to obtain a target of 200 valid responses. The companies from the pilot survey were excluded. Once again, the sampling rate was lower for the higher-numbered strata. Selection was random except for stratum 1, which continued as a certainty sample (Table A2).

The actual response rate turned out higher than that achieved in the pilot survey (Table A3), due partly to the inclusion of stratum 1 companies. As was expected, response rates for strata 1 and 2 (companies with the largest number of permitted trucks) were higher than for strata 3 and 4 (Table A4). Larger companies have a bureaucratic organization with specialists such as dispatchers and safety directors able to answer the types of questions posed in the survey. In addition, smaller companies and owner/operators were more difficult to contact. For strata 3 and 4, interviewers were more likely to encounter a nonworking number or an answering machine.

Survey Results

Our survey-based estimates pertain to the population of companies that held a permit in both fiscal year 1999—the year to which the TxDOT database relates—and July 2000, when our survey was conducted. Some companies that held permits in fiscal year 1999 no longer held them in July 2000, and for some companies that held permits in both periods, the number of permits would have changed. Because of these and other factors, the number of 2060 trucks differs between our survey-based estimate and the TxDOT database (Table A5). That the survey-based estimate is the larger is reflective of the general growth in the number of permits over time (as was shown in Figure 1).

Stratum weights were used to compute estimates for the populations to which the survey related. The weights adjusted for the fact that companies with relatively many trucks – that is, the trucks in the lower-numbered strata – were over-represented in the sample. The weights were thus smaller for the lower-numbered strata. For estimates pertaining to the population of companies with permits, the stratum weights were calculated by:

$$W_j = C_j / CV_j$$

where W_j is the weight for stratum j, C_j is the population of companies in stratum j, and CV_j is the number of sampled companies in stratum j from which valid responses were obtained. Since CV_j varied between survey questions, the stratum weight was question-specific.

Similarly, for estimates pertaining to the population of trucks with permits, the stratum weights were calculated by:

$$W_j = T_j / TV_j$$

where W_j is again the stratum weight, T_j is the population of trucks with permits, and TV_j is the number of trucks in stratum j companies from which valid responses were obtained.

The population estimates are presented in Tables A5 through A15, followed by the questionnaire (Exhibit A1). The reported response rates represent the ratio of valid responses for a question to the number of respondents holding 2060 permits. Standard errors could not be calculated, but the survey sample was clearly too small to warrant a high degree of confidence in some of the estimates, particularly those for the lower-ranking counties in Table A11.

The population estimates indicate that a typical 2060 truck is a truck-tractor that:

- Hauls aggregate, cement, or asphalt.
- Forms a five-axle combination with a trailer.
- Uses permits to increase both GVW and axle weights.
- Travels mostly with gross vehicle weights of 80,000–84,000 lb, although fairly often at lower weights.
- Travels 84,000 miles per year, mostly on state-maintained roads.
- Avoids load-posted bridges, but drives a small percentage of trips on load-zoned roads.

The estimates also suggest that travel by 2060 trucks is concentrated in north/central, east and south Texas, and that much of this travel is in or near major urban areas.

APPENDIX A TABLES

Table A1: Distribution of Companies and Trucks by Stratum among Companies with "2060" Permits, FY 1999

Company Stratum[a]	Companies	Trucks	% of Trucks
Stratum 1	41	4,792	30
Stratum 2	177	4,781	30
Stratum 3	409	3,209	20
Stratum 4	1,940	3,195	20
	2,567	15,977	100

[a] The number of trucks with permits are in the following ranges: sixty-one to 405 for companies in stratum 1, fifteen to sixty for stratum 2, five to fourteen for stratum 3, and less than five for stratum 4.

Table A2: Distribution of Companies and Trucks by Stratum among Companies in Survey Sample, FY 1999

Company Stratum[a]	Companies	Trucks	% of Trucks
Stratum 1	41	4,792	53
Stratum 2	120	3,149	35
Stratum 3	120	931	10
Stratum 4	119	195	2
	400	9,067	100

[a] Companies were assigned to strata based on the number of permits held during fiscal year 1999. See Table A1.

Table A3: Response Rate Summary for July 2000 Survey

	Companies
Sample Size	400
Total Number of Responses	260
No Longer Hold Permits	21
Number of Valid Responses	239[a]
Total Response Rate	65.0% [b]
Valid Response Rate	59.8% [b]

[a] Valid responses are from companies holding a permit during the time of this survey.
[b] The non-respondents include companies for which the listed phone numbers were incorrect or nonworking. When these companies are excluded from the calculations, the total response rate becomes 73 percent and the valid response rate becomes 67 percent.

Table A4: Distribution of Companies and Trucks by Stratum among Companies Responding to Survey

Company stratum[a]	Companies	Trucks	% of Trucks	Response Rate
Stratum 1	28	3,051	49	68%
Stratum 2	87	2,453	39	73%
Stratum 3	70	653	10	58%
Stratum 4	54	106	2	45%
	239	6,263	100	

[a] Companies were assigned to strata based on the number of permits held during fiscal year 1999. See Table A1.

Table A5: Number of Trucks with Permits in Fiscal Year 1999 and July 2000 among Companies Holding Permits in Fiscal Year 1999

Fiscal Year 1999 (from TxDOT database)	15,977
July 2000 (survey-based estimate)[a]	17,359

[a] Estimate based on response to survey question, "How many trucks do you have these permits for?" The response rate to this question (Q2) was 98.7%

Table A6: Reasons for Obtaining Permit (Q3 and Q4)

	% of Trucks
Increase GVW	84
Increase axle weights	75
Increase both GVW and axle weights	61
Travel on load zoned roads	3

Response rate 95.4%
Responses are not mutually exclusive; thus, the percentages exceed 100.

Table A7: Commodities (Q5 and Q6)

	% of Trucks
Aggregate, cement, and asphalt	62.4
Forestry, wood and paper products	7.6
Crude oil and related equipment	5.9
Agricultural or food products	10.4
Chemicals, petroleum, or related products	7.3
Containers	0.7
Equipment/construction equipment	0.4
Refuse or garbage	2.4
Water	0.4
Scrap metal	0.2
Dirt, sand, or mud	0.7
Crushed cars	0.8
Steel	0.4
Heavy machinery	0.4
	100

Response rate 99.6%

Table A8: Vehicle Types (Q7)

	% of Trucks
Truck-tractor and trailer combination	96.4
Straight truck usually pulling a trailer	2.0
Straight truck usually not pulling a trailer	1.4
Other	0.2
	100

Response rate 95.8%

Table A9: Number of Axles (Q8-Q10)

Truck-tractor and trailer combination

No. of Axles	% of Trucks
3	5.8
4	1.4
5	90.8
6	1.7
7	0.4
	100

Response rate 90.0%

Straight truck usually pulling a trailer

No. of Axles	% of Trucks
3	12.6
4	0.5
5	82.0
7	4.9
	100

Response rate 60.0%

Straight truck usually not pulling a trailer

No. of Axles	% of Trucks
2	40
3	60
	100

Response rate 21.1%

Table A10: Gross Vehicle Weight (Q11–Q13)

Percent of time GVW under 80,000 lb

% of Time	% of Trucks
0	24
1–20	23
21–40	7
41–60	12
61–80	10
81–100	24
	100

Response rate 97.1%

If under 80,000 lb, percent of time under 70,000 lb

% of Time	% of Trucks
0	48
1–20	32
21–40	11
41–60	6
61–80	0
81–100	3
	100

Response rate 92.0%

Percent of time GVW 80,000–84,000 lb

% of Time	% of Trucks
0	7
1–20	25
21–40	6
41–60	13
61–80	11
81–100	39
	100

Response rate 95.4%

Percent of time GVW over 84,000 lb

% of Time	% of Trucks
0	80
1–20	16
21–40	3
41–60	0
61–80	0
81–100	1
	100

Response rate 94.6%

If over 84,000 lb, percent of time over 90,000 lb

% of Time	% of Trucks
0	33
1–20	0
21–40	0
41–60	0
61–80	12
81–100	55
	100

Response rate 60.0%

Table A11: Main Counties of Travel (Q14)

County A	% of Trucks	County B	% of Trucks	County C	% of Trucks
Wise	14.82	Tarrant	12.60	Tarrant	12.20
Dallas	11.26	Denton	7.16	Dallas	11.71
Harris	10.29	Collin	6.06	Rockwall	3.45
Denton	4.74	Wise	5.34	Wise	3.22
Fort Bend	4.18	Dallas	4.87	Collin	3.17
Travis	3.33	Harris	3.82	Fort Bend	2.57
Brazos	3.01	Brazoria	3.63	Washington	2.27
Tarrant	2.32	Williamson	2.83	Brazoria	2.22
Colorado	1.97	Fort Bend	2.63	Galveston	2.06
Angelina	1.89	Wharton	2.08	Montgomery	2.00
Webb	1.71	Austin	1.98	Hardin	1.97
Nueces	1.47	Jasper	1.93	Robertson	1.64
Burnet	1.42	Hartley	1.91	Ellis	1.57
Grayson	1.36	Brazos	1.59	Lampasas	1.54
Bexar	1.33	Galveston	1.55	Hunt	1.52
Nacogdoches	1.31	Bosque	1.54	Milam	1.45
Lamar	1.30	Cameron	1.46	Johnson	1.42
Montgomery	1.20	Rusk	1.41	Burleson	1.36
Moore	1.18	Henderson	1.29	Dallam	1.33
Dallam	1.10	Montgomery	1.23	Bexar	1.32
Taylor	1.09	Nueces	1.16	Van Zandt	1.21
McLennan	1.01	Angelina	1.11	Victoria	1.15
Liberty	0.90	Ector	1.10	Parker	1.14
Freestone	0.88	Kleberg	1.08	Duval	1.10
Hidalgo	0.85	Zapata	0.97	Cooke	1.09
Wharton	0.81	Matagorda	0.96	Shelby	1.06
Bell	0.79	Maverick	0.93	Colorado	1.04
Cherokee	0.73	Childress	0.91	Austin	1.02
Burleson	0.73	Grayson	0.90	Moore	1.01
Comal	0.70	Travis	0.89	Wharton	1.00
Willacy	0.70	Jim Wells	0.86	Howard	0.94
Cooke	0.69	Tyler	0.86	Harris	0.93
Panola	0.68	Castro	0.83	Wilbarger	0.91
Fannin	0.65	Lampasas	0.82	Wichita	0.85
Tyler	0.63	Harrison	0.77	Hidalgo	0.79
Henderson	0.62	Burnet	0.77	Angelina	0.73
Hockley	0.61	Van Zandt	0.69	Grayson	0.71
Trinity	0.61	Jackson	0.69	Lamb	0.69
Val Verde	0.61	Gaines	0.66	Rusk	0.69
Jim Wells	0.60	Kinney	0.66	Uvalde	0.69
Jefferson	0.59	Colorado	0.66	Kleberg	0.65
Grimes	0.59	Fayette	0.61	Bastrop	0.63

Rusk	0.57	Sherman	0.61	Burnet	0.58
Johnson	0.53	Hardin	0.59	Cass	0.57
Jasper	0.52	DeWitt	0.51	Williamson	0.57
Potter	0.52	Irion	0.48	Newton	0.53
Erath	0.51	Archer	0.47	Fayette	0.52
Parmer	0.49	Bastrop	0.46	Oldham	0.52
Lubbock	0.48	Bowie	0.44	Sterling	0.49
Polk	0.48	Hamilton	0.44	Motley	0.49
Cameron	0.46	Frio	0.43	Smith	0.49
Tom Green	0.46	Panola	0.38	Brazos	0.48
Palo Pinto	0.45	Walker	0.38	Comanche	0.46
Victoria	0.45	Delta	0.36	Harrison	0.46
Hall	0.42	Chambers	0.35	Lavaca	0.46
Cass	0.40	Oldham	0.35	Panola	0.46
Limestone	0.37	Polk	0.35	Deaf Smith	0.45
Robertson	0.35	Smith	0.35	La Salle	0.45
Calhoun	0.31	Ellis	0.34	Travis	0.45
Deaf Smith	0.30	Parker	0.34	Willacy	0.45
Lee	0.29	Cass	0.31	Hill	0.42
Comanche	0.28	Johnson	0.31	Potter	0.41
Gregg	0.28	Comal	0.30	Gregg	0.40
Parker	0.28	Robertson	0.28	Polk	0.40
Wichita	0.28	Garza	0.27	Jasper	0.38
Leon	0.26	Hansford	0.27	Liberty	0.38
Starr	0.26	Hidalgo	0.27	Houston	0.37
Archer	0.25	Limestone	0.27	Jim Hogg	0.37
Austin	0.24	McCulloch	0.24	Waller	0.37
Fayette	0.21	Deaf Smith	0.23	Camp	0.33
Kleberg	0.21	Coryell	0.22	Marion	0.33
Mason	0.21	Kaufman	0.22	Orange	0.33
Runnels	0.21	Mills	0.22	Nacogdoches	0.32
Hunt	0.20	Potter	0.22	Webb	0.32
Jack	0.20	Red River	0.22	Guadalupe	0.31
Lampasas	0.20	Young	0.22	Freestone	0.28
Ellis	0.17	La Salle	0.22	Hockley	0.28
Gaines	0.17	Tom Green	0.22	Jackson	0.28
Marion	0.14	Dawson	0.20	Sherman	0.28
Smith	0.14	Houston	0.20	San Jacinto	0.27
Young	0.14	Lamar	0.20	Starr	0.27
Terry	0.10	Burleson	0.19	Matagorda	0.25
	100	Hill	0.16	Gillespie	0.24
		Nacogdoches	0.16	Castro	0.24
		Freestone	0.14	Bell	0.23
		Swisher	0.12	Stephens	0.23
		Leon	0.11	Titus	0.23
		Somervell	0.11	Frio	0.23

Victoria	0.11	Sutton	0.23
Caldwell	0.10	Fannin	0.20
Callahan	0.08	Tyler	0.20
Erath	0.08	Yoakum	0.20
Duval	0.04	Jack	0.17
Milam	0.04	Jim Wells	0.17
	100	San Augustine	0.16
		Upshur	0.16
		Leon	0.14
		Hale	0.12
		Lubbock	0.12
		Anderson	0.11
		Hood	0.11
		Nueces	0.10
		Jones	0.08
		Mills	0.08
			100

Response rate (A) 89.1% Response rate (B) 83.7% Response rate (C) 78.7%

Lower-ranking counties may contain large sampling errors due to the size of the sample.

Table A12: Miles Driven by "2060" Trucks ((Q20)

Median	84,000
Mean	84,655

Response rate 85.0%

Table A13: Road Usage (Q21–Q22)

Percent of miles driven on state-maintained roads

% of Miles	% of Trucks
0–20	7
21–40	3
41–60	23
61–80	25
81–100	41
	100

Response rate 87.9%

Percent of miles on state-maintained roads that are FM or RM

% of Miles	% of Trucks
0	6
1–20	48
21–40	28
41–60	18
61–80	4
81–100	2
	100

Response rate 80.3%

Table A14: Travel over Load Restrictions (Q15–Q16)

Percent of trips using load-zoned roads	% of Trips	% of Trucks
	0	22
	1–20	44
	21–40	10
	41–60	12
	61–80	4
	81–100	8
		100

Response rate 81.6%

Percent of trips crossing load posted bridges	% of Trips	% of Trucks
	0	54
	20	29
	40	4
	60	7
	80	1
	100	5
		100

Response rate 78.7%

Table A15: County Road Use (Q17–Q19)

Use county roads for neither delivering nor pick-up

	% of Trucks
No	54
Yes	46
	100

Response rate 97.9%

Percent of trips that travel over county roads for neither delivering nor picking up

% of Trips	% of Trucks
0–20	49
21–40	12
41–60	28
61–80	3
81–100	9
	100

Response rate 81.7%

Reasons for using county roads for neither delivery nor pick-up

	% of Trucks
No alternative route available	83
Reduce distance or travel time	55
Both no alternative and reduce distance and travel time	43
Other	7

Response rate 94.2%

Responses are not mutually exclusive; thus, the percentages exceed 100.

Exhibit A1 Survey Questionnaire

You or someone at your company may have received a letter recently explaining our study.

It would be very helpful if you could take a few minutes while I ask a few quick questions.

I would like to remind you that all of your answers will be confidential, and that you are under no obligation to answer any or all of these questions. If you don't want to answer a question, please let me know and I'll move on.

The Texas Department of Transportation sells annual permits—popularly known as "2060" permits—that allow trucks to exceed their normal weight limits: by 5 percent for gross vehicle weight and by 10 percent for axle weight. According to its records, TxDOT mailed some of these permits to your address during fiscal year 1999.

If your company has several branch offices, consider only the permits that were mailed to your address.

The following questions relate to the trucks for which you hold these "2060" overweight permits.

Q1. Do you still hold some permits of this type?

1. Yes___ ⇒ **Go to Q2.**
2. No___ **End of questionnaire.**

Q2. How many trucks do you have these permits for?

____

Q3. Do you get the permits to increase:

1. gross vehicle weights? ______ **if "yes" to options 1 and/or 2, go to Q5, if no**
2. axle weights? ______ **"yes" responses, ask Q4.**

Q4. Why do you get the "2060" permits? ____________________________

This question is an open-ended response.
Interviewer should code response into the following categories:

1. **To travel on load-zoned roads**
2. **To travel over load-posted bridges**

Other—give respondent's specific answer

Q5. Which of the following best describes the commodities that the trucks carry? Please select only one.

1. Aggregates, cement, and asphalt _____
2. Forestry, wood and paper products _____
3. Crude oil and related equipment _____
4. Other products _____

Q6. Are these other products:

1. Agricultural or food products, including livestock _____
2. Chemicals, petroleum, or related products _____
3. Something else—please specify ___________________________

Q7. How many trucks with a permit are of the following types?

a) Truck-tractor and trailer combination _____ **skip Q8 if "none"**
b) Straight truck usually pulling a trailer _____ **skip Q9 if "none"**
c) Straight truck usually not pulling a trailer _____ **skip Q10 if "none"**
d) Other—please specify _________________

Q8. For your typical truck-tractor and trailer combination, how many axles are on the combination?

____

Q9. For your typical straight truck pulling a trailer, how many axles are on the truck and trailer combined?

____

Q10. How many axles are on your typical straight truck not pulling a trailer?

____

Q11. When your trucks with permits are carrying loads, what percent of the time does the gross weight of the truck fall into the following ranges:

(a) under 80,000 lb ⇒ _______% **skip Q12 if answer is less than 15 percent**
(b) between 80,000 and 84,000 lb _______%
(c) over 84,000 lb ⇒ ________% **skip Q13 if answer is less than 15 percent**

Q12. When your loaded trucks have a gross weight under 80,000 lb, what percent of the time is the weight under 70,000 lb? _________%

Q13. When your loaded trucks have a gross weight over 84,000 lb, what percent of the time is the weight over 90,000 lb? _________%

Q14. What are, in order of most mileage driven, the three main counties in which your trucks with "2060" permits travel?

a) County A _______________
b) County B _______________
c) County C _______________

Q15. On what percentage of trips do your trucks travel on load-zoned roads?

__________%

Q16. On what percentage of trips do your trucks with a permit travel across load-posted bridges?

__________%

Q17. Do your trucks sometimes use county roads on which they are neither delivering nor picking up?

1. Yes___ ⇒ **go to question 18.**
2. No___ ⇒ **go to question 20.**

Q18. On what percent of trips does that happen?

__________%

Q19. When trucks use county roads on which they are neither delivering nor picking up, there may be a number of reasons why this occurs. Could you tell me if either of the following reasons are important to your business?

1. The trucks must use county roads because there is no alternative route over a state-maintained road. _______
2. There is an alternative route over a state-maintained road but the distance or travel time would be significantly greater. __________

Q20. What is the average number of miles driven annually in Texas per truck?

____

Q21. What percent of the miles driven by trucks with permits are driven on state-maintained roads, as opposed to county or local roads?

____________%

Q22. Of the miles driven on state-maintained roads, what percent are either on farm-to-market or ranch-to market roads?

__________%

Q23. Thank you for participating in our survey. In the future, a few of the respondents to this survey may be approached for a follow-up interview about their use of overweight permits. Would your business be willing to participate in the follow-up interview?

1. Yes___
2. No___

APPENDIX B

Telephone interviews were conducted with seventeen states to gather information on divisible-load permit systems and related aspects of truck weight regulation. The goal of the state survey was to identify best practices that might be applicable in Texas.

STATE SURVEY METHODOLOGY

States were selected for the survey based on two main criteria: issuance of divisible-load permits and geographic diversity. Geographic diversity was important to obtain a wide variety of permit alternatives because some states adopted permit systems similar to those in neighboring states. Whether a state issued divisible-load permits was ascertained primarily from FHWA (1998) and the *Alert Network Oversize/Overweight Permits Transmittal Sheet*, which listed contact names and telephone numbers for sixteen states. In addition, references from the state interviewees proved to be a valuable source for gathering contact names and telephone numbers. TxDOT recommended contacting Oklahoma, Arkansas, and Louisiana because these states resemble bordering areas of Texas in their road types, climate, and commodity mix. Michigan was included because it has unusually liberal weight allowances.

The interviewees were staff members of the state transportation divisions dealing with permits. Additional information on state permitting practices was obtained from the *1998 Compendium of State Permits of Overdimensional Loads and Vehicles* and state DOT Web sites.

Interview topics included the following:

- Basic provisions of the permit system, such as weight tolerances and fees.
- Permit travel restrictions, such as load-posted roads and bridges and general route restrictions.
- Current and proposed methods of permit administration.
- Enforcement issues related to overweight vehicles.
- The role of counties in the permit system.

Additionally, contacts were asked if they knew the rationale behind their permit system and if any economic studies of the permit system were conducted in their state.

STATE SURVEY FINDINGS

After a general overview of permitting practices in the surveyed states, we describe in more detail the allowances in these states for overweight trucks.

Overview

Three of the contacted states — Arkansas, Michigan, and Missouri — do not issue divisible-load overweight permits. Of the fourteen states with a divisible-load permit system, only five issue comprehensive permits that are not commodity or area specific: Montana, New York, Oregon, Utah, and Virginia (Table B1).

All the states except Michigan, Oklahoma, and Washington reported normal weight limits identical to the federal limits. Some interviewees reported federal bridge formula limits on axles, but on a typical five-axle truck-tractor, this amounts to the federal limit of 34,000 lb on a tandem axle.

Only one of the states, Virginia, does not include a tolerance on GVW in its divisible-load permits. However, nine states offer divisible-load permits without any relaxation of axle weight limits in the bridge formula (the federal formula or, in Oregon's case, a modified version). Normal gross vehicle weights are exceeded in these states by the use of additional axles or split-tandem axles. The permit fees are generally set to cover only administrative costs but in Montana, New York, and Pennsylvania, they partially cover road damage costs as well.

Apart from Oklahoma, whose permits are valid on both state and county roads, none of the surveyed states issue permits that are valid off the state-maintained network. Counties may issue permits, but the interviewees reported that few exercise this option.[a] Unlike Texas, the surveyed states do not issue permits that supersede road and bridge load-postings.

The vast majority of surveyed states use the phone, fax, or mail to receive permit applications and issue permits. All the states are considering, or have adopted, an Internet-based permit administration system and, for nondivisible permits, an automated routing system. The states currently using either of these systems are Pennsylvania, Washington, and Montana. Pennsylvania issues about 40 percent of its permits via the Internet, and the percentage is expected to increase; automated routing is utilized for about 57 percent of the permits. Washington accepts nondivisible-load permits over the Internet through a sales agent. The agent has authorization to pass through the Washington DOT firewall and log onto the DOT computer system. Montana uses automated routing to generate exception reports for route clearance. North Carolina is in the process of implementing the GEO-PACK system, which facilitates Internet-based permit processing and automated routing. Many states are awaiting results from other states' experiences with automated routing before beginning implementation. The contact from Missouri had reservations about using automated routing because of the difficulty of maintaining an updated road network database.

The states that responded to our law enforcement questions all have provisions for permit revocation and for requiring trucks to off-load (or shift-load) when caught

[a] North Carolina, Pennsylvania, and Virginia do not have a county road system.

overweight.[b] However, actual practices vary across the surveyed states. Mississippi reported that off-loading is seldom utilized, while Oregon stressed the importance of off-loading as a deterrent and requires off-loading even if a truck is very near its destination. Revocation usually results from egregious or multiple violations of a permit's provisions, but most states reported that a new permit can be purchased immediately.

Overweight fine structures vary significantly. The average fine in Louisiana is only $40; Mississippi fines at a rate of 11 cents per pound for 1,000 to 10,000 lb overweight; while in New York, GVW violations can cost up to $2,700 and axle violations up to $4,500. New York has the most stringent penalties of the surveyed states, with the highest potential fines, an automatic one year permit suspension for weights above load-posted limits or 10 percent above other limits (GVW or axle), and a $5,000 fee to obtain a new permit after revocation.

In addition to the studies of the Louisiana and New York permit systems (discussed earlier in this report), the interviewees mentioned some studies as being relevant, or possibly relevant, to an economic evaluation of their states' permit systems. North Carolina is planning an assessment of damage to pavement and bridge structures. The study mentioned for Montana was, and those for Michigan and Oregon sounded very much like, a highway cost allocation (HCA) study. An HCA study estimates a breakdown between vehicle classes of the costs of a highway system and of the revenues from highway-related taxes and government charges. By comparing the contributions of each class to costs and revenues, the studies throw some light on the fairness of existing taxes and charges. The Montana study, conducted by Montana State University in 1992, resulted in a lowering of vehicle registration fees.

[b] Overweight enforcement information was not obtained from Arkansas, Kansas, Missouri, and Oklahoma.

Table B1: Divisible-Load Overweight Permitting Practices

	Annual Divisible-Load Permit	GVW Allowances	Axle Allowances	County Permits
Arkansas	N	NA	NA	-
Florida	R	Y	B	Y
Kansas	R	Y	B	Y
Louisiana	R	Y	Y	N
Michigan	N	NA	NA	-
Mississippi	R	Y	B	Y
Missouri	N	NA	NA	-
Montana	C	Y	B	Y
New York	C	Y	B	Y
North Carolina	R	Y	Y	NA[a]
Ohio	R	Y	B	Y
Oklahoma	R	Y	B	N
Oregon	C	Y	B	Y
Pennsylvania	R	Y	Y	NA[a]
Utah	C	Y	B	-
Virginia	C	N	Y	NA[a]
Washington	R	Y	Y	-

Legend: B – Restricted by bridge formula; C – Comprehensive; N – No; NA – Not applicable;
R – Restricted; Y – Yes

a. North Carolina, Pennsylvania, and Virginia do not have a county road system.

State Weight Allowances and Fees

The allowances described below are for travel above the normal state limits on gross vehicle weight and axle weight.

Arkansas

No divisible-load overweight permit offered.

Unprocessed forestry goods are allowed over the normal axle limits during initial delivery.

Florida

GVW Allowances: 95,000 lb for containerized cargo

Axle Allowances: Subject to bridge formula

Annual Fee: $500

Kansas

GVW Allowances: Determined by bridge formula for the special vehicle combination (SVC) permit that allows triple trailer combinations to operate on a 28-mile stretch of I-70 leading into Colorado.

The Oilfield Certification Program (OSR) allows oilfield-servicing rigs to operate at:
84,000 lb with four axles
95,000 lb with five axles
110,000 lb with six axles
120,000 lb with seven or more axles

Axle Allowances: OSR:
24,000 lb for single axles
49,000 lb for tandem axles
60,000 lb for tridem axles

Annual Fee: The SVC permit costs $2000 per company and $50 per power unit.

Louisiana

GVW Allowances:	Harvest Season Permit for produce, forestry products in their natural state, and cattle allows 86,600 lb off Interstates and 83,400 lb on Interstates. Sugar Cane Permit allows 100,000 lb off Interstates. Louisiana also has permits for forestry and cotton module vehicles.
Axle Allowances:	Harvest Season Permit: 22,000 lb for single axle off Interstates 37,000 lb for tandem axle off Interstates Sugar Cane Permit: 12,000 lb for steering axle 48,000 lb for tandem axle
Annual Fee:	Harvest Season Permit costs $10. Sugar Cane Permit costs $100.

Michigan

No divisible-load overweight permit offered. However, Michigan allows trucks to travel at a maximum GVW of 164,000 lb. Axle weights are governed by a bridge formula.

The annual registration fees are as follows:

72,001–80,000	lb: $1,660
80,001–90,000	lb: $1,793
90,001–100,000	lb: $2,002
100,001–115,000	lb: $2,223
115,001–130,000	lb: $2,448
130,001–145,000	lb: $2,670
145,001–160,000	lb: $2,894
over 160,000	lb: $3,117

Exceptions: Trucks used exclusively for farming operations and owned by the farmer, trucks owned by a wood harvester and used exclusively for that purpose, and trucks used exclusively to haul milk from the farm to the first point of delivery are charged 75 cents per 100 lb of empty weight.

Mississippi

GVW Allowances: Harvest permit allows 84,000 lb for sand, gravel, fill dirt, and agricultural products.

Permit for two-piece timber cutting equipment allows 95,000 lb.

Axle Allowances: None

Annual Fee: Harvest permit costs $25.
Permit for two-piece timber-cutting equipment requires a blanket fee of $250 and 5 cents per thousand lb overweight per mile.

Missouri

No divisible-load overweight permit offered.

Montana

GVW Allowances: 129,000 lb

Axle Allowances: Subject to bridge formula

Annual Fee: $100 plus $46 for each ton overweight

New York

GVW Allowances: Upstate—102,000 lb for five axles and 107,000 lb for six axles

Downstate—120,000 lb

Axle Allowances: Subject to bridge formula

Annual Fee: Upstate five axles costs $750.
Upstate six axles costs $815.
Downstate costs $1,000.

These fees apply to the power unit only; an extra $20 is charged for each trailer.

Farmers can obtain a harvest permit at half the cost that is valid for four months.

North Carolina

GVW Allowances:	4,000 lb above the allowable federal bridge formula GVW for forestry by-products
Axle Allowances:	22,000 lb for single axle 42,000 lb for tandem axle
Annual Fee:	$50, but will increase to $100 effective October 2000.

Ohio

GVW Allowances:	154,000 lb for 3 counties bordering Michigan.
Axle Allowances:	Subject to bridge formula
Annual Fee:	$55

Oklahoma

GVW Allowances:	15% for garbage and utility trucks operated by towns and cities or by contractors to towns and cities. 5% for certain primary commodities such as forestry and grains
Axle Allowances:	None
Annual Fee:	$100

Oregon

GVW Allowances:	105,000 lb
Axle Allowances:	None
Annual Fee:	$8

Oregon also has a weight-distance tax that ranges from 13.65 cents per mile for 80,000 lb to 19.2 cents per mile for over 96,000 lb.

Pennsylvania

GVW Allowances:	Up to 107,000 lb for a variety of commodities
Axle Allowances:	21,000 lb on a single axle

Annual Fee: Ranges from $400 to $3,000, depending on registered weight

<u>Utah</u>

GVW Allowances: 129,000 lb

Axle Allowances: Subject to bridge formula

Annual Fee: 80,001–84,000 lb cost $200.
84,001–112,000 lb cost $400.
112,001–129,000 lb cost $450.

<u>Virginia</u>

GVW Allowances: Restricted to 80,000 lb

Axle Allowances: 5%, except for forestry and agricultural products which allows 10%

Annual Fee: 1% over normal limits–$35
2% over normal limits–$75
3% over normal limits–$115
4% over normal limits–$160
5% over normal limits–$200
Farm vehicles pay half the fee.

<u>Washington</u>

Axle Allowances: 6,000 extra lb on the rear axle of a two-axle truck and 8,000 lb on the rear axle of a three-axle truck used for refuse collection.

Annual Fee: $42 per extra 1,000 lb

Washington allows trucks to travel over 80,000 lb for a higher registration fee.

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Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
BTE	Bureau of Transport Economics
DOT	U.S. Department of Transportation
FHWA	Federal Highway Administration, U.S. Department of Transportation
TRB	Transportation Research Board
TTTCA	Texas Tank Truck Carriers Association

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