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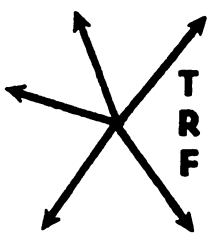

TRANSPORTATION RESEARCH FORUM

An Efficiency Assessment of the Highway User Charge System

*by Fred Lee Smith, Jr.**

WHEN THE CARRIAGES which pass over the highway or the bridge, and the lighters which sail upon the navigable canal, pay toll in proportion to their weight or their tunnage, they pay for the maintenance of these public works exactly in proportion to the wear and tear which they occasion of them. It seems scarce possible to invent a more equitable way of maintaining such work. Adam Smith[1]

INTRODUCTION

Despite the early prodding by Adam Smith, the current user charge system in the United States achieves to only a limited degree the functions of a pricing system. The current system lacks the economic coherency that an efficient user charge system would possess—marginal cost prices plus efficient revenue taxes if necessary. Economics dictates that users should be charged the costs that their use occasions. Thus, the marginal costs of road use should be determined and appropriate charges should be introduced to charge users for each use-related cost. Since there are several dimensions of use along which costs increase, the appropriate user tax system should be multi-part, with several types of charges.

Highway overhead costs are a large fraction of total costs, while most past research indicates that occasioned costs are relatively small. For this reason marginal cost-based charges alone are unlikely to yield revenue adequate to finance the highway system. Although political and economic considerations suggest that the major part** of any shortfall still be financed by road users, efficiency requires that the additional revenue charges reduce road use as little as possible* This efficiency focus—marginal cost-based charges whenever possible and non-distorting taxes, as necessary, to cover any revenue shortfall—is developed in this paper, and used to assess the current user charge system.[2]

More efficient use of the highway system is important. Highway and highway use are a major sector of our economy. In 1975, government highway expenditures were $30 billion, while expenditures and expenses on road travel equalled $277 billion.[3] Even small improvements in the way these expenditures are incurred via more rational road financing would involve large large savings.

The paper is divided into three sections. The following section discusses the implications of an efficiency-based highway user charge structure. The marginal costs of road use are identified and the functional relationships between use and such costs discussed. In this section also the concept of efficient revenue taxes is introduced and discussed. The second section of the paper discusses each of the tax instruments now being used and considers whether they are suitable to either the pricing or revenue role. Few existing taxes have any meaningful incentive role; although some appear efficient revenue raisers. The discussion in both sections is qualitative; the analyses necessary to critique conclusively the current system have not yet been conducted.

As these conclusions are tentative, the final section of the paper, therefore, indicates the analysis necessary to assess the appropriateness of current system. This question is topical, since Treasury

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**User charges currently make up only 75 percent of all highway revenue. This ratio has persisted for many years and is unlikely to change.

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*Note, however, that use may reflect benefits derived and this may politically justify use-based charges in excess of direct costs as an "equitable" way of financing common costs. The creation of political consensus is expensive; thus schemes which reduce political costs may well be "efficient" in this meta-sense. Finally, use-related charges may provide better dynamic information on the benefits to be derived from additional capacity investment or improved road quality. Acquiring such information via use-related charges may be efficient enough to outweigh the lost benefits of discouraged road use.

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has been requested by Congress (Section 507 of the Surface Transportation Assistance Act of 1978) to evaluate the current highway excise tax program and to suggest an improved system. Thus, this paper may be viewed as an input to that process.

CRITERIA FOR EFFICIENT HIGHWAY TAXATION

In this section, the types of road costs that vary with use are identified and the functional relationships between such use and costs are discussed. Charges based on these considerations play a resource allocation or pricing role. Taxes designed to raise revenues efficiently are then introduced, along with a brief discussion of the necessity for such taxes.

Design Criteria for Highway Taxes Serving a Pricing Role

The rationale for setting charges equal to the marginal or avoidable costs of road use is to ensure that society benefits from road use. The economic consequences of permitting a specific road use, its marginal costs, should be calculated and charged to the user. Through this means, the user will then judge whether the benefits of the trip exceed its total costs.

Highway system costs vary in different ways depending upon road use. Decisions made by road users affect maintenance costs, interference costs, and external costs. Since each of these costs varies along a different dimension of road use and may also differ substantially over time and by locale, the appropriate user charge structure would incorporate a similar diversity of tax instruments. The various national level charges might be based on average use-related costs, with state and local surcharges introduced to incorporate regional cost variations.

At each level, the cost-related charge should track as closely as possible the decisions actually affecting road costs. This should continue to the point that the additional efficiency gains of a more precise pricing scheme would be outweighed by its administrative costs. This design problem is analogous to the commonplace experience of the shared lunch. Only if billed individually will each diner consider fully the costs of his selections. A collective bill (a less precise pricing scheme) will weaken the incentive of each individual to consider the costs of his decisions, and this weakening effect will increase as the number of people involved increases. The efficiency losses will depend upon the extent to which the decisions would differ under the two pricing schemes. Individual billing does involve greater administrative expenses but in many cases these are outweighed by the greater savings induced by assigning direct cost responsibility. The question of how precise the charge should be cannot be answered without analysis, but high administrative costs should not alone rule out a charging concept. In any case, that a vehicle class cover its cost is not adequate, as this may be achieved by massive cross-subsidies.

In any event, the design of an efficient multi-part tax structure depends upon an understanding of the relationship between use and costs; these are now discussed.

Variable Maintenance Charges. The efficiency rationale for levying variable maintenance charges is to ensure that road users consider the impact their use has on road quality, and hence on government maintenance expenditures and user travel costs. Engineering studies indicate that vehicle weight and the configuration and type of axles over which this weight is distributed determine the stress placed on a road and hence the avoidable fraction of road deterioration. The costs of this depend upon the design of the road, the unit costs of road maintenance and repair, and the nature of the traffic exposed to the degraded roadway.

The economic consequences of the weight-induced deterioration equal the sum of the present value of the costs of an accelerated maintenance schedule and of the additional user costs. This sum, divided by a standardized measure of the additional stress, defines the appropriate charge. Although these calculations have not been conducted, the engineering ability to make such estimates is relatively well developed.* The efficiency gains

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*Pending such analysis, an indication of the appropriate variable maintenance charge can be obtained from work carried out by the Urban Institute. During the 20-year period 1956 to 1975, total road stress expressed in units of miles of 18,000-pound, single-axle travel was estimated as 860 billion units, while the corresponding avoidable government maintenance and rehabilitation expenditures (changes in user costs related to road quality were not assessed) were estimated as $44 billion.[4] These figures imply that the variable maintenance charge would average about 5.2¢ per equivalent axle mile traveled. This estimate is understated by the exclusion of the user-experienced costs of de-

ferred maintenance, but overstated by the assumption that all maintenance costs result from use.

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from introducing damage-based maintenance charges are unknown but could be considerable, given the growing share of maintenance expenses in the highway budget, and the massive costs involved in deferred maintenance.

Variable maintenance charges in principle should vary depending upon road design and climatic conditions. A standard load will do greater physical damage to a light than a heavy duty road, to a wet than a dry roadbed. Damage to light duty roads, however, is less expensive to repair and may affect fewer vehicles. In any case, engineering studies suggest that the relation between road stress and axle weight follows a fourth power rule; as axle weight doubles, damage increases 16 times. The relation of vehicle weight to stress will be somewhat less since road stress varies with axle weight, not gross weight. However, as shown in Figure 1, the stress imposed by a 5-axle truck also increases exponentially; at 80,000 lbs. the damage is over 6 times that created at 50,000 lbs. Thus, the variable maintenance charge component (not necessarily the total user charge burden) paid by a vehicle should increase rapidly as the weight of the vehicle increases.

Interference Charges. When several vehicles whose performance characteristics differ use the same facility, they interfere with each other with some probability. The results of this interference are increased travel times, accident rates, vehicle operating costs, and driver discomfort. The cost of these interference effect will be a function of road design, topography, the vehicles involved, and the level of traffic. Interference includes such phenomena as passing conflicts and platooning; however, congestion—the intensive interference experienced in high-volume traffic—is the major element in interference costs. Indeed, at times, economists have treated congestion as if it constituted the sole case for introducing road prices.

A British study, **Road Pricing: Economic and Technological Possibilities,** suggested major savings* from introducing even crude congestion prices.[5] The magnitude of these savings results from the major differences between private and total costs of road use during peak-use periods. A recent analysis suggests that during peak-hour conditions, total road use costs would almost double average private costs.[6]

The revenues that might be raised via interference charges are not readily determined. Small and Keeler provide estimates of the tolls appropriate under various volume and speed conditions, but present no data on their relative importance. Moreover, as they discuss, rational pricing would include some peak shifting and dampening that would reduce revenues. Nonetheless, even assuming their lowest estimate, interference charges would raise over one billion dollars. Since Small estimates peak load interference charges as more than three hundred times off-peak charges (34¢ vs. .1¢ per mile), peak load pricing would raise greater sums—introduced broadly, perhaps tens of billions of dollars. However, peak as opposed to average interference charges should be levied in a time- and locale-sensitive fashion. This may make such charges infeasible.

External Noise and Pollution Charges. Besides the costs to other road users and to government of additional road use, road travel creates additional costs resulting from pollution and noise. The economic significance of these will depend upon the population adjoining the road and their sensitivity to such externalities. Although the literature on pollution and noise costs is extensive, few view the current estimates with confidence. Nonetheless, such costs obviously vary with road travel and should be paid by the user where relevant. Again, the magnitude of such charges is likely to be highly locale- and time-specific. Pollution in a windy, clean, unpopulated area is less costly than the same pollution in an urban area.

One attempt to estimate the per mile pollution charges attributable to vehicle traffic was conducted by Kenneth Small.[7] Pollution costs varied by type and vintage of vehicle; pre-1975 diesel buses were estimated to cause $.0096 per mile of air pollution costs (noise impacts were not addressed), while 1974 model cars resulted in pollution costs of only $.002 per mile. Newer models were projected to drop below $.0004 per mile traveled. Small's results support the belief that external costs vary regionally; estimated per mile pollution costs in California were three times the national average.

The external costs of motor vehicle travel appear less important on a per mile basis than interference costs. None-

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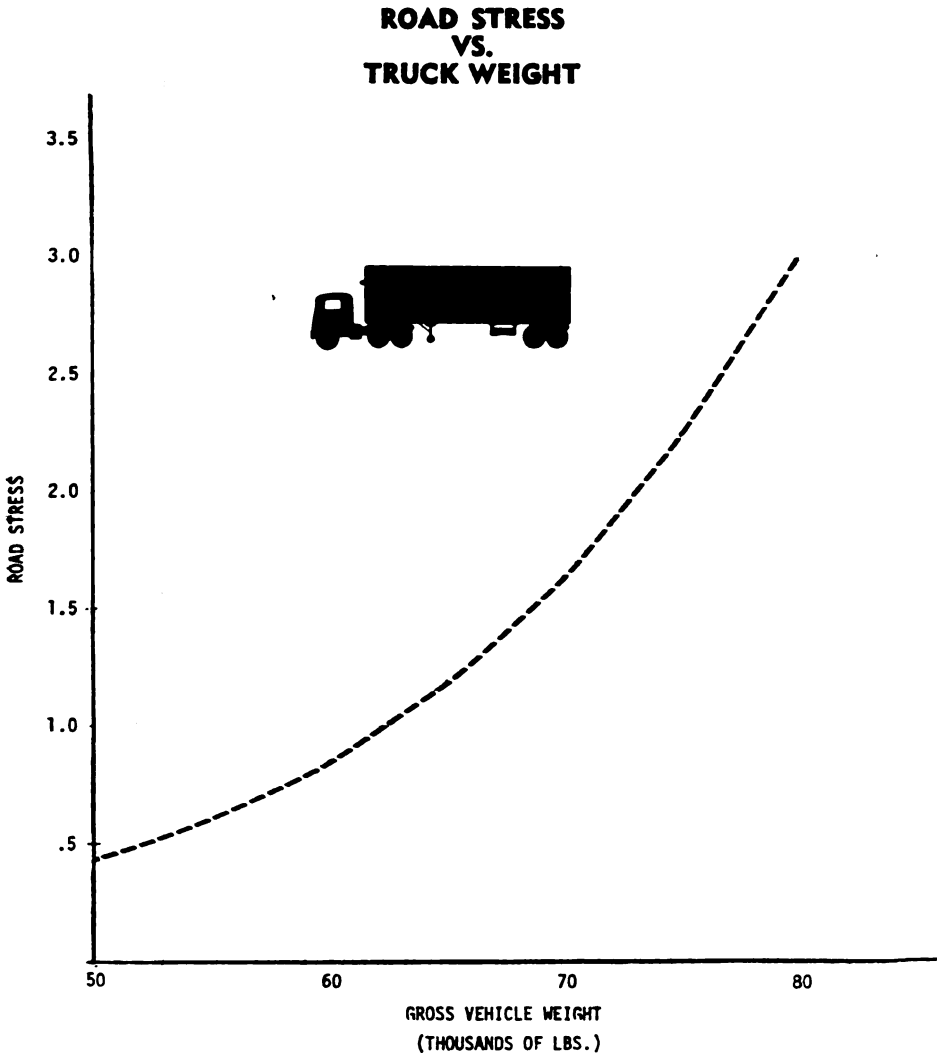
*Benefits were estimated at £100 to £150 million; at that time revenues from motor vehicles were only £713 million. Benefits of this magnitude might well justify relatively elaborate pricing approaches.



Source: This curve is derived from the equivalency factors of Figure #3, Testimony Before the Oversight Subcommittee of House Ways and Means. American Association of State Highway and Transportation Officials, November 29, 1977. Similar factors are presented in NCHRP Report #141, *Changes in Legal Vehicle Weights and Dimensions.* Robert E. Whiteside, et al., 1975. These latter figures indicate somewhat lower stress factors, especially for tandem axles.

FIGURE 1

theless, were such charges introduced, revenues on the order of billions of dollars might be obtained, although this would gradually decline as less polluting vehicles enter the vehicle fleets. The efficiency benefits of introducing external cost charges may be substantial, since current control strategies make little use of the substantial opportunities users possess to reduce the impact of pollution and noise.

Summary: The analysis necessary to estimate the efficiency benefits of marginal costs pricing have not been con-

ducted. However, the scale of the costs involved—road maintenance, user operating costs, interference, and air pollution—is large, on the order of tens of billions of dollars annually. The current financing system, as later discussed, creates few incentives for users to consider the impact their acts have on these costs. Thus, the case that substantial benefits might be realized is plausible. A quantitative case will require further study. An analysis of the revenue marginal cost charges would raise has not yet been conducted, although the discussion above suggests that such user charges could raise substantial sums. Indeed, since total road expenditures in 1975 were about $28 billion, widespread introduction of marginal cost charges might even yield a revenue surplus,* although this is highly unlikely, since it would require widespread use of interference charges, which are likely to encounter great political resistance.**

*The concept of surplus depends upon the costs attributed to the highway system. Lee argues that the relevant road budget should include the extra costs that private industry would incur in a comparable role.[8]

**As evidence, consider the reaction of EPA's attempt to introduce urban parking surcharges as a means of controlling air pollution.

For the foreseeable future, the revenues raised via road prices will fall far short of the total revenue requirements of the road system. Thus, an important role for revenue taxes seems inevitable. The criteria that should guide their development are now discussed.

Design Criteria for Revenue-Raising Taxes

Taxes intended to raise revenue are necessary, as long as incentive or pricing charges prove inadequate to finance the road system. Although the requirement that road users finance the road system yields no precise revenue requirement, this paper makes the conventional assumption that the highway budget is the sum of federal, state, and local road expenditures. If the non-user subsidy of 25 percent continues, user charges should raise about $21 billion. Marginal cost-based charges likely to be instituted (largely, variable maintenance and average interference charges) might raise one-fourth of this. The remainder would be raised by revenue taxes.

Unlike pricing or incentive charges, revenue taxes should not influence individual user or user class behavior. Such shifts would move the road system away from an efficient pattern of resource utilization. Unfortunately, any tax offers some opportunity for evasion and thus introduces some inefficiency. The design problem become that of defining a set of revenue taxes that finance the shortfall, while minimizing the combined administration and inefficiency costs.*

*In principle, all economic activities would be candidates for such revenue-raising taxes. As noted, some highway financing already derives from general taxes. However, political considerations make it likely that taxes levied on road users will continue to be the major source of highway financing.

The economics of this are shown in Figure 2. The marginal cost curves are assumed to include any relevant efficiency-based user costs. In Panel 2A, the efficient level of road use is defined by the intersection of the two curves. Panel 2B indicates that a revenue tax surcharge shifts upward the supply curve. This both distorts the consumption pattern and raises revenue. The triangle MNO represents the net inefficiency (welfare loss, "excess burden," dead weight loss) of the tax, while the rectangle NMP'P* represents the revenues raised. The ratio indicates the costs or burden of the specific tax at the level indicated.*

*Research to estimate the burden of specific taxes is relatively rare. The resource misallocation or inefficiency costs of taxation are not currently reported in the Budget, although Treasury has taken a step in its reporting on tax expenditures.[9]

The highway situation is, of course, more complex. Current charges are levied not on road use per se but on some travel-related commodity such as fuel. Also, charges imposed on one type of use or activity may well affect the demands for other goods; for example, gasoline taxes will increase the demand for diesel. This more general question of how revenue shortfalls under marginal cost pricing should be financed has been considered and answered in the public utility literature.[10] The rule is that introduced earlier—efficient revenue taxation should follow an "inverse elasticity" rule—taxes should be levied on those

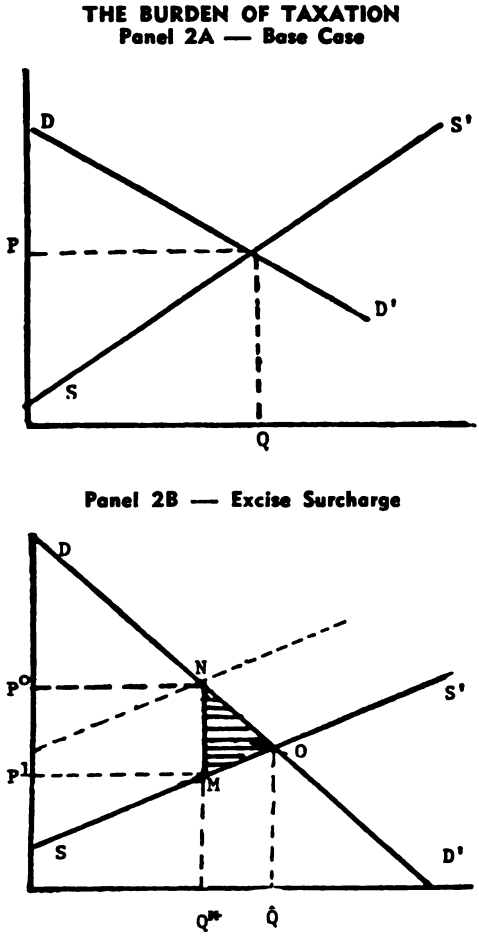


FIGURE 2

user decisions least influenced by the additional charge.

Summary

From this discussion, several design criteria emerge. User charges, should be based on the actual costs of travel. To the extent compatible with administrative cost considerations, charges should be levied as closely as possible in time, place, and use to the activity occasioning that cost. The benefits of cost-based prices might well justify the additional administrative costs of more elaborate pricing methods. The system should include a tax corresponding to each significant dimension of variable road cost. Thus, the pricing side of the user charge system should resemble the multi-part tariffs of public utility theory.

For taxes intended to raise revenue, the criteria are simple. Taxes should raise as much revenue as possible, while creating little administrative and tax burden costs. An efficient tax structure has no place for taxes that involve substantial administrative costs, but that raise little revenue and that serve no pricing role. Special taxes may, however, be the most effective way of levying charges or collecting revenues from a special subgroup of road users.

In brief, user charges should encourage users to make most efficient use of the road system, while financing most government highway expenditures. There is no perfect or final highway tax program—each program represents a compromise between the administrative and political costs of the scheme and the efficiency benefits of more precise or less burdensome taxes. The optimal solution will change with technology and public perception. The extent to which the current system achieves these goals is next considered.

ASSESSMENT OF CURRENT USER TAX SYSTEM

Introduction

In assessing the highway financing system, we must note that it is a "system" in concept only. Both the federal and state highway tax program are in reality little more than a collection of miscellaneous taxes; there is little coordination among or between government departments; no one is responsible for ensuring that highway taxes are modified over time to reflect changes in cost responsibilities.

The current user charge system (see Table 1) is an elaborate system of largely federal and state taxes which, in 1975, raised over $19 billion. User charges are the dominant revenue source at the federal and state levels, accounting for almost 85 percent of all highway revenues. Local government user charges are less important, as they account for less than 10 percent of their highway revenues. The lack of user charges at the local government level is a major problem since many highway costs are best charged locally. In total, however, user charges provide almost three-quarters of all highway revenues.[11]

Assessing highway financing from the efficiency perspective involves first determining whether the tax serves any pricing function; and if not, whether it raises revenues at reasonable administrative cost and with few distorting impacts. Each of the current user charges is now considered in this context.

TABLE 1

USER TAXES BY LEVEL OF GOVERNMENT

	Federal	State Level	County & Municipal
Motor Vehicle Excises	Trucks Only	No*	No*
Registration Fees	Trucks Only	Yes	Some
Fuel Tax	Yes	Yes	Some
Lube Oil Tax	Yes	No	No
Tire Tax	Yes	No	No
Parts Tax	Trucks Only	No	No
Mileage Tax	No	Most†	No
Ton-Mileage Tax	No	(Colo)	No

* Many state and local jurisdictions levy sales taxes which could be, and in some cases are, used to finance highways.
† Most states require interstate trucks to maintain mileage records as a means of enforcing fuel use taxes.

Motor Vehicle Excises

The current motor vehicle excise is a 10 percent ad valorem tax on manufacturer's selling price of heavy trucks. In 1975 the tax raised $393 million. Since there are few manufacturers, the tax is readily administered although some problems are encountered in clarifying what equipment should be included in the tax base.

The tax, however, has few pricing functions. An ad valorem tax considers only selling price—a statistic of little predictive value in assessing the costs the vehicle will impose on the highway system. Some incentive effects would result were motor vehicle excises to vary based on some physical characteristic of the vehicle; however, this would also involve greater administrative costs. Moreover, such taxes ignore the variations in use that occur for vehicles of the same type. As it stands, the motor vehicle excise tax must be viewed as a revenue, not a pricing tax.

How does it rank on this basis? Excises raise the selling price of new equipment and thus encourage potential buyers to make do with fewer vehicles. Estimating the resulting burden requires an investigation of the demand for heavy trucks. Pending such analysis, the low administrative costs of this tax suggest that it be viewed as a logical candidate for revenue purposes.

Registration Fees

Registration fees are a major component, over $5 billion, of the current highway financing system. In 1975 **Highway Statistics** reported $704 million spent for "collection and administration of highway user revenues." What fraction of this is attributable to the revenue collection function is not clear; however, any tax collected on a one-on-one basis, will almost always be more expensive to administer than taxes collected in some more aggregate manner.

Registration fees are not effective prices, because ownership of a vehicle per se has little to do with road costs. Registration fees play little interference pricing role either, although area specific licenses might play a role here. A restricted license would limit the hours and areas in which the vehicle might operate. This would provide some incentives to opt out of the market for driving during highly congested periods. Registration fees of this type are not yet being used in the U.S.

Most states levy weight-based registration fees or surcharges, and these are often assumed to play a pricing role in allocating road damage costs among road users. However, most states levy registration fees on the maximum weight the vehicle is authorized to carry. Since the average load will be lower, the rate implicitly assumes some "average" load. Vehicles of that type carrying less than this average subsidize those vehicles carrying more. This topic was debated at the time the federal truck registration fee was imposed. Treasury spokespeople noted that administrative considerations required that trucks be grouped into fairly aggregate categories, but that this led to cross-subsidies. Treasury viewed this as a regrettable but unavoidable aspect of any tax scheme.

Registration fees may distort commercial fleet operating policies and family car ownership. Higher registration fees encourage owners to operate fewer vehicles more intensely. Commercial oper-

ators are also likely to minimize registration costs by relocating; and this is encouraged by the highly complex pattern of registration rules among states.*

*A recent study found state highway tax payments substantially lower for vehicles based outside the state.[12]

No quantitative assessment of these burden costs has been conducted.

Fuel Taxes

Fuel taxes raise over $12.5 billion and are thus the single most important user charge. Over 65 percent of all user charge revenues are derived from fuel taxes. They make up about 74 and 61 percent of federal and state highway user charge revenues respectively.

Despite their importance, fuel taxes are of little use as road prices. They are a poor pricing mechanism for charging variable maintenance costs. Although weight is correlated with fuel consumption, the fuel increase is miniscule in comparison with the damage shifts of heavier vehicles. For example, a five-axle truck increases its fuel consumption only 12 percent as its weight increases from 50,000 to 80,000 pounds, while the damage it occasions increases by almost 600 percent.[13]

Fuel taxes also poorly relate to interference costs. Fuel consumption does increase as travel in delay conditions increases; however, the interference costs increase far more. External costs are also weakly associated with fuel consumption. The noise and pollution generated by a vehicle is more closely related to the design of the vehicle and the control equipment installed.

Fuel taxes are a plausible revenue tax. The price elasticity of fuel is relatively low which lowers the inefficiency effects of the tax.* Some road use is discouraged and some users buy smaller cars.

*Recent work on the impact of energy taxes indicates that the burden costs of the gas tax might approach 1 percent of revenues collected.[14]

In assessing the role of fuel taxes for revenue purposes, administrative costs must also be considered. Both gasoline and diesel are important fuels, but their administration is very different. Taxing gasoline is fairly straight forward in terms of administration. Virtually all gasoline is consumed in highway use; moreover, gasoline is readily distinguishable from other petroleum products. Therefore, gasoline can be taxed at the distributor level rather than at the retail level, which greatly simplifies the administration.

Taxing diesel and other special fuels, however, is a more complicated matter. Diesel is used in rail, barge and other off-road transport modes and is not readily distinguishable from home heating oil. This makes taxation of diesel at an early point in the system difficult, since the distributor would have to know the ultimate use of the products sold. Also, many commercial firms maintain their own system of fuel depots, which complicates the taxpayer identification and auditing process. Currently, the federal government spends a considerable portion of all resources devoted to excise tax administration on the diesel tax.[15] With the rapid dieselization of the light vehicle fleet, it is expected that these tax administration problems will greatly increase. As a result, fuel taxation is unlikely to retain its role as the obvious source of highway revenue. Fuel taxes were never a good pricing mechanism. They will become an increasingly more expensive revenue tax.

Lube Oil Tax

At the time the excise tax on lubricating oils was shifted to the highway trust fund, all lubricating oils were taxed. The tax has since been modified so that it is applicable only to lubricating products consumed in on-road vehicles. The tax is still collected as a manufacturer's excise but, given its restricted scope, now requires complex refund and exemption rulings. Moreover, relatively little money is collected by this tax—only $66 million in 1975.

It should also be noted that a tax on lubricating oils has essentially the same role as a fuel tax. It serves no pricing purpose and as a revenue tax could readily be replaced by other taxes at less administrative cost.

Tire, Tube, and Retread Rubber Tax

Excise taxes on tires, tubes, and retread rubber are often assumed to play a pricing function, since tire wear correlates with road use. Again the supposition does not bear scrutiny. First, recycled rubber is taxed at a lower rate which arbitarily reduces the tax for vehicles using retreads. Moreover, from the pricing or incentive view, the tax is perverse, since the tax is based not on rubber used—a factor that might correlate with road stress—but rather on rubber purchased. Taxes increase as more tires are placed between the road and

the load. Yet, distributing a load over a larger area via more axles and tires reduces the stress on the road. But the rubber tax actually discourages users from such cost-reducing actions.

The tax is, however, easy to collect. It is collected as a manufacturers' levy, and thus involves few administrative problems. It may thus have some value as a general revenue measure since it does raise substantial sums—over $675 million in 1975. The question remains as to whether these revenue-raising advantages offset its disadvantages.

Parts Tax

The tax on truck parts is a remnant of a once-extensive system of revenue excises. Redefinition and modifications have reduced the impact of this tax until it now applies only to selected truck parts. The tax is weakly linked to use in that a vehicle used more intensively will typically require more parts. However, as noted repeatedly, intensive use does not necessarily imply greater road costs. In any event, the value of parts is a poor proxy for road use.

The tax does raise revenues. In 1975 some $116 million was raised by this tax. However, the tax also raises major definition problems—when is a part a truck part? These definitional issues have become the focal point of intense lobbying and judicial debate and add to the administrative burdens of this tax. These administrative problems may outweigh the revenue value of the parts tax.

Mileage Taxes

Mileage taxes are taxes based on the mileage a vehicle travels. The mileage traveled by a specific vehicle is a plausible basis for pricing variable maintenance costs. Vehicle type is to some extent correlated with weight carried, and the number of miles traveled provides an indication of how much pavement is exposed to this damage potential. (Of course, actual weight would be preferred.) Those states that explicitly use a mileage-charge structure charge vehicles differently based on their authorized weight. Since mileage taxes can have a major impact on operating costs, vehicles will register their vehicles as closely as possible to the weight they will carry. Thus, the mileage tax can become a surrogate for road damage. The rates now in effect poorly track this cost responsibility since they increase only linearly while, as noted earlier, damages increase exponentially; however, this problem could be addressed by redesigning the rate schedule.

Such taxes do involve greater administrative costs; however, the administrative structure to levy such taxes is already in place in most states, under the label of fuel use taxes. A fuel use tax is a reporting requirement imposed on road users who might evade the normal fuel tax laws through out-of-state or direct purchases of fuel. There is no administratively simple way to tax these road users. Fuel use laws require that mileage records be maintained, and this would permit the state to levy a vehicle specific mileage charge. In fact, most states still tax such users on a nominal fuel consumption basis. By allowing a useful proxy for road use—vehicle specific mileage—to be degraded to a less valuable use dimension—fuel consumed—an opportunity for more rational road pricing is lost.

Mileage taxes are not particularly useful as revenue taxes, since they involve substantially higher administrative costs than the earlier taxes discussed. However, mileage taxes need not be imposed on all road users, and to the extent that they act as road prices, they may justify the higher administrative costs.

Ton Mileage Taxes

Only Colorado currently uses a ton mileage tax. Nonetheless, ton mileage taxes are worth considering, because a tax of this type comes closest of all current taxes to pricing variable maintenance costs. In the Colorado scheme, the rate varies both with the class of the vehicle and the tons carried. Every empty mile traveled is charged at a base rate of .8 mills per mile. A surcharge of two mills per cargo ton mile is imposed, resulting in a per mile tax rate increase of two mills per additional ton.[16] This rate of increase is much greater than that of a fuel tax. Still, the marginal rate is constant while marginal damages increase rapidly with load. A relatively simple change in the tax could eliminate these problems. The rate charged per marginal ton could vary with tonnage so that each additional ton would pay a higher fee.

Summary

The current tax system contains some taxes that appear unnecessary. An example is the lube oil tax. Other taxes, such as the tire tax, provide perverse incentives. Other taxes play a valuable revenue raising role, although current trends threaten this—fuel taxes are the major example. Motor vehicle excises and registration fees appear useful revenue charges—charges of this type are unlikely to induce major efficiency losses. Other taxes play no relevant pricing role but cannot be ruled out as revenue

taxes—an example is the truck parts excise. Still other taxes, in particular the mileage and ton mileage taxes, might be redesigned to more effectively price at least the variable maintenance component of road use costs. The most serious shortcoming of the current system is that no charges are now levied for interference costs. Some form of area licensing might be of use here.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, a rational user charge scheme would be multi-part, including both pricing and revenue taxes. The current system, however, seriously departs from this ideal. Few taxes have any significant pricing role and, of these, none are applied in a consistent nationwide fashion. Some taxes are redundant in the sense that another tax provides a more logical pricing role or fulfills the revenue-raising role more cheaply. Taxes based on use play an excessive role when only a fraction of all highway costs are attributable to road use. This suggests a shift away from use taxes, perhaps to registration fees or motor vehicle excises.

Improvements are possible, but will require greater knowledge of the costs associated with road use and the administrative and efficiency costs of alternative taxes. The Surface Transportation Assistance Act of 1978 assigned responsibilities in this area to both the Department of Transportation and Treasury. The Department of Transportation is required to undertake a highway cost allocation study which should yield estimates of the marginal costs of road use and of the economic impacts of various highway charges. However, past cost allocation studies have not addressed the economic issues involved in highway financing, and there is some likelihood that the current effort will also fail to yield any relevant information about highway pricing.[17]

Treasury is therefore advised to consider developing such information directly, although they should encourage DOT to consider such questions also. Treasury is required to assess current highway excise taxes and to recommend an improved system. This requires estimating the marginal costs of highway use, the benefits of marginal cost pricing, and the inefficiencies of charges departing from these levels. The estimated savings and costs must be considered in conjunction with the administrative costs to government and to the taxpayer of the various charge instruments. From this review should emerge the elements of a rational user charge structure.

Treasury should also assess the current system of federal, state, and local highway financing and evaluate the relative advantages of prices and revenue taxes at each level. Along with this, consideration should be given to improve coordination of federal, state, and local tax administration. As manager of the highway trust fund, Treasury might report annually on the highway excise program with updates of not only the revenues obtained and auditing and compliance statistics, but also estimates of the efficiency benefits currently realized by the pricing elements of the program and of the tax burdens associated with the revenue taxes. Administrative costs should similarly be reported.

As noted in the introduction to this paper, the highway sector of the economy is large. The way this system is financed has much to do with the value it provides. To date, the role of efficient financing in regulating the use and design of this system has been little recognized. The advantages of such recognition appears substantial; their realization will require considerable research and change.

FOOTNOTES

1 Quoted by William Ross in "Basic Theory of State Highway Financing," pp. 107-127, in **Financing Highways**, edited by Wilfred Owen, et al. Proceedings of a symposium conducted by the Tax Institute, November 8-9, 1956, Princeton, N.J. Published 1957.

2 This is essentially the approach recommended by A. A. Walters, **The Economics of Road User Charges**, World Bank Publication, 1964.

3 **National Transportation Statistics.** Prepared by Transportation Systems Center, Sept. 1978.

4 Kiran Bhatt, et al. **An Analysis of Road Expenditures and Payments by Vehicle Class** (1956-1975). An Urban Institute research report. March 1977. Table 4 and 5 and unpublished data.

5 Great Britain: Ministry of Transport. **Road Pricing: The Economic and Technical Possibilities.** London. Her Majesty's Stationary Office, 1964.

6 Private operating costs for an automobile are about 18¢ per mile (table 41, National Transportation Statistics). Small and Keeler estimate congestion charges of up to 34¢ per vehicle mile. See Theodore Keeler and Kenneth Small, "Optimal Peak-Load Pricing, Investment, and Service Levels on Urban Expressways," **Journal of Political Economy**, 1977, Vol. 85, No. 1, Table 5.

7 Kenneth Small, "Estimating the Air Pollution Costs of Transportation Modes." Working Paper, No. 261, Institute Urban and Regional Developments, University of California, Berkeley, 1975.

8 Douglas B. Lee, Jr. "Full Cost Pricing of Highway Services," in **Proceedings 19th Annual Meeting of the Transportation Research Forum**, Vol. XIX, 1978.

9 For representative work of this type see Don Fullerton, et al. "General Equilibrium Analysis of U.S. Tax Policy," 1978 Compendium of Tax Research, OTA, ed. by Emil Sunley. See also, Allen Miedema, "An Empirical Evaluation of Market Net Welfare Effects of a Product Disposal Charge," Research Triangle Institute Report for U.S. EPA; and Steve Buchanan, "Evaluating the Efficiency of the Solid Waste Charge," Sept. 1978, Solid Waste Policy Symposium, Philadelphia, PA, Sponsored by U.S. EPA, NERL.

10 William Baumol and David Bradford, "Optimal Departures from Marginal Cost Pricing."

11 Highway Statistics: Summary to 1975, Table HF-211.

12 George Hoffer and Charles Gallegher, "The Effect of Registration Reciprocity on Road User Tax Rates," Southern Economic Journal, April 1978.

13 The fuel consumption versus weight was based on data in Trucker's Guide to Fuel Savings, FEA, DOT, EPA, March 1976, p. 5. The damage estimate was taken from the sources quoted in Figure 1.

14 This estimate is based on the diagram shown in the text and the results of Data Resources Inc., A Study of the Quarterly Demand for Gasoline and Impacts of Alternative Gasoline Taxes, December 1978.

15 Unpublished IRS Summary Audit Statistics.

16 For a comprehensive review, see The Role of Tthird Structure Taxes in the Highway User Tax Family, The University of Mississippi for U.S. DOT, 1968.

17 For a critical review of past work, see Leonard Lee Lane, "A Critique of BPR-FHWA Analysis of Highway Costs," pp. 258-264. Proceedings—Nineteenth Annual Meeting of the Transportation Research Forum. Vol. XIX, No. 1. 1978. See also, Ralph Turvey, The Analysis of Economic Costs and Expenses in Road and Rail Transport, Transport Series No. 4, Commission of the European Communities, 1976.