Results of the Kentucky Highway Finance Study

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The Automotive Safety Foundation's engineering appraisal of Kentucky's roads and streets disclosed numerous deficiencies. If the value of the highway dollar remains constant over the next 20 years, an average of about $160 million a year will be needed for modernization. Estimated revenues under 1955 laws, combined with federal aid, probably would be sufficient to complete the improvement program in 20 years, but they would not be adequate to follow the recommended expenditure pattern, which contemplates completion of two-thirds of the program in the first 10 years. Highway costs may well rise by an average of at least 3 percent annually. If so—assuming the 20-year program is adopted—certainly a user tax increase, and probably credit financing, would be required. The primary purpose of the highway finance study was to determine how the Commonwealth and its subdivisions could most economically finance the recommended 20-year program.

The division of costs between highway users and nonusers was accomplished by first determining the nonuser share on the basis of past revenue contribution and then assigning the residual amount to users. Under this scheme, users would be required to pay about 85 percent of the total cost exclusive of federal aid. The incremental cost approach was employed to obtain a division of user expenditure responsibility among users of various types and sizes of vehicles. A comparison of 1965 incremental assignments with 1965 tax contribution estimates indicates that, with no change in 1955 tax laws, serious inequities would result. Domestic vehicle operators, in total, would contribute slightly more than their relative responsibility; foreign vehicle operators, in total, would meet only 90 percent of their responsibility. Among the types of domestic vehicles, passenger cars and light nonform trucks would be overtaxed; farm trucks and the heavier nonfarm trucks would be undertaxed. The incremental relationships were established before nonuser charges and federal aid were deducted; that is, the assignment of relative responsibility was determined independent of the method of financing.

Equity, adequacy, mitigation of administrative and compliance problems, and minimization of interference with transportation received attention in tax planning. Three user-tax plans embodying various combinations of motor fuel, registration, and third-structure taxes were devised. The motor fuel tax would account for about 83 percent of the user revenue under each plan. A diesel fuel tax rate differential of 50 percent was found necessary to eliminate inequality. For-hire carriers were assigned the cost of regulatory functions, and this added responsibility would be recouped through a utility certificate fee. If highway costs rise by as much as 3 percent a year, a gasoline tax as high as $0.11 per gallon might be required from all users.

In addition to formulating tax plans, possible credit financing was examined. Expenditure programs involving the use of various amounts of bonds were compared with a program involving no credit. The interest cost of each credit finance program would undoubtedly be more than offset by savings that would result from accelerating the construction program. The state could reduce stop-gap work and would obtain ad-

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ditional revenue from more extensive use of the modern facilities; motorists would benefit earlier from lower vehicle operating costs, reduced accident rates and time savings. In addition, assuming a rise in highway costs, the earlier in the program the work is done, the lower would be the cost.

● KENTUCKY, like other states, faces the problem of financing a modern system of roads and streets. If the value of the highway dollar does not change from its 1953 level during the next 20 years, an average of almost $160 million a year must be spent to eliminate the numerous deficiencies and otherwise bring the highway system to modern standards. Even though revenue under 1955 laws plus federal funds[2] might be sufficient to complete the program in 20 years, the schedule recommended by the Automotive Safety Foundation could not be followed. This fact (Fig. 1) suggests the use of bond financing.

The available evidence indicates that highway costs will rise by an average of at least 3 percent a year over the next 20 years. In the event of a 3 percent annual increase, an average of around $207 million a year would be needed to follow the Automotive Safety Foundation schedule (Fig. 2). A bond issue large enough to obtain the difference between estimated revenues and recommended expenditures would be politically unacceptable. In any case, means of paying debt service would be essential.

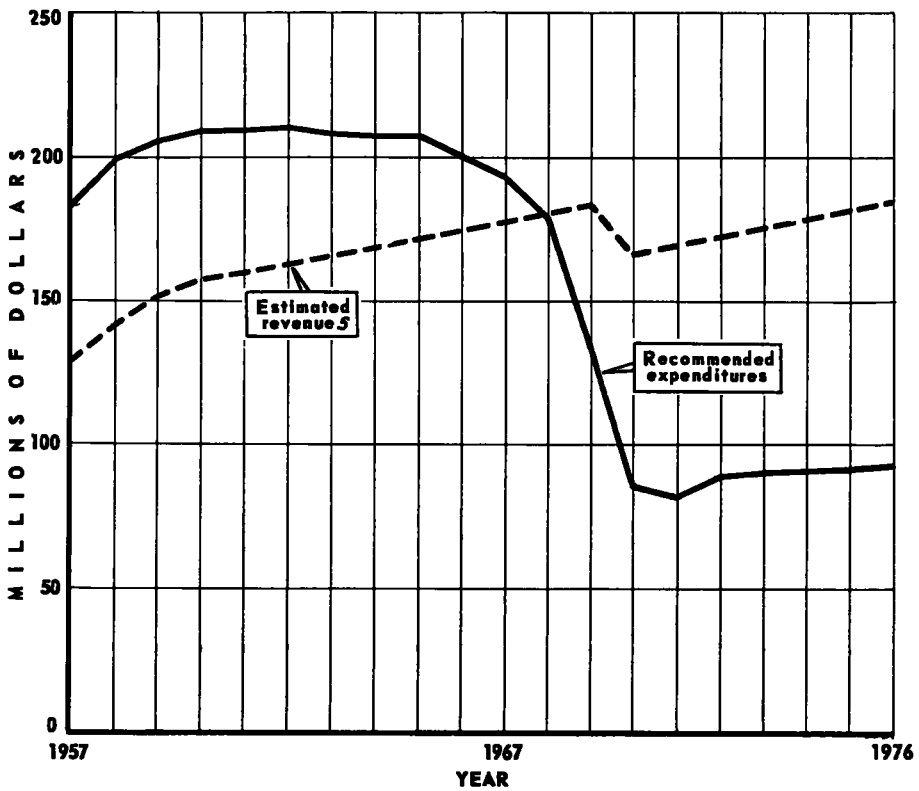

Figure 1. Recommended highway expenditures in 1953 dollars compared with estimated revenues (1957-1976).

[2] The amount of federal aid that Kentucky will receive was assumed to be equal to the latest estimate of interstate construction and replacement costs plus a continuation of the 1959 figure for other systems. It was also assumed that roughly one-third of average annual interstate funds will be added to other federal aid systems when the interstate system is completed.

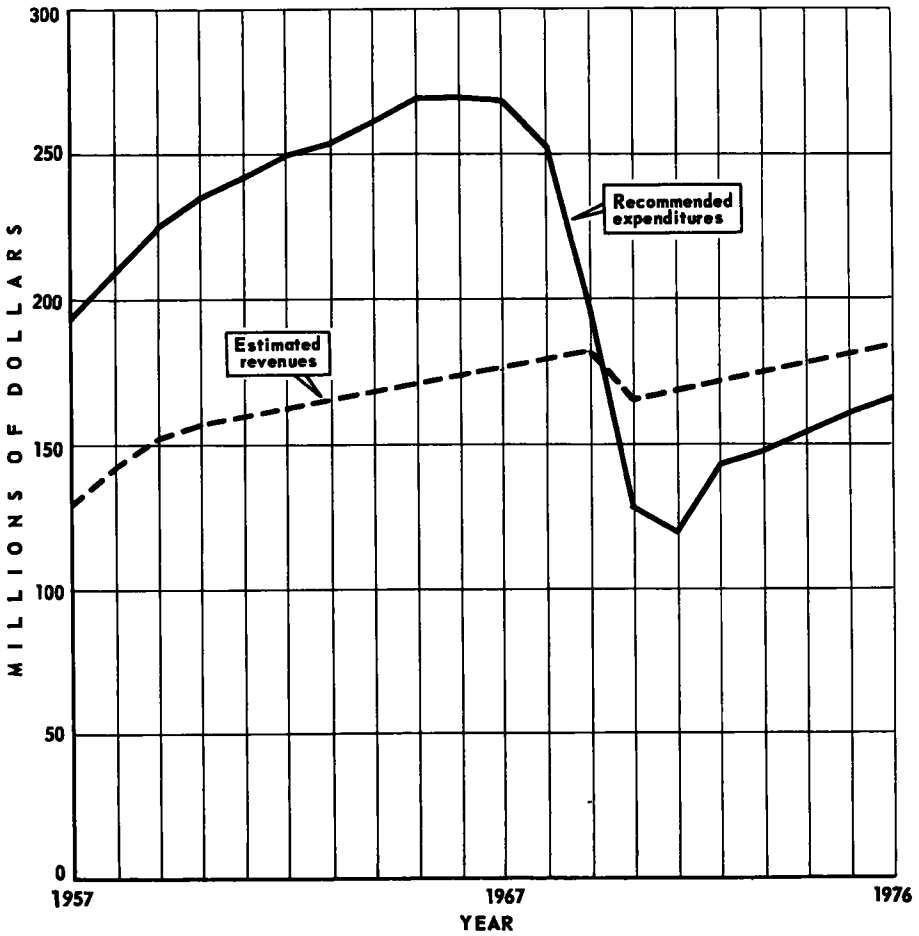

Figure 2. Recommended highway expenditures assuming a 3 percent annual increase in highway cost compared with estimated revenues (1957-1976).

Therefore, if Kentucky's roads and streets are to provide tolerable service with costs rising at the assumed rate, an increase in taxation seems inevitable.

The finance study attempted to provide a basis for equitably distributing the load among taxpayers and also to ascertain what modifications should be made in the level of expenditures. The need for revenue to finance the improvement program is directly related to the expenditure schedule. In addition to fluctuations in the value of the highway dollar the cost of stop-gap improvements, replacements, and interest all vary according to the timing of expenditures. The effect of timing of expenditures was studied by comparing several selected expenditure programs. All of these problems were analyzed under the assumption that the state would adopt the 20-yr program.

SPREADING THE BURDEN

The Kentucky study attacked directly the problem of dividing the costs of highways among the beneficiaries of roads and streets. In doing so, the authors accepted the estimated average annual expenditures for the 20-yr program, as an approximation of annual costs sufficiently accurate for statistical study.

The basic problem of dividing costs as thus approximated was conceived as involving, for purposes of the investigation, division between highway users and other taxpayers and division of user expenditure responsibility among users of various types and sizes of vehicles. The division of responsibility among non-user taxpayers, an

admittedly important matter, was excluded as being largely a problem of general taxation.

The authors referred to the added-expenditure, differential-benefits, standard-costs, relative-use, predominant-use, and earnings-credit solutions.

It was found that, historically, the state has supplied in 1953 dollars a nearly constant amount of highway revenue from general taxes. Recently, that amount has been about $17 million. The long-standing public decision on this point was accepted for purposes of the study. It was assumed that about the same amount in 1953 dollars will continue to be available as a long-range political decision; the remainder will be secured from highway user imposts. This historical approach to the assignment of responsibility between highway users and nonusers is admittedly crude as a measure of fairness, but the same is true of other available methods. This historical plan has the merit of prior public acceptance and of noninterference with established policy decisions respecting the comparatively rigid local finance patterns. Under this scheme, highway users would be required to pay about 85 percent of the total amount expended exclusive of federal aid. Some states in which one or more of the usual methods of study have recently been invoked (California, Illinois, Michigan, and Ohio) show a range of from 56 to 82 percent assignable to highway users.

Before considering the distribution of the tax load among highway users, it is necessary to examine the problem of how to treat federal aid. The usual practice in earlier studies has been to deduct federal aid from the total expenditure requirements for each road and street system before any attempt is made to allocate responsibility among users of various types and sizes of vehicles. This handling of the problem involves possible distortions in the distribution of responsibility. For example, assume that three-axle combination vehicles travel exclusively on the proposed interstate system of highways for which federal aid will provide 90 percent of the expenditure for construction. If federal aid were deducted from expenditure for the system before the assignment of responsibility, these users would be relieved of 90 percent of their tax responsibility for this construction. Suppose another group of vehicles, which otherwise would have equal expenditure responsibility per mile, travels the same number of miles on roads the construction of which the federal government does not aid. The operators of the latter vehicles would be relieved of none of their responsibility. Although common sense would dictate that the responsibility for construction expenditures should be about the same in each of the two cases, strict application of the logic of the usual procedure would assign 10 times as much to the users of the second class of vehicles as to the users of the first class.

Thus, an innovation in method is indicated. The problem was solved for the moment by making assignments on the basis of total expenditures. That is, the relationships among various road and street users were established before any deduction was made for either nonuser or federal contributions to the highway program. This is the first major step toward avoiding distortion by determining the assignment of relative responsibility in a manner independent of the method of financing.

There are two widely held views concerning the relative tax loads of users of various types and sizes of vehicles. The first is that relative financial responsibility should be based on the comparative benefits which operators of different types and sizes of vehicles receive from the use of roads and streets. The second is that such responsibility should be distributed rather on the basis of the comparative expense of providing highway service to users of different types and sizes of vehicles. The first of these two concepts has been the basis for several approaches to the task of devising a measuring stick for the quantitative assignments: relative operating costs, differential benefits, standard costs, and gross ton mileage. The second concept has led to incremental costs analysis as a means of finding the expense occasioned by each type and size of vehicle. There are two quantitative attacks on the problem which appear to involve elements of both theories: the cost function and the space-time solutions.

Of the specific solutions to the problem of distributing highway expenditure responsibility among operators of various types and sizes of vehicles according to the relative benefits from highway use the assignment on the basis of gross ton mileage is the most popular. It is the easiest to apply because of the availability of data and because of its

TABLE I

ESTIMATED 1965 EXPENDITURE RESPONSIBILITY OF KENTUCKY REGISTERED VEHICLES AND THE ESTIMATED AMOUNT OF USER TAXES UNDER 1955 TAX LAWS

Vehicle Type by Weight	Responsibility per Vehicle			User Taxes per Vehicle	
	Gross Ton-Mile Method	Incremental Method Private	Incremental Method For-Hire	Private	For-Hire
Passenger cars	$ 26	$ 40		$ 48	
Farm trucks					
Panel and pickup					
0-22,000	51	59		49	
2-axle dual tired					
0-22,000	126	58		56	
Nonfarm trucks					
Panel and pickup					
0-5,000	45	58	$ 62	66	$ 78
5,001-8,000	74	60	65	84	104
8,001-10,000	94	61	65	94	129
10,001 and over	116	63	67	105	143
2-axle dual tired					
0-5,000	78	101	.	98	110
5,001-8,000	130	105	112	121	141
8,001-10,000	166	107	114	136	171
10,001-12,000	202	125	132	150	188
12,001-14,000	240	136	143	165	207
14,001-16,000	279	148	155	178	225
16,001-18,000	319	155	162	191	245
18,001-21,000	379	170	177	254	280
21,001-24,000	444	193	200	273	319
24,001-27,000	559	223	231	296	405
3-axle single unit					
18,000 and under	125	118	123	145	199
18,001-21,000	187	158	164	235	261
21,001-24,000	270	215	223	285	331
24,001-27,000	367	274	284	335	404
27,001-30,000	478	335	347	394	478
30,001-33,000	609	419	432	452	554
33,001-36,000	742	503	518	514	636
36,001-39,000	916	596	613	591	739
39,001-42,000	1,116	690	709	694	855
3-axle semi-trailer combination					
21,000 and under	$ 149	$ 130	$ 135	$ 214	$ 240
21,001-24,000	170	135	141	226	272
24,001-27,000	192	148	154	233	302
27,001-30,000	293	209	217	297	381
30,001-33,000	411	276	286	359	461
33,001-36,000	548	378	390	430	552
36,001-39,000	693	465	479	505	653
39,001-42,000	862	571	587	604	765
42,001 and over	1,067	659	677	680	841
4-axle semi-trailer combination					
27,000 and under	265	196	204	288	357
27,001-30,000	407	312	322	377	461
30,001-33,000	617	472	486	481	583
33,001-36,000	763	570	587	564	686
36,001-39,000	961	719	739	666	814
39,001-42,000	1,187	964	987	794	955
42,001-46,000	1,362	1,045	1,068	846	1,007
46,001-50,000	1,544	1,255	1,280	902	1,063
50,001 and over	1,826	1,458	1,484	978	1,139
5-axle semi-trailer combination	1,743	1,661	1,686	978	1,139
Buses					
School	129	54		84	
Heavy intercity	1,373		1,208		1,342
Laght intercity	429		419		323
City	332		286		414

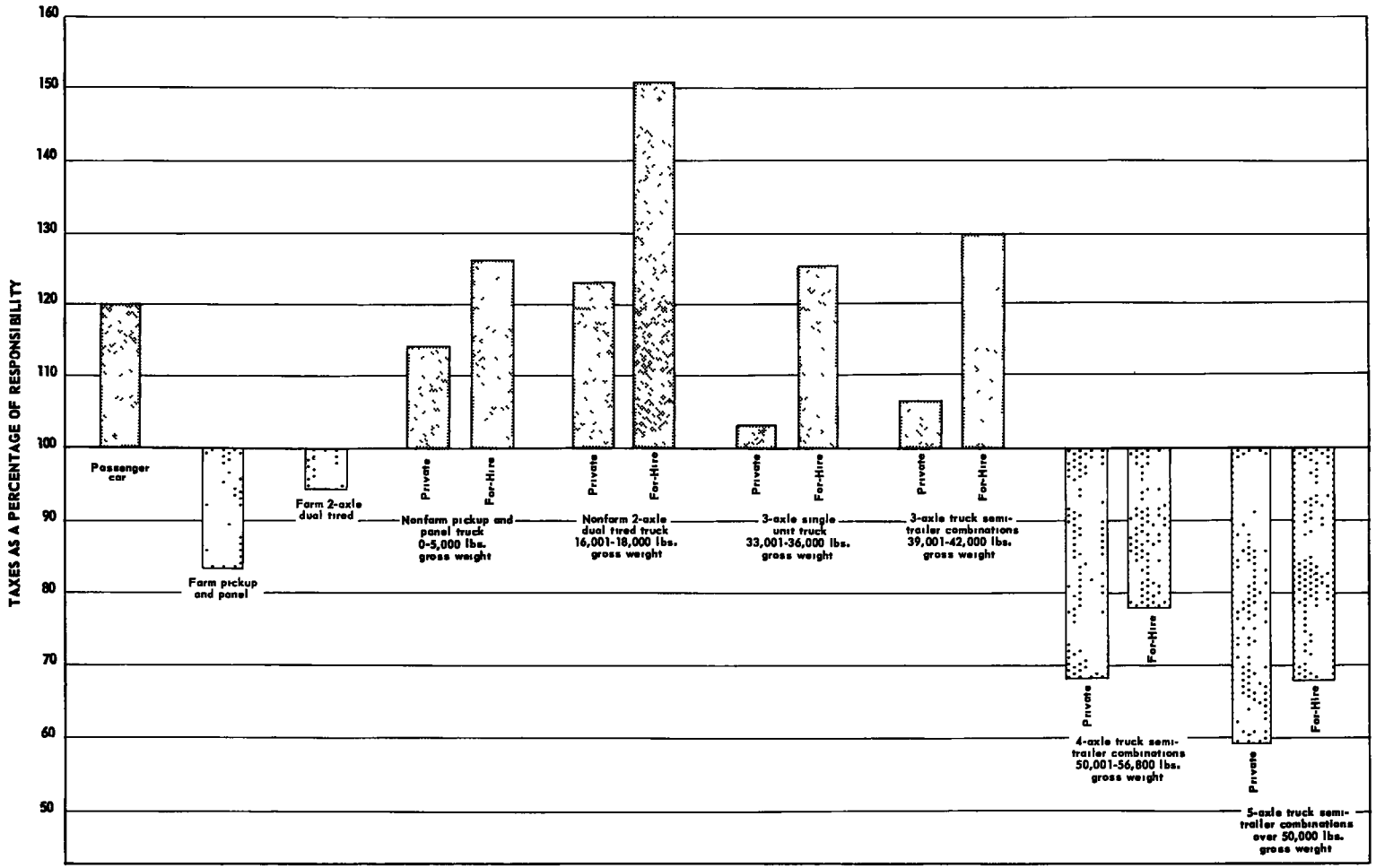

Figure 3. Estimated user taxes under 1955 tax laws compared with incremental expenditure responsibility, for selected types and weights of privately owned Kentucky registered vehicles, 1965.

arithmetical simplicity. Under this plan average annual ton miles of operation (the product of aggregate weight and mileage traveled) is the measure of relative benefit. Thus, a vehicle which with its load weighs 40,000 lb is assigned 10 times as much expenditure responsibility as another vehicle traveling the same distance which with its load weighs 4,000 lb. This method of assignment, which was employed in the Kentucky study for comparative purposes, is subject to objection on the ground that it treats as homogeneous quantities which are known to be nonhomogeneous, for example, ordinary passenger automobiles and their loads and tractor-semi-trailer combinations and theirs. The Kentucky study introduced a refinement not usual in such studies: The ton-mile computation was made system by system, as were the computations for the incremental study. This means that the data for each of the eight systems were treated separately and then aggregated. But some authorities regard this method as the only practical basis for assigning relative expenditure responsibility.

For those persons who accept the view that the proper logical basis for the assignment of expenditure responsibility among types and sizes of vehicles is the cost each class occasions in providing highway service, there is general acceptance of the incremental solution as the best available. Therefore, this attack on the assignment of financial responsibility was accepted as the basis for a distribution of responsibility consistent with the "cost-of-service" theory.

The study found 34 clearly identified design systems for rural and urban highways. They undertook to reduce the number of systems because (a) despite the availability of relatively good traffic data they did not know enough about traffic to justify so many and (b) they found the computation task for 34 systems too formidable. Aside from the interstate highways, the design standards differ only slightly for the various systems having similar traffic density, and it was found feasible to employ but eight classes of roads and streets for purposes of computation. Six groups are based on traffic volume (0-99, 100-399, 400-999, 1,000-1,999, 2,000-2,999, and 3,000 or more vehicles per day). The other two groups are composed of 2-lane interstate and 4-lane interstate highways respectively. This and some other technicalities which involve significant departures from tested methodology have been developed at greater length elsewhere (1, 2).

Highway expenditures were classified. Those attributable to vehicle travel and weight were assigned according to separate indexes of increments depending on whether they were for grading and drainage, for base and surface, or for structures. Those attributable to vehicle travel only, for example, right-of-way acquisition and traffic control, were assigned according to vehicle mileage on the system. Those attributable to neither travel nor weight, such as landscaping and certain administrative overhead, were assigned to all vehicles indiscriminately. The increments were determined separately for new construction, for resurfacing and widening, and for resurfacing alone. (3)

Vehicles were grouped according to vehicle type and vehicle gross weight. Axle loads were distributed into such groups and were combined with estimated traffic to establish the number of axle miles of each weight that the roads must carry per year. The expenditures treated incrementally were distributed among different types of vehicles and weight groups on the basis of the number of axles and the incremental cost indexes. Those expenditures not treated incrementally were assigned to the different registration classes on the basis of vehicle miles of travel or proportionately to all vehicles.

Because $160 million (the average annual expenditure requirements on highways) was the cost figure employed for the incremental solution, it was necessary to obtain the expenditure responsibility assigned to each vehicle class as a percentage of the total expenditures. After federal aid and nonuser charges were deducted from the total, the percentages were used to obtain the users' share by vehicle class. The class assignments were subdivided into responsibility of Kentucky-registered vehicles and responsibility of vehicles registered in other states ("foreign" vehicles). Dividing the share assigned to Kentucky vehicles by the estimated number of Kentucky-registered vehicles in 1965 in each group yielded the expenditure responsibility per Kentucky-registered vehicle. By dividing the domestic and the foreign group assignment by the axle miles of travel for each group, the assignment per axle mile was secured. This

measure provided a basis for comparing domestic and foreign vehicle responsibility. The innovations (a) of finding incremental relationships before eliminating nonuser charges and federal aid and then applying the proportions so established to the amount to be financed by state and local user taxes (2) and (b) of finding incremental values separately for foreign and state-registered vehicles will be apparent to students of the problem. These procedures, especially the former, seem to be among the most significant methodological refinements made in this study. The former is the second major device for keeping the increments entirely independent of the method of financing employed.

The comparative results of the gross ton-mile and the incremental solutions to the problem of distributing Kentucky highway-user expenditure responsibility are what might have been expected. For the smaller sizes of vehicles, the assigned responsibility is much higher if computed by the incremental method. For larger sizes, the contrary is true. The data shown in Table 1 assign expenditure responsibility on a per registered vehicle basis (but excluding traffic by foreign vehicles). The known biases in the Kentucky version of the incremental solution tend consistently toward a relatively higher assignment to the smaller vehicles—and, of course, a relatively lower assignment to the larger vehicles and combinations. The incremental method yields a sort of maximum responsibility for the smaller vehicles—as compared with the gross-ton mile solution and thus a minimum for larger vehicles.

The incremental solution has a sounder theoretical basis and a more widespread acceptance than does the gross ton-mile solution. Most of the results of the Kentucky expenditure responsibility assignments, therefore, can be considered in the light of the former approach. Certain observations may be based on a comparison of the tax yields under 1955 laws as estimated for 1965 with the incremental assignments estimated for the same year. The study showed that foreign vehicle operators would pay less than their relative responsibility, largely because they pay little more than fuel taxes in most cases. Domestic passenger vehicles, exclusive of buses, were shown to be overtaxed as measured by assigned responsibility. Farm trucks and the largest legally authorized 4- and 5-axle tractor semi-trailer combinations would fall considerably short of meeting their incremental responsibility.

As regards annual miles traveled by private and for-hire vehicles, the Kentucky traffic information revealed no significant differences. Thus, under the gross ton-mile method, the expenditure responsibility for private and for-hire vehicles was the same. Under the incremental solution, however, for-hire vehicles were charged with certain administrative costs such as the cost of rate and schedule making which do not apply to private vehicles. Thus, under the incremental method the expenditure responsibility of for-hire vehicles is slightly greater than of private vehicles.

Certain problem areas involved in the Kentucky division-of-costs study are so well defined that they require comment. The recent Highway Research Board studies in Maryland and especially Idaho seem to suggest that, for purposes of incremental analysis of pavement construction costs, the AASHO standard, (one single axle-load of 18,000 pounds = a tandem axle-load of 32,000 pounds) should be rewritten to read roughly: one single axle-load of 18,000 pounds = a tandem axle-load of 27,000 pounds. The Kentucky study, on the other hand treats each axle-load, whether single or in tandem arrangement, as being like each other axle-load. In tax planning, a study area attacked later, some effort has been made to correct for this crudity. Obviously, the incremental study itself suffers from the failure to build the refinement into the incremental treatment itself. The traffic data in Kentucky provide an inadequate basis for determining whether differential assignment of expenditure responsibility to for-hire vehicle operators on grounds of more or less than average mileage is justified. Perhaps a special study would be in order.

Because of differences in the character of traffic in urban areas, it is possible that city data ought to be examined as special incremental systems. This was not seriously considered in the study because of historic traffic data treatment. A subsequent study might well take account of this limitation.

TAX PLANNING

The incremental expenditure assignments adjusted to reflect axle arrangements provided the basis for tax planning. A comparison of 1965 expenditure assignments with estimated 1965 tax contributions (assuming the laws of 1955) clearly indicates, as already observed, that serious inequities would occur. The tax plans should be designed to eliminate at least the major injustices. Fiscal adequacy is another ingredient of an acceptable tax system. In the event highway prices rise by 3 percent annually, 1955 user tax rates would have to be raised an average of approximately 41 percent if the program is to be completed by 1976, and still the work could not be done on a pay-as-you-go basis according to the recommended expenditure schedule. Considerations in addition to equity and adequacy received attention in the tax planning. For example, administrative and compliance problems are quite important inasmuch as a tax theoretically equitable may be quite unjust if it is poorly administered. Another important feature is that taxes should interfere as little as possible with motor vehicle travel.

Implicit in each of the plans is the assumption that motor-fuel taxation, including the gasoline use tax applicable to heavier vehicles with interstate travel, is the major tax measure. In addition, it was assumed that the several miscellaneous user taxes and fees such as local parking meter receipts and drivers' and chauffeurs' licenses will be continued. Available evidence suggests that a diesel fuel tax rate differential of approximately 50 percent is necessary to eliminate discriminations among users. The added responsibility of for-hire carriers would be recouped by requiring a utility certificate. Certificate rates would be slightly graduated by type and size of vehicle.

Three tax plans using various combinations of the three major types of highway-user taxes (motor-fuel, registration, and third-structure) were developed. The first plan employed the fuel and a registration tax with an apportionment feature for large vehicles. The fuel tax, if the rate (nearest whole cent per gallon) exceeded the current rate of $0.07 per gallon, would result in contributions in excess of incremental expenditure responsibility for vehicles of the lower weight groups. Therefore, the current rate was used. Under this plan the bulk of the difference between responsibility and fuel taxes at their present level would come from the basic registration tax. Registration tax rates would range from $3.50 for passenger cars to around $1,500 for the heaviest trucks and buses. However, the tax on all nonfarm trucks and buses having a gross weight in excess of 18,000 lb with interstate travel would be determined by that fraction of the basic rate which their travel in Kentucky is of their total travel in all states. This apportionment privilege would also be available to operators of two or more nonfarm trucks or buses with gross weight 18,000 lb or less. Special licensing provisions for fleets would facilitate the most economical use of such vehicles. An alternative per trip tax of $10 per trip would be available to users making only occasional trips. Thus, all vehicles with gross weights in excess of 18,000 lb would be required to present evidence of paying either the registration or per trip fee. Compliance with the apportioned registration tax may necessitate the payment of a tentative tax liability at the beginning of the year based on estimated travel and a final settlement at the end of the year based on actual travel.

Another plan employs the motor-fuel tax, a registration tax for light-weight vehicles, and a nominal registration tax plus a weight-distance type tax for heavy vehicles, supplemented by the miscellaneous state and local taxes and fees. Under this plan, the fuel tax would be identical with that of the first plan; so would the registration tax for light-weight vehicles. Operators of the heavy domestic types of trucks and buses would pay a registration tax for identification purposes, which would defray a nominal proportion of their expenditure assignment. The weight-distance tax would absorb the difference between their expenditure responsibility and their motor-fuel and other tax contributions. The weight-distance tax would apply to both foreign and domestic vehicles. Tax rates would range from $0.01 to $0.28 per 100 axle miles for trucks. The heaviest intercity buses would pay a nominal registration tax and a weight-distance tax computed at $0.43 per 100 axle miles.

The third plan differs from the other two in that the motor-fuel and miscellaneous taxes are supplemented by a $0.01 per gallon motor-fuel surtax, a registration tax, and a weight-distance tax on vehicles of the heaviest classes. The fuel surtax would apply to foreign and domestic vehicles and combinations having three or more axles and gross weights in excess of 18,000 lb. The surtax would be administered in conjunction with the present fuel use tax.

Under the third plan, the basic registration tax rates would range from $3.50 for passenger cars to $90 for the heaviest 3-axle single unit trucks, none of which would be subject to the weight-distance tax, and to $75 for the heaviest 4- and 5-axle tractor semi-trailer combinations which would be subject to the weight-distance tax. The weight-distance tax rates range from $0.02 per 100 axle miles for a 4-axle tractor semi-trailer combination with a gross weight of 30,001 to 33,000 lb to $0.22 per 100 axle miles for a 5-axle tractor semi-trailer combination of more than 50,000 lb gross weight.

Revenuewise, the motor-fuel tax would account for about 83 percent of the total under each of the three plans, registration and weight-distance taxes roughly 12 percent, and miscellaneous taxes and fees about 5 percent.

The study underscores the need for policing motor vehicle size and weight limit laws. Inasmuch as excessive axle weights damage pavements, the proposed penalty provisions call for the use of a penalty schedule with the penalty directly related to the weight and arrangement of axles. The study illustrated this point by presenting a schedule roughly correlated with relationships between single and tandem axles found in recent engineering tests. That is, for each 2,000-lb increase in excess weight of a single axle the penalty approximately doubles. Tandem axles are treated as being approximately equal to a single axle with a gross weight of $\frac{2}{3}$ as much. For most effective size and weight law administration, local conditions suggest that the state rely on administrative-type penalties, supplemented by criminal provisions.

Because the incremental assignments were based on traffic and expenditure projections, the research emphasizes the need for re-evaluating the tax plans should traffic patterns or expenditure requirements change significantly. An adjustment in the level of federal aid or nonuser contributions would merit an adjustment in the level of taxation but the relationship among users may not be directly affected and therefore may need little or no adjustment.

CREDIT FINANCING

In addition to formulating tax plans, the study reflects an attempt to determine the probable effects of several alternative expenditure programs involving the use of various amounts of credit financing. If highway prices remain constant, revenues, though adequate in total, would not be sufficient to follow the recommended pattern of expenditures which contemplates the completion of almost two-thirds of the program in the first 10 years. If, however, highway prices rise as anticipated, both a tax increase and the use of credit may be desirable. Of more immediate concern was a proposal, submitted to the voters of Kentucky, which would allow the state to borrow $100 million to be used to match federal aid. This proposal was approved by an overwhelming margin in November 1956.

Under the assumption that highway costs remain constant, four different expenditure programs were examined and compared with a program involving no credit financing. In two programs the amount of bonds was limited to $100 million. The third program involved the use of $675 million of bonds, the amount necessary to follow the schedule recommended by the ASF. In the fourth program, expenditures are made for maximum acceleration limited only by the estimated capacity of the state and local governments and the highway construction industry. This program would reach the peak in the fifth year when expenditures almost 2.5 times as large as recent annual expenditures would be made. The issuance of $790 million of bonds would be required for this program.

All bonds are assumed to be retired serially from road fund revenues according to various schedules of repayment. The bonds would be state instruments backed by the full faith and credit of the Commonwealth and would be callable after 10 years from the date of issuance. The average interest rate was estimated to be $2\frac{3}{8}$ percent for 10- to 20-yr repayment.

The interest cost of each of the programs was compared with the estimated savings that would result from acceleration through the use of credit. This, of course, could not be done in precise fashion because of the inability to measure nonmonetary savings and because some of the monetary savings are extremely difficult to estimate. However, it appears that any of the four programs could be justified, because savings to the state and local governments and to motorists would undoubtedly more than offset the interest cost in each case. Some of the most important savings of accelerating the improvement program are (a) stop-gap work could be reduced; (b) motorists would benefit from lower vehicle operating costs, reduced accident rates and time savings much earlier; (c) assuming that motorists would make greater use of modern facilities, additional tax revenue for the state would be generated by speeding up the program.

If the more realistic assumption that highway cost will increase by an average of 3 percent a year is substituted for the assumption that these costs will remain constant, another type of saving becomes apparent. If work can be done early in the program, it can doubtless be done at a considerably lower cost than if it is done later.

If highway costs do rise by an average of 3 percent annually, present laws plus federal aid would produce only 70 percent of the revenue that would be needed to complete the improvement program in 20 years. About $1,250 million of bonds would be required to complete the remaining 30 percent of the program, and these bonds would be outstanding at the end of the 20-yr period. It would not be feasible to issue and repay such a large amount of bonds nor to pay interest on them amounting to about $30 million a year. Thus, the highway finance situation in Kentucky clearly indicates that, if road and street inadequacies are to be eradicated during the next 20 years, an increase in user taxation is necessary.

REFERENCES

1. "Initial Problems Confronted in the Kentucky Incremental-Cost Study," HRB Bulletin 121, p. 8.

2. Christian, V. L., "Methodology of the Kentucky Incremental Analysis," HRB Proc., Vol. 35, pp. 29-32, (1956).

3. Federal Coordination of Transportation, "Public Aids to Motor Transportation," Washington: Government Printing Office, 1940.