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Some Allocational Problems in Highway Finance

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The manner in which highways are financed has long been of great interest to transportation economists because of its important bearing upon the broader problem of achieving an economical allocation of resources among competing agencies of transportation. There are, however, additional reasons for giving further consideration to this topic at the present time.

First, in recent years revenues and expenditures for highway purposes have grown at a rapid rate and have reached impressive totals. Receipts, excluding transfers and the proceeds of bond sales, totalled $11,899 million in 1963, which was nearly three times the figure for 1950 and not far from five times that for 1940.[1] Second, the growth of highway expenditures has been accompanied by a strong trend toward increased reliance upon user charges as sources of revenue. The ratio of user contributions to the total of user and nonuser contributions for highways, excluding bond issue proceeds, increased from 44 per cent in 1940 to 59.8 per cent in 1950 and 79.9 per cent in 1963.[2] Third, and most important, the increased reliance upon user charges has been accompanied by a trend toward extending user-charge support to an increased mileage of highways, and consequently toward devoting a disproportionate share of user revenue to roads and streets having very low traffic volumes. Hence, increased reliance upon highway user charges has been paralleled by a progressive departure from the matching of payments by, and benefits to, particular users or classes of users, which is the underlying rationale of these levies.

[1] Data for 1940 and 1950 from *Final Report of the Highway Cost Allocation Study*, House Doc. No. 54, 87th Congress, 1st Session, Washington, D.C., 1961, Table III-I. Data for 1963 from U.S. Dept. of Commerce, Bureau of Public Roads, Release, January 30, 1964, Table HF-1.

[2] *Ibid.*

Finally, the *Highway Cost Allocation Study* conducted by the U.S. Bureau of Public Roads in accordance with the terms of the Highway Revenue Act of 1956 has made available data which permit the determination, state by state, of the extent of the aforementioned departure from the benefit principle and which provide a basis for the adoption of corrective policies.[3]

The achievement of an economical allocation of highway resources is not a single problem but a complex of at least five interrelated problems. These involve the appropriate division of financial responsibility (1) between highway users as a group and nonusers; (2) among operators of different types of motor vehicles; (3) among users of different segments of the road systems of individual states; (4) among the users of highway systems of different states, a problem growing out of the collection and allocation of Federal highway user charges; and (5) between present and future highway users, a problem which arises when long-lived highway improvements are financed by means of current or accumulated user levies. This paper will be confined to the third and fourth of the foregoing problems, except to the extent that these also involve the question of the division of highway costs between users as a class and nonusers.

The problem of allocating resources among different segments of the road system of a state arises from a combination of circumstances. First, as shown in Table 1, roads and streets differ widely in construction and maintenance costs and in traffic volumes, with a resulting wide diversity in cost per vehicle mile. Moreover, with few exceptions, vehicle-mile cost varies inversely with traffic volume. The exceptions occur in connection with both very high cost and very low cost facilities. It should be noted that the figures in Table 1 are annual costs which reflect the spreading of capital costs over the estimated life of the facilities and not the annual expenditures incurred in a pay-as-you-go program.

Second, it would be administratively impracticable to take account of differences in vehicle-mile costs by maintaining separate schedules of user charges for different segments of a state's road system, although it is feasible to supplement state registration fees with special city motor vehicle licenses. The alternative—a universal toll road system with toll gates at every intersection—would not be seriously considered.[4]

[3] *Final Report of the Highway Cost Allocation Study*, Note 1.

[4] It may eventually be possible, as Professor Vickrey contends, that use of various electronic devices installed along the roadside and in vehicles will permit the direct pricing of highway services without the necessity of a universal system of toll gates.

Finally, to a large extent the users of different segments of the road system are different individuals.

The foregoing combination of circumstances constitutes a substantial limitation upon user charges as a method of highway finance. Because of differences in vehicle-mile costs, a level of user charges which would provide adequate intercity highways would not be adequate to finance local rural roads and many city streets. The latter would therefore necessarily have to be financed in large part from nonuser sources. It may be argued that this departure from user-charge financing would contribute to an over-all misallocation of resources as between highway and rail transportation, but two considerations reduce the force of this objection. First, most of the traffic carried by the roads in question is local in character and is not competitive with rail transportation. Second, if the share of the cost not covered by user charges is financed by special assessments on abutting property owners the effect of these levies is similar to that of a user charge, since the persons concerned will in almost all cases be road users. The assessments are analogous to the special contributions to defray the cost of line extensions which electric and telephone utilities sometimes require as a condition of serving isolated customers.

It is possible, of course, to finance light-traffic roads and streets to any desired extent by means of user charges, given a sufficiently high level of charges and an allocation of the proceeds which disregards the relative use made of different segments of the road and street system (as measured by vehicle miles or on some other basis). This is the situation which actually prevails in varying degrees at the present time. However, since this policy involves the allocation of user-charge revenue to the various segments of the road and street system without regard to the relative traffic volumes thereon, the connection between payments made and benefits received by particular users and groups of users is broken and the benefit principle is violated. When this occurs the light-traffic segments of the road and street system will be overdeveloped, and the heavy-traffic segments correspondingly underdeveloped, in relation to traffic requirements; there will be a significant

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It would also be possible to convert much of the interstate system, by reason of its limited access feature, to toll roads, thereby extending the scope of direct pricing of highway services. Whether, on balance, such a step would be advantageous is a question which it is not feasible to consider here. It may be noted, however, that although a strong case can be made for the use of tolls to reduce congestion on, and secure efficient utilization of, certain urban facilities, their use under these circumstances is often impractical because of the need to maintain numerous access points to the facilities concerned.

TABLE 1

COMPARISON OF ANNUAL TOTAL COSTS PER MILE AND PER VEHICLE MILE
FOR ALL ROAD AND STREET SYSTEMS IN THE UNITED STATES[a]

Highway System and Surface Type	Rural			Urban		
	Cost Per Mile[b] (dollars)	Cost Per Vehicle Mile (mills)	Vehicles Per Day Per Mile	Cost Per Mile (dollars)	Cost Per Vehicle Mile (mills)	Vehicles Per Day Per Mile
Interstate: high type	19,165	4.1493	12,655	73,798	3.7022	54,612
Other federal-aid primary:						
High type	10,012	7.0635	3,883	32,679	4.9714	18,010
Intermediate type	6,835	37.7804	496	6,667	22.2222	822
Low type	1,250	18.1818	188	--	--	--
Subtotal	9,634	7.5638	3,490	32,633	4.9727	17,979
Federal-aid secondary, state:						
High type	7,771	10.4862	2,030	17,445	4.6468	10,285
Intermediate type	2,288	18.5302	338	8,523	52.2059	447
Low type	2,664	77.2392	95	--	--	--
Unsurfaced type	461	24.1379	52	--	--	--
Subtotal	4,444	12.5376	971	16,147	4.9910	8,864
Federal-aid secondary, local:						
High type	3,861	8.1335	1,301	10,884	4.3337	6,880
Intermediate type	2,206	37.4289	162	5,910	63.1250	256
Low type	1,523	86.9296	48	2,151	25.0000	236
Unsurfaced type	--	--	40	--	--	--
Subtotal	2,401	16.2039	406	9,568	5.0473	5,193
All federal-aid systems	5,446	8.3239	1,792	30,140	4.5164	18,284
Other state highways:						
High type	9,601	16.6846	1,577	19,692	4.6262	11,662
Intermediate type	2,539	26.7629	260	5,702	22.1622	705
Low type	2,441	67.2222	100	--	--	--
Unsurfaced	--	--	--	--	--	--

(continued)

TABLE 1 (concluded)

Highway System and Surface Type	Rural			Urban		
	Cost Per Mile[b] (dollars)	Cost Per Vehicle Mile (mills)	Vehicles Per Day Per Mile	Cost Per Mile (dollars)	Cost Per Vehicle Mile (mills)	Vehicles Per Day Per Mile
Subtotal	5,464	18.7120	800	16,031	4.9856	8,810
Other local roads and streets:						
High type	4,941	13.8040	981	8,242	7.0109	3,221
Intermediate type	1,837	31.1759	161	3,853	55.2233	191
Low type	877	49.9616	48	2,434	121.1178	55
Unsurfaced type	203	21.9507	25	656	64.8649	28
Subtotal	1,134	25.6732	121	5,614	9.9717	1,543
All nonfederal-aid systems	1,275	24.4070	143	5,764	9.5876	1,647
Grand total	2,384	11.2296	582	7,746	7.0745	3,000

Source: *Final Report of the Highway Cost Allocation Study*, House Doc. No. 54, 87th Congress, 1st Session, Washington, D.C., 1961, adapted from Table III-G-1.

[a]Does not include Alaska and Hawaii; includes District of Columbia. Does not include toll-facility mileage or the 2,012-mile expansion of the Interstate System.

[b]Estimated annual cost of investment in right-of-way and construction and estimated maintenance and construction costs. Costs at last half of 1956 price level and 0 per cent interest rate.

misallocation of resources both as between different parts of the highway transportation system and between highway and other forms of transportation.

A policy of allocating user revenues to the different segments of the highway system in accordance with the relative traffic volumes thereon would avoid the latter result and would also permit handling a larger volume of traffic with a given level of highway investment than is the case under present arrangements. This is a very important consideration in view of the magnitude of current highway expenditures and the rapid growth in demand for highway facilities.[5] Existing policies, by allocating a disproportionate share of user revenue to light-traffic roads and streets, contributed significantly to the deficiencies which have increasingly characterized main intercity highways and urban arteries since World War II. It has been pointed out that the modern toll road movement which was inaugurated largely to alleviate these deficiencies, has in turn helped to perpetuate existing revenue allocation policies.[6]

The justification of the proposed policy for the allocation of user-charge revenue in terms of its contribution to the achievement of an economical allocation of resources, and hence to the maximizing of economic welfare, is subject to two qualifications. First, the policy rests on the premise that user-charge financing should approximate as closely as possible the results which would be attained if highway services could be priced directly through the market mechanism, i.e., if the universal application of the toll principle were practicable. However, the attainment of an ideal allocation of resources within the framework of the market mechanism is ideal only to the extent that private and collective values coincide and this is not always the case. For example, national defense considerations might dictate an allocation of highway user revenue somewhat different from that based on individual user choices as reflected in relative traffic volume. It is the intent of this study neither to ignore such considerations nor to pass judgment on the extent to which they should be reflected in highway financing decisions, but merely to provide a basis for weighing the

[5] This statement does not imply that the objective should be *merely* to maximize ton-miles or vehicles miles per dollar of investment. It is equally important, for example, that highways handle only that volume and type of traffic which they can handle more advantageously than other means of transportation, and the policy regarding user-charge allocation recommended here would contribute to the attainment of this objective.

[6] See Wilfred Owen, *Toll Roads and the Problem of Highway Modernization*, Washington, D.C., 1951, Chapter 6; and D. Netzer, "Toll Roads and the Crisis in Highway Finance," *National Tax Journal*, June 1952, p. 110.

costs incurred in giving effect to such considerations against the resulting benefits.

Second, the proposal is subject to the limitations inherent in any partial application of the principles of welfare theory. In technical terms, the attainment of a Paretian optimum requires the simultaneous fulfillment of all the optimum conditions; if there exists some constraint which prevents the attainment of one of the Paretian conditions, a "second-best" optimum can be attained only by departing from all the other optimum conditions.[7] As applied in the case at hand, this means that policies designed to attain optimum allocation of a given total level of highway expenditure among different segments of the road and street system will contribute to maximizing welfare only if the total level of expenditures is also optimum. The analysis in this study therefore assumes that the total level of highway expenditures is, in some sense, optimum. Furthermore, it rests on the premise that, subject to the qualification noted in the preceding paragraph, adherence to the benefit principle of taxation will result in an optimum allocation of a given total expenditure among different parts of the road and street system. Subject to the stated qualifications, the preceding analysis suggests that there would be important advantages in adopting the policy of allocating user revenues among the various segments of the road and street system in accordance with the relative traffic volumes thereon.

The problem of allocating resources among the various segments of the highway system cannot be completely isolated from that of allocating highway costs between users as a whole and nonusers. This is true even under the so-called public utility approach to highway finance, which treats highway costs as almost entirely the responsibility of users. The reason is to be found in the fact that, as previously mentioned, it is necessary for administrative reasons to have a uniform schedule of user charges throughout a given jurisdiction, whereas there is a wide range in the vehicle-mile costs on different segments of the road system to which the user charges apply. The choice of the level of vehicle-mile costs to which user charges are to be equated will not only determine the proportion of the total highway system costs which will be borne by users as a whole, but also whether or not user-charge earnings on one segment of the highway system are to subsidize other parts of the system. The latter result can be avoided only if the

[7] For further discussion of this point see R. G. Lipsey and R. K. Lancaster, "The General Theory of the Second Best," *Review of Economic Studies*, 1956–57, No. 1, p. 11.

user charges are established at a level which will support the segment of the highway system which has the lowest vehicle-mile cost.

There are two closely related procedures for allocating total highway system costs between users as a whole and nonusers which avoid internal subsidization and the resulting violation of the benefit principle and misallocation of resources among different segments of the road system. One is the so-called standard road method, which is most often associated with Professor H. D. Simpson's Ohio highway study of 1951.[8] Under this method the allocation of user charges to each segment of the road and street system would be proportional to the number of ton-miles or vehicle-miles on it at a rate per ton-mile or per vehicle mile sufficient to support the state primary system. The additional revenue necessary to support the roads and streets below the primary level would be derived from nonuser sources. This method calls for a level of user charges which would provide 100 per cent support of that part of the road system having the heaviest traffic volume and lowest ton-mile or vehicle-mile cost.

The other procedure is known as the earnings-credit method and consists of threee steps.[9] The first step involves the same procedure as in the standard road method, i.e., the cost per vehicle mile on the primary system is taken as determining the user share and is applied to the entire road and street system. The nonuser share on roads and streets below the primary level is obtained by subtracting the amounts allocated on this basis from the total costs. The second step is to find the cost per mile of tertiary or access roads and streets having a minimum traffic volume. This is taken as determining the nonuser share and is applied to the entire road and street system. The user share is determined by subtracting the amount allocated on this basis to roads and streets above the tertiary level from the total cost thereof, and reducing the difference to a vehicle-mile basis. The third step is to take the mean of user cost per vehicle mile as determined in the first two steps and apply this vehicle-mile cost to the entire road and street system. The nonuser share is computed by subtracting the user share thus determined from the total cost of each road and street system. Whereas the first step results in assigning 100 per cent of the cost of the primary system to users and the second step 100 per cent of the cost of the tertiary system to nonusers, this last step results in dividing the cost responsibility of each road and street system between users and nonusers, though of course in widely differing proportions.

[8] H. D. Simpson, *Highway Finance, A Study Prepared for the Ohio Program Commission*, Columbus, Ohio, 1951.

[9] *Final Report of the Highway Cost Allocation Study*, Section III-G.

The earnings-credit method, like the standard road method, recognizes that the user-charge allocations to secondary and tertiary road systems should not exceed the rate per vehicle mile which can be used efficiently on the primary system. Unlike the latter method, however, it recognizes some degree of nonuser responsibility on the primary system as well as on the other systems. The fact that both the standard road and earnings-credit methods provide a reasonable basis for dividing highway costs between users as a whole and nonusers without interfering with an economical allocation of resources between different segments of the highway system is, in the writer's view, an important and somewhat neglected argument in their favor.[10]

If user-charge revenue is to be allocated to the various segments of the highway system in proportion to the relative traffic volumes thereon, it is necessary to have a measure of traffic volume which will accurately reflect the use made of highways by operators of various types of motor vehicles. Ton-miles would serve this purpose, since this measure reflects both the volume of traffic and its composition by vehicle type. However, ton-mileage figures broken down by class of road on a nationwide basis are not available, and it would be administratively very difficult and expensive to compile these data and to keep them up to date on a comprehensive basis. Fuel consumption appears to be the best available alternative, since it likewise reflects both the volume of traffic and its composition by vehicle type. However, it is not an accurate measure of ton-mileage, since fuel consumption for heavy trucks is more per vehicle mile but less per ton-mile than for automobiles; although a reasonably satisfactory measure of the benefit received by users as a whole from each segment of the road and street system, fuel consumption is not a satisfactory measure of the benefit received therefrom by operators of individual classes of vehicles.

Data showing aggregate fuel consumption by class of road are not available, but, this information can be derived from two other sets of data, namely, fuel consumption (both gasoline and diesel) by vehicle

[10] Mr. Zettel suggests another procedure, whereby the user share would be determined by applying the average cost per vehicle mile for the entire road and street system to each segment of the system. The nonuser share would be determined by subtracting the amount allocated on this basis to each segment of the road system from the total cost of each segment. Zettel holds that this procedure gives the minimum amount which is properly allocable to nonusers. He recognizes that it involves some internal subsidization in the case of roads having vehicle-mile costs above the average for the entire system but says that if this "subsidy" is not considered large, "it might be accepted on the ground that it helps provide an integrated plant and that feeder roads potentially contribute to traffic and earnings of the other roads." R. M. Zettel, "Some Problems of Highway Cost Assignment, With Special Reference to the Truckers' Share," *Proceedings of the National Tax Association*, 1953, p. 96.

type, and vehicle miles by type of vehicle for each class of road. These data have been compiled in connection with the *Highway Cost Allocation Study*, although some breakdowns of vehicle-mile data are not presently available in published form.[11] The vehicle-mile data are for 1957, with projections to 1964. They were derived by a scientific sampling procedure involving traffic volume counts at 365,000 stations plus nearly 29,000 classification counts for the purpose of differentiating traffic volume according to its vehicle-type components. Vehicle-mile data were collected for fifteen vehicle types on each of twelve classes of roads.[12]

On the basis of fuel-consumption data derived from the foregoing sources it is possible to compare the estimated percentage of total traffic carried by various segments of the road and street system with the percentage allocation of user-charge revenue. Such a comparison provides a rough measure of the degree to which existing policies have resulted in a departure from the benefit principle and in a misallocation of resources among different segments of the road and street system. Table 2 shows that for the United States as a whole in 1960 the allocation of state user-charge revenue to state highways was only slightly in excess of the amount justified by traffic volume, as measured by fuel consumption; whereas, on the same basis, the amount allocated to county and local roads was approximately 50 per cent greater than was justified, and the amount allocated to city streets less than half the amount justified. On the basis of relative traffic volume, approximately $135.6 million less should have been spent on state highways in 1960, $331.4 million less on country and local roads, and $467 million more on city streets. Table 3 indicates that for the East North Central Region there was a slight underallocation of user-charge revenue to state highways but, in comparison with the national situation, a heavier overallocation to county and local roads and a smaller underallocation to city streets. For the State of Illinois, as shown in Table 4, there was a substantial underallocation to state highways, a very heavy overallocation to county and local roads, and only a slight underallocation to city streets.[13]

[11] For making available unpublished data and generously assisting in other ways, the writer is indebted to Messrs. Robley Winfrey, C. A. Steele, Stanley Bielak, W. R. McCallum, and G. P. St. Clair of the U.S. Bureau of Public Roads.

[12] *Final Report of the Highway Cost Allocation Study*, p. 177.

[13] Fuel consumption data by road system for individual states can be computed only for 1957, since vehicle miles by states are available only for that year. Vehicle-miles data for 1957 were projected to 1964 only for census regions and the United States as a whole.

TABLE 2

ALLOCATION OF REVENUE FROM STATE MOTOR FUEL TAXES AND STATE MOTOR VEHICLE REGISTRATION AND RELATED FEES TO ROAD AND STREET SYSTEMS IN THE UNITED STATES, 1960, COMPARED WITH ESTIMATED FUEL CONSUMPTION ON ROAD AND STREET SYSTEMS, 1964[a]
(dollars in thousands)

	Total	State Highways[b]	County and Local Roads	City Streets
Disposition of state motor fuel tax revenue[c]	3,176,013	2,226,546	654,441	295,026
Percentage distribution	100.0	70.1	20.6	9.3
Disposition of revenue from state motor vehicle registration and related fees[c]	1,315,381	922,789	296,790	95,802
Percentage distribution	100.0	70.1	22.6	7.3
Disposition of combined revenue from motor fuel taxes and motor vehicle registration and related fees	4,491,394	3,149,335	951,231	390,828
Percentage distribution	100.0	70.1	21.2	8.7
Estimated percentage distribution of fuel consumption, 1964	100.0	67.1	13.8	19.1

Source: U.S. Department of Commerce, Bureau of Public Roads, *Highway Statistics, 1960*, Tables G-3 and MV-3 and unpublished Bureau of Public Roads data.

[a] Forty-eight states and District of Columbia.

[b] Includes funds allotted for city streets forming urban extensions of state highway systems.

[c] Net funds available for distribution, less expenditures for state highway police and safety and nonhighway purposes.

As might be expected, a materially different picture emerges when fuel consumption is compared with the allocation of total highway revenue from all sources, including not only state user charges but also federal aid and other sources of revenue. This comparison is presented in Table 5. State primary rural roads show a substantial overallocation of revenue in relation to fuel consumption. State secondary rural roads and other state rural roads show a very large underallocation in relation to fuel consumption, whereas county and township roads show a slight overallocation. On the other hand, if state secondary rural roads and other state rural roads are classed with county and township roads, on the ground that the type of service rendered on much of the mileage of these systems is more nearly like that on local than on primary roads, there is a slight underallocation in relation to fuel consumption. The showing with respect to urban facilities is especially significant. Expenditures on municipal extensions of state highway systems conform closely to the amount indicated as desirable

TABLE 3

ALLOCATION OF REVENUE FROM STATE MOTOR FUEL TAXES AND STATE MOTOR VEHICLE REGISTRATION AND RELATED FEES TO ROAD AND STREET SYSTEMS IN THE EAST NORTH CENTRAL REGION, 1960, COMPARED WITH ESTIMATED FUEL CONSUMPTION ON ROAD AND STREET SYSTEMS, 1964
(dollars in thousands)

	Total	State Highways[a]	County and Local Roads	City Streets
Disposition of state motor fuel tax revenue[b]	667,984	358,271	176,109	133,604
Percentage distribution	100.0	53.6	26.4	20.0
Disposition of revenue from state motor vehicle registration and related fees[b]	296,135	146,482	102,929	46,724
Percentage distribution	100.0	49.5	34.7	15.8
Disposition of combined revenue from motor fuel taxes and motor vehicle registration and related fees	964,119	504,753	279,038	180,328
Percentage distribution	100.0	52.4	28.9	18.7
Estimated percentage distribution of fuel consumption, 1964	100.0	57.4	14.3	28.3

Source: U.S. Department of Commerce, Bureau of Public Roads, *Highway Statistics, 1960*, Tables G-3 and MV-3 and unpublished Bureau of Public Roads data.

[a] Includes funds allotted for city streets forming urban extensions of state highway systems.

[b] Net funds available for distribution less expenditures for state highway police and safety, park and forest roads, and nonhighway purposes.

on the basis of fuel consumption, whereas other city streets show a particularly serious underallocation on this basis.[14]

It must be emphasized that because of limitations of the available data the foregoing analysis indicates only the general order of magnitude of the discrepancy between the actual and an optimum allocation of user-charge revenue among road and street systems. There is need for a more detailed breakdown of data by road systems. For example, in the analysis of state user charges in Tables 2, 3, and 4 it was necessary

[14] A recent study by Dr. Philip H. Burch, Jr., which appeared after the first draft of the present paper had been completed, finds that, in contrast with the showing in Table 5, there is a smaller overallocation of total highway revenue to state rural roads, a larger underallocation to state and local urban arteries, and a heavy overallocation to local rural roads. It should be noted that, except for four states, Burch defines local rural roads to include state secondary roads. He finds that the allocation of total highway revenue for 1957–59 was 52.7 per cent to state rural roads, 22.6 per cent to local rural roads, and 24.7 per cent to state and local urban arteries; the proper allocations would have been 44.3 per cent, 11.0 per cent, and 44.7 per cent, respectively. Burch's allocations were derived, with various adjustments, from the relative rural and urban populations. He rejected the available

TABLE 4

ALLOCATION OF REVENUE FROM STATE MOTOR FUEL TAXES AND STATE MOTOR VEHICLE REGISTRATION AND RELATED FEES TO ROAD AND STREET SYSTEMS IN ILLINOIS, 1960, COMPARED WITH ESTIMATED FUEL CONSUMPTION ON ROAD AND STREET SYSTEMS, 1957
(dollars in thousands)

	Total	State Highways[a]	County and Local Roads	City Streets
Disposition of state motor fuel tax revenue[b]	143,632	38,012	45,606	60,014
Percentage distribution	100.0	26.4	31.8	41.8
Disposition of revenue from state motor vehicle registration and related fees[b]	75,925	55,088	11,867	8,970
Percentage distribution	100.0	72.5	15.7	11.8
Disposition of combined revenue from motor fuel taxes and motor vehicle registration and related fees	219,557	93,100	57,473	68,984
Percentage distribution	100.0	42.4	26.2	31.4
Estimated percentage distribution of fuel consumption, 1957	100.0	54.8	11.4	33.8

Source: U.S. Department of Commerce, Bureau of Public Roads, *Highway Statistics, 1960*, Tables G-3 and MV-3 and unpublished Bureau of Public Roads data.

[a]Includes funds allotted for city streets forming urban extensions of state highway systems.

[b]Net funds available for distribution less expenditures for state highway police and safety, park and forest roads, and nonhighway purposes.

to confine comparisons to three very broad divisions of the highway system, thus neglecting a number of significant differences in vehicle-mile costs within these divisions. Thus, it was not possible to take account of the differences in vehicle-mile costs between the federal-aid primary and secondary systems, to the extent that both are under state control, or between the rural and urban portions of either of these systems. Second, and of the greatest importance, the classification of roads as primary, secondary and local does not correspond in any close and consistent manner with a classification based upon the

vehicle-mile data as a basis for determining the proper allocations on the ground that some of the state traffic surveys from which the vehicle-mile data were derived were unreliable and produced inconsistent results. While this may be true in individual instances the writer nevertheless is of the opinion that, on a national basis at least, the vehicle-mile figures and the fuel-consumption figures derived therefrom are likely to give a closer approximation to the actual relative traffic volumes by road systems than the method used by Dr. Burch. See Philip H. Burch, Jr., *Highway Revenue and Expenditure Policy in the United States*, New Brunswick, N.J., 1962, pp. 174–175.

TABLE 5

ALLOCATION OF TOTAL HIGHWAY REVENUE TO ROAD AND STREET SYSTEMS IN THE UNITED STATES, 1960, COMPARED WITH ESTIMATED FUEL CONSUMPTION ON ROAD SYSTEMS, 1964[a]
(dollars in thousands)

Road System	U.S. Bureau of Public Roads Highway Classification Number[b]	Total Expenditure[c]	Percentage Distribution of Expenditure	Estimated Percentage Distribution of Fuel Consumption
State primary highways--rural	1, 3	3,534,344	51.9	35.9
State secondary roads--rural	5	418,083	6.1	9.3
Other state roads--rural	9	36,005	0.5	3.1
County and township roads	7, 11	1,062,214	15.6	12.8[d]
Municipal extensions of state systems	2, 4, 6, 10	1,358,222	19.9	18.8
Municipal streets	8, 12	407,307	6.0	20.1[d]
Total		6,816,175	100.0	100.0

Source: U.S. Department of Commerce, Bureau of Public Roads, *Highway Statistics, 1960*, Tables SF-2 and and SF-4A and unpublished Bureau of Public Roads data.

[a]Forty-eight states, exclusive of toll facilities.

[b]The numerical code for road classification adopted by the Bureau of Public Roads in its *Highway Cost Allocation Study* is as follows:

1. Interstate-rural
2. Interstate-urban
3. Federal-aid primary-rural
4. Federal-aid primary-urban
5. Federal-aid secondary-rural, state
6. Federal-aid secondary-urban, state
7. Federal-aid secondary-rural, under local control
8. Federal-aid secondary-urban, under local control
9. Other state roads-rural

predominant function served by the respective road systems. Finally, the classification of roads as primary, secondary, and local does not correspond completely with the administrative classification of roads as state or county and local. Thus, roads on the federal-aid secondary system are partly under state and partly under local control in varying proportions in different states. The adoption of a road classification based upon functional principles, and a division of administrative responsibility between the states and their local governments which is consistent with such a classification, is essential to the improvement of highway financing policies.

The allocation of user-charge revenues to those segments of the road and street system which are not under state control involves the further problem of determining the share of these allocations to be received by the individual local governments concerned. Fuel consumption would not be a practicable measure for this purpose. The problem is therefore to find some alternative measure or combination of measures which would serve equally well in making apportionments to individual local governments in accordance with the requirements of the benefit principle.

A number of measures are currently used for this purpose, each of which is open to objection, and there is no general agreement as to which is most satisfactory. In the writer's view the choice is narrowed to vehicle miles, motor vehicle registration fee collections, and road mileage, singly or in some combination. Vehicle mileage is doubtless the best single available measure of relative use, but the surveys required for its determination involve considerable expense and need to be repeated at fairly frequent intervals. Instances have also been reported where vehicle mileage has been dishonestly manipulated by running a

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NOTES TO TABLE 5 (concluded)

10. Other state roads-urban
11. Local rural roads
12. City streets, excluding municipal extensions of state highway systems

[c]Data for state highways and their municipal extensions cover capital outlays and maintenance expenditures; data for county and township roads and municipal streets cover total expenditures and fund transfers, excluding service of obligations for local roads.

[d]The percentages of total fuel consumption shown in this table for county and township roads and municipal streets, respectively, differ slightly from those shown in Table 2 because road system number 8 is included with county and township roads in Table 2 and with municipal streets in Table 5.

vehicle back and forth over the recording tapes. The dollar amount of motor vehicle registration fees is a better measure than the number of registrations, in that it reflects the composition of the registrations by vehicle types, but neither of these measures, unless supplemented by special local studies, indicates the use which the registered vehicles make of the roads in the jurisdiction concerned. Road mileage is not regarded as satisfactory unless adjusted to reflect differences in types of roads, and hence in traffic density and construction and maintenance costs, in different jurisdictions. One recent careful study recommends an apportionment formula weighted 50 per cent on the basis of vehicle miles and 50 per cent on the basis of road mileage adjusted in the manner just described; or, alternatively, if the collection of vehicle mileage data is regarded as impracticable, 50 per cent vehicle registrations and 50 per cent adjusted road mileage.[15]

The second major problem with which this paper is concerned is the appropriate division of financial responsibility for the highway system among users in different states. This problem arises from the fact that, with the passage of the Highway Revenue Act of 1956, the financing of federal highway appropriations was shifted from a general-fund basis to a user-charge basis, whereas the policy governing allocation of federal-aid funds among the states has not been altered to conform with the implications of the new method of financing.

Federal-aid funds, other than for the interstate system, are apportioned among the states on the basis of a formula which gives equal weight to population, area, and road mileage. Funds for the interstate system, originally apportioned according to the same formula, were modified beginning with the fiscal year 1956 to give a weight of two-thirds to population, one-sixth to area, and one-sixth to road mileage. Beginning with the fiscal year 1960, the interstate apportionment was changed to a cost-of-completion basis, i.e., the ratio that the estimated cost of completion of the system in each state bears to the estimated cost of completing the entire system. By contrast, the user-charge basis of financing adopted in 1956 would call for an allocation of funds proportionate to the contributions to the Federal Highway Trust Fund made by highway users in the respective states.

It should be noted that the recommended basis for the allocation of federal-aid funds among the states is the same as for the allocation

[15] Charles H. Bradford, "State Aid for Highways: Development of an Apportioning Formula," Unpublished doctoral dissertation, Harvard University Library, 1961. Quoted in Commonwealth of Massachusetts, *Report Submitted by the Legislative Research Council Relative to State Aid to Cities and Towns for Highway Purposes*, House Doc. 3580, Boston, 1962, p. 54.

of state user-charge revenue among the road and street systems within the individual states; namely relative volume and composition of traffic. But the measures of traffic volume used in the two cases differ somewhat. In the former case the measure used is the relative amount of federal user-charge revenue generated in the respective states; in the latter case it is the relative amount of fuel consumption, and hence fuel tax revenue generated, on the various road and street systems within the individual states. However, it is unlikely that the two measures of traffic volume would produce significantly different results, particularly in view of the dominant importance of the fuel tax among the federal user-charge revenues.

The discrepancy between the existing allocations and those which would be made on the proposed basis is shown in Table 6.[16] This discrepancy is a measure of the extent to which federal highway policies result in a misallocation of resources and in a departure from the benefit principle as among highway users in different states.[17] However, it will be observed from this table that, in general, the federal-aid apportionments for 1962 will probably reduce the magnitude of the discrepancies between the two bases of allocation, a trend which reflects the influence of the revised basis of apportionment adopted for the interstate system in 1960.

A special problem arises in the case of the interstate system. There is a conflict between the present basis of allocation, which is designed to accomplish completion of the entire system by the same date, and allocations which would be proportional to the contributions to the Highway Trust Fund made by users in the respective states. If the simultaneous achievement of both of the foregoing objectives be regarded as sufficiently important to justify some departure from the user-charge basis of financing, this could be accomplished by supplementary user-charge allocations based on the benefit principle with appropriations from general funds where necessary to insure a uniform completion date.

Even if the allocations of federal-aid highway funds were revised in the manner just suggested, thereby recognizing the benefit principle as

[16] It was necessary to compare payments to the Highway Trust Fund with federal-aid receipts rather than with federal-aid allocations because the latter are published on a fiscal year basis whereas payments to the Highway Trust Fund are reported on a calendar year basis.

[17] It should be noted that Table 6 does not imply that *total* road outlays are too high in states which receive more federal aid than is warranted on the basis of highway-users contributions to the Highway Trust Fund, or too low in states where the reverse situation prevails. The comparison merely shows the extent to which federal-aid allocations violate the benefit principle.

TABLE 6

FEDERAL-AID RECEIPTS AND USER PAYMENTS TO THE HIGHWAY TRUST FUND, CALENDAR YEAR 1960, AND FEDERAL-AID ALLOCATIONS, FISCAL YEAR 1962
(dollars in thousands)

Rank by Federal-Aid Receipts	State	Federal-Aid Receipts	User Payments to Highway Trust Fund[a]	Ratio of Payments to Receipts	Federal-Aid Allocations, Fiscal Year 1962
1	Illinois	186,893	137,779	73.7	147,694
2	Texas	163,070	178,019	109.2	148,281
3	New York	160,437	178,961	111.5	157,248
4	California	146,640	264,294	180.2	273,564
5	Ohio	119,915	148,238	123.6	174,732
6	Michigan	94,736	119,224	125.8	116,262
7	Pennsylvania	78,813	151,291	192.0	125,175
8	Tennessee	77,889	52,304	67.2	80,749
9	Florida	74,140	80,712	108.9	74,852
10	Indiana	70,840	80,666	113.9	82,467
11	Louisiana	66,874	43,404	64.9	70,646
12	Minnesota	64,169	54,278	84.6	62,514
13	Alabama	56,412	47,493	84.2	58,732
14	Virginia	55,714	61,807	110.9	108,283
15	Georgia	55,009	62,254	113.2	72,721
16	Massachusetts	52,684	65,284	123.9	74,691
17	Missouri	47,623	73,470	154.3	83,822
18	Kentucky	46,374	40,644	87.6	51,862
19	North Carolina	44,156	68,471	155.1	31,846
20	Iowa	44,080	46,568	105.6	38,194
21	New Jersey	41,562	94,550	227.5	86,659
22	Wisconsin	41,085	57,438	139.8	41,791
23	Kansas	39,062	38,442	98.4	36,434
24	South Carolina	38,508	34,190	88.8	29,413
25	Mississippi	36,892	31,145	84.4	37,035
26	Oregon	33,945	32,567	95.9	49,745
27	West Virginia	33,312	23,279	69.9	35,259
28	Nebraska	33,294	26,088	78.4	26,706
29	Washington	32,751	43,888	134.0	52,995
30	Arkansas	31,931	29,807	93.3	32,623
31	Arizona	31,121	24,869	79.9	41,083
32	Colorado	28,918	31,207	79.2	29,830
33	Oklahoma	28,644	43,818	153.0	35,247
34	Maryland	27,862	41,703	149.7	58,652
35	Montana	27,537	13,249	48.1	37,263
36	South Dakota	26,008	12,068	46.4	19,100
37	Connecticut	25,947	35,844	138.1	33,861
38	North Dakota	24,585	10,467	42.6	18,482
39	Utah	24,080	15,114	62.8	28,951
40	Wyoming	24,049	8,867	36.9	30,156
41	New Mexico	23,248	20,454	88.0	37,376
42	District of Columbia	19,211	9,465	49.3	25,982
43	Vermont	19,030	6,272	33.0	23,922
44	Idaho	17,232	13,222	76.7	22,970
45	Maine	17,126	15,601	91.1	16,876
46	New Hampshire	16,660	9,381	56.3	15,957
47	Alaska	13,537	2,223	16.4	36,975
48	Rhode Island	11,847	11,488	97.0	14,596
49	Nevada	9,179	7,528	82.0	19,417
50	Delaware	7,415	8,248	111.2	11,325
51	Hawaii	5,312	6,370	119.9	16,384
	Totals	2,497,449	2,711,901	108.6	3,037,398

between highway users in different states, they would, unless coordinated with the allocations of state user-charge revenues, result in a misallocation of resources as among the different segments of the highway systems of the individual states. The problem arises from the concentration of federal-aid funds upon a limited portion of the highway systems of the states. Federal-aid funds, other than those for the interstate system, are apportioned 45 per cent to the federal-aid primary system, 30 per cent to the secondary system, and 25 per cent to the urban extensions of these systems. This concentration of federal-aid funds on the more heavily traveled segments of the state road and street systems counterbalances the tendency, previously noted, for the states to allocate a disproportionate share of their user-charge revenue to light-traffic roads. However, as Tables 7 and 8 indicate, the result may also be the allocation of a disproportionate share of total revenue to the federal-aid systems.[18] A comparison of Tables 2 and 5 leads to a similar conclusion for the United States as a whole.

In any event, the combination of federal-aid apportionments and allocations of state user-charge revenues is almost certain to result in total allocations to the various segments of the road and street systems of individual states which are materially different from allocations based on some measure of relative use, such as fuel consumption or vehicle miles. An obvious solution of this problem would be for the states to take account of federal aid in allocating their user-charge revenue, so that total allocations would reflect the relative use of each segment of their highway systems. However, in some instances this would call for state user-charge allocations smaller than the matching funds which states must currently appropriate in order to qualify for the full amount of federal aid. To the extent that this is the case, the elimination of the misallocation of highway revenue would appear to be virtually out of the question at the present time, since it would be

[18] It was necessary to make comparisons with vehicle miles in Table 7 because fuel-consumption data by road systems were not available for states other than Illinois. It will be noted that the vehicle-mile figures for Illinois in Table 7 are not greatly different from the fuel-consumption figures for Illinois in Table 8.

NOTES TO TABLE 6

Source: Computed from U.S. Department of Commerce, Bureau of Public Roads, *Highway Statistics, 1960*, Tables SF-1, E-7, E-8, and FA-4.

[a] Both the highway user portion of total taxes paid and the distribution by states were estimated by the Bureau of Public Roads, based on U.S. Internal Revenue Service collections. Amounts paid on U.S. government purchases, as estimated by the Bureau of Public Roads, have been excluded.

TABLE 7

ALLOCATION OF STATE USER-CHARGE AND FEDERAL-AID RECEIPTS TO ROAD AND STREET SYSTEMS, 1960, COMPARED WITH VEHICLE MILES, 1957, EAST NORTH CENTRAL STATES
(per cent)

States	State Highways[a]			County and Local Roads			City Streets		
	State User Charges[b]	State User Charges Plus Federal-Aid	Vehicle Miles	State User Charges[b]	State User Charges Plus Federal-Aid	Vehicle Miles	State User Charges[b]	State User Charges Plus Federal-Aid	Vehicle Miles
Illinois	42.4	66.3	52.5	26.2	16.7	11.6	31.4	17.0	35.9
Indiana	52.1	67.8	63.2	32.0	21.8	8.9	15.9	10.4	27.9
Ohio	61.0	71.1	54.4	26.1	19.7	13.6	12.9	9.2	32.0
Michigan	49.0	63.3	49.3	34.0	25.0	18.9	17.0	11.7	31.8
Wisconsin	55.6	63.4	47.6	28.8	25.5	25.8	15.6	11.1	26.6
Total	52.4	67.0	53.1	28.9	20.8	15.7	18.7	12.2	31.2

Source: U.S. Department of Commerce, Bureau of Public Roads, *Highway Statistics, 1960*, Tables G-3, MV-3, and SF-1 and unpublished Bureau of Public Roads data.

[a]Includes funds allotted for city streets forming urban extensions of state highway systems.

[b]Net funds available for distribution less expenditures for park and forest roads, state highway police and safety, and nonhighway purposes.

TABLE 8

ALLOCATION OF STATE USER CHARGES AND FEDERAL-AID RECEIPTS TO ROAD AND STREET SYSTEMS, 1960, COMPARED WITH FUEL CONSUMPTION, 1957, IN ILLINOIS
(per cent)

	Total	State Highways[a]	County and Local Roads	City Streets
Allocation of receipts from state user charges	100.0	42.4	26.2	31.4
Combined allocation of receipts from state user charges and Federal-aid	100.0	66.3	16.7	17.0
Estimated fuel consumption by road system	100.0	54.8	11.4	33.8

Source: U.S. Department of Commerce, Bureau of Public Roads, *Highway Statistics, 1960*, Tables G-3, MV-3, and SF-1 and unpublished Bureau of Public Roads data.

[a]Includes funds allotted for city streets forming urban extensions of state highway systems.

unrealistic to expect the states to adopt the suggested policy where it involved the sacrifice of a portion of the available federal-aid funds.

In conclusion, it seems probable that the allocational problems discussed in this paper have been relatively neglected partly because of preoccupation with other aspects of highway finance and partly because of the lack of data necessary for investigation. The latter deficiency has been at least partially remedied by the availability of data developed in connection with the *Highway Cost Allocation Study* of the Bureau of Public Roads. The financial consequences of the misallocation of resources revealed by these and other data are of sufficient magnitude to warrant both further investigation and remedial action along the lines suggested in this paper.

COMMENT

PETER O. STEINER, University of Wisconsin

Harbeson's paper is highly informative in its identification of the divergence between the pattern of incidence of highway user taxes and the allocation of expenditures on roads of different types. I have, however, some fundamental reservations about whether the discrepancies may be taken to be a demonstration of resource misallocation, and thus I have real reluctance in accepting his suggestions for remedial policies.

In order to focus on my doubts, I will put my understanding of his argument as baldly as possible:

1. Road services are predominantly a private commodity and ideally one would like to use the market mechanism (jointly) to: (a) allocate funds between road services and other goods; (b) allocate funds between types of roads and roads in different places; (c) assure optimal use of the roads constructed.

2. But direct pricing is impractical[1]—a toll booth at every intersection adversely affects the service—and this necessarily creates problems if we substitute indirect pricing in the form of user taxes.

(a) Since taxes must be based on vehicle use or upon residence, they will fail to reflect use of different types of roads (whose cost varies per vehicle mile) by different users.

(b) By virtue of being indirect, the allocative or rationing effect among roads is absent and thus optimal use may be lost.

[1] Although Professor Vickrey and others have suggested that some form of direct pricing may be practicable, I will accept this conclusion for the subsequent discussion.

(c) The appropriate total level of investment in road services is left undetermined. (This is implicit in the Harbeson paper. I add it now, because I deem it crucial to my subsequent comments.)

3. The best practical approach to the ideal is to raise the required total revenue through user taxes and to allocate it: (a) among types of roads within a state by a measure of relative traffic volume when no prices are charged; (b) among political subdivisions by size of user payments.

4. Using the best available measures, Harbeson finds allocation not optimal in either sense: too little goes to city streets and secondary state roads, too much to intercity highways; too little to New Jersey and Pennsylvania, too much to Vermont, Wyoming, South Dakota and Montana.

My reservations are several.

1. The "ideal," if it were feasible, would be ideal only if private and collective values coincided. These arguments are familiar and I will not rehearse them in detail. But there are collective benefits in a coherent road system, in at least minimum standards of access to all places, and (given lags) in anticipation of future demands. The major appeal of market determination would be that it would solve a major allocation problem and could, so far as it neglected collective needs, be supplemented by public roads. But let this pass: when near Rome, think as a Roman. I accept for the remainder of these comments the ideal as ideal.

2. Assuming the free market is not available, is the *benefit principle* as Harbeson uses it part of the second best? This is the very heart of the matter and its deserves discussion. This principle—to each according to his contribution—*is* a part of a market pricing scheme; economists have long called it consumer sovereignty. But, given the constraints that block use of the market system, the benefit principle is a proxy—and an imperfect one—for only *some* of the functions of the pricing mechanism. Unless those for which it *is* the proxy are of dominant importance, its use may be unwise or at least unimportant.

Indirect user payments, in the first place, do not provide a clue as to the level of the program of investment in road services. The benefit principle provides no help: it divides a pie according to the way it is collected. But how much should be collected, and in what way? These are important questions that are not independent of the allocational problems to which Harbeson addresses himself. To see this quickly, notice that any arbitrary amount and pattern of highway investment is "optimal" (according to the benefit principle) for some pattern of

taxation; a change in the technique of taxation is as effective as a change in allocation in reducing discrepancies of the kind noted in the paper. "Optimal resource allocation," under the benefit principle, is no longer an independent goal toward which we strive, but is instead determined by the method of fund raising employed and the amount of taxes collected.

How *should* the level of investment be determined? Clearly, we do not choose to maximize something like ton-miles per dollar (which would mean building only the busiest road). Nor, at the other extreme, do we maximize the revenue we can extract from users by user related taxes. Instead, we plan a system whose size *and composition* is judged to be adequate (whether by the criterion of private or public needs is not critical in this discussion). One can visualize being very sophisticated within the private goods frame of mind: giving people what they would pay for in a free market, using an appropriate rate of discount that reflects private consumption and investment margins, and so on. Ranking of projects and selecting an optimal level of program is conceptually routine, although it is enormously complex and difficult in practice. But—and this is the point—once such an "optimal program" is selected, the allocational issues have all been decided. The question that remains is how and where to raise the funds. The benefit principle, if we use it, dictates the technique of taxation, not the expenditure of the receipts. Demonstrated discrepancies between users and taxpayers of the kind Harbeson develops suggest that we tax inequitably, not that we allocate resources among types of highways unwisely.

Put differently, Harbeson's use of the benefit principle substitutes taxpayer sovereignty for consumer sovereignty. Since the very essence of the allocative problems that Harbeson discusses is that taxpayers and users are imperfectly paired, the substitution is critical in evaluating the findings. The imperfect pairing of users and taxpayers may be partly a matter of conscious public policy, or it may be the result of some taxpayers being able to, and choosing to, avoid certain taxes (e.g., by operating a car with low fuel consumption). This however does not measure how much they value (and would pay for) roads of different types.

3. By neglecting the rationing function of prices, the use of the benefit principle fails to come to grips with the key element of peak load problems: the simultaneous solution of optimal investment and optimal use. This is the problem Vickrey discusses elsewhere in this volume. Relative traffic volumes of roads of different kinds (and of

different qualities and costs) when all are free, is both a poor and an uncertain guide to what use people would make of a different mix of roads with an optimal tariff on each.

To summarize my central criticism, the benefit principle does not seem to me to come to grips with the major allocative problems of highway finance. *If* the level of total expenditure and the forms of taxation precisely matched the pattern and amount of receipts of an "ideal" pricing scheme, the allocation of funds according to the benefit principle would assure perfect allocation. Without these conditions (and they are absent), a discrepancy between present allocation and present sources of funds is certainly ambiguous as to which is non-optimal (both may be, of course) and is very possibly of a second order of importance in the larger framework of determining the levels of need for highway construction and the optimal investment in roads of different kinds and in different places. The benefit principle may retain its significance as an element in the fabric of social justice, but this case must be made in very different terms.

Finally, a few questions about the more specific suggestions for policy. (1) Are relative traffic volume, as among roads within a state, and taxpayers' contributions as among states, equivalent principles of allocation? This may be true, but it is not apparent to me. (2) Why, for a given investment, is maximizing ton-miles per dollar a sensible objective? Not only would I weight people differently from freight, but I believe the comparative advantage in transportation by roads, rail, and water of different commodities is very different, and is systematically related to weight. (3) In what meaningful sense should road outlays in Vermont be judged three times too high; in Montana, Wyoming and South Dakota, more than twice as high as is proper? Conversely, why are New Jersey's roads receiving less than half of the proper amount? Having driven in all of these states the conclusions seem preposterous. Neither the access problems of the vast plains and mountain states nor the overpopulation and overcrowding of megalopolis will be solved by this sort of reallocation of funds. This is a pity, because it would be an easy solution to hard problems.

O. H. BROWNLEE, University of Minnesota

Harbeson is concerned with how to collect for highways and how to allocate the proceeds when it is not feasible to charge users of a given class different fees for different qualities of service. Although this typically is the kind of problem faced, I believe that we could

decrease its relative importance by converting much of the so-called "interstate" system to toll roads with proceeds from gasoline tax revenues being credited to the various segments in accordance with the volumes of various kinds of vehicles which use each segment. Limited access highways usually are those that lend themselves to operation as toll roads without high collection costs. And toll roads permit charging different amounts per unit of distance traveled, on different roads at a given time or a given road at different times, which is what we want.

However, even if the "interstate" were to be converted into a toll road, there would still be much of the road and street system where tolls would not be feasible and for which Harbeson's problem would still exist. If the schedule of charges were optimal, then clearly the revenues returned to the various sectors of the road system should be proportional to the revenues earned. Whether, in absolute amounts, revenues returned should be less than, equal to, or greater than revenues earned depends upon whether there are increasing, constant, or decreasing returns technologically to highway production. However, it is unlikely that allocating revenues in the best manner for an optimal fee pattern also will be optimal when the fee pattern is not an optimal one.

Harbeson proposes two closely related procedures which he claims are such as to result in no transfer of earnings from any broad segment of the highway system to any other. In turn, he claims that there is thus no subsidization of some users from funds collected by taxing others, and thus no misallocation of resources among various broad sectors of the road system. (The over-all system may be too large or too small but Harbeson is not discussing this problem.) One of these procedures establishes the standard per mile fee at the average cost per mile of privilege fees (Harbeson calls then nonuser taxes) sufficient to cover average costs on the other sectors. The second procedure seems to do somewhat the same, although I cannot translate the verbal statement into an algebraic one so that I can check my conjecture.

Although I intuitively believe that Harbeson's proposed general procedure is superior to that currently used, I cannot prove this to be the case without specific cost and utility functions. Existing fee schedules largely ignore congestion costs—the principal item on much of the urban portion of the road system. Optimal fees cannot be based only on construction and maintenance costs, since the system produces joint products. And I believe that the measurement of benefits is operationally impossible.

Those who advocate a benefit approach to the allocation of highway costs typically argue that taxes paid by various classes of users and benefits per unit of use ought to be proportional. However, since a highway user can be expected to use a facility to the extent that any larger use would increase his costs (operating, *waiting*, etc.) by more than it would increase his benefits, the net benefit—at the margin—is zero. This will be the case (except for indivisibilities) on all kinds of highways.

The difficulties associated with an allocation scheme alloting revenues proportionate to traffic volume can be shown by the case in which there are two roads with equal volumes but much different levels of congestion. Both would (assuming identical construction and maintenance costs) receive the same revenue; but the more congested one should be charging more and also receiving more for expansion.

Although it is not a central idea in Harbeson's proposal, the suggestion is made that we should "use surplus revenue generated on urban arteries to assist in the financing of urban mass transit facilities." This could represent an improvement, insofar as highways are financed from nonuser sources and prices for highway service are below the optimal ones. However, removing the subsidy to highways would be still better.