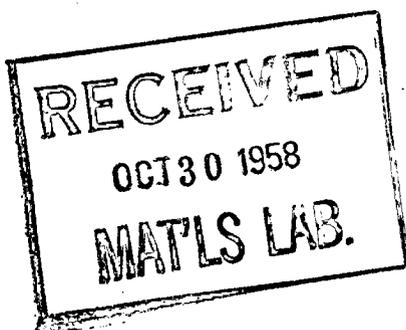


HIGHWAY RESEARCH BOARD

Special Report 35

***A Highway Taxation
Cost-Benefit Analysis***



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***A Highway Taxation
Cost-Benefit Analysis***

BERTRAM H. LINDMAN
Consulting Engineer and Economist
Washington, D. C.

1958

Washington, D. C.

Department of Economics, Finance and Administration

Guilford P. St. Clair, Chairman
Director, Highway Cost Allocation Study
Bureau of Public Roads, U. S. Department of Commerce
Washington 25, D. C.

AD HOC COMMITTEE ON STATE HIGHWAY FINANCE AND TAXATION STUDIES

C. A. Steele, Chairman
Chief, Taxation and Economic Studies Branch
Financial and Administrative Research Division
Bureau of Public Roads, U. S. Department of Commerce
Washington 25, D. C.

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- J. P. Buckley, Automotive Safety Foundation, Washington, D. C.
- Philip M. Donnell, Engineer-Director, Highway Planning Survey Division, Tennessee Department of Highways and Public Works
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Foreword

In recognition of the need for study of techniques and procedures for highway finance and tax studies, particularly as they relate to problems encountered in the engineering phases of highway needs studies, the Highway Research Board appointed in 1956 an Ad Hoc Committee on State Highway Finance and Taxation Studies. This committee included members of the Board's Committees on Highway Costs and on Highway Taxation and Finance.

To assist the Ad Hoc Committee in carrying out its objectives, the Board retained Bertram H. Lindman as a consultant. The activity was financed through grants of funds provided by the Automotive Safety Foundation and the Bureau of Public Roads. The Ad Hoc Committee reviewed the work of the consultant as it progressed and offered its comments for his consideration.

This research produced two reports. The first, a paper entitled "Economic Forecasting for Statewide Highway Studies", was presented during the 36th Annual Meeting of the Highway Research Board, and was published in HRB Bulletin 158 (1957). The second, published herein, reviews the problems of highway tax allocation and proposes a "highway taxation cost-benefit analysis".

This area of research has received attention previously by the Highway Research Board. In recent years various committees have produced several significant contributions in the field, notably "Suggested Approaches to the Problems of Highway Taxation", published in the Proceedings of the 27th Annual Meeting (1947); a symposium of five papers on the general subject of "Allocating Motor-Vehicle-Tax Responsibility by the Incremental Method", published as HRB Bulletin 121 (1946) and a symposium of five papers on "Allocating Highway Cost Responsibility--Reports on Studies in Five States", published as Bulletin 175 (1958). The Ad Hoc Committee believes that the report contained in this bulletin is a further important contribution toward the solution of problems of highway financing.

C. A. Steele, Chairman
Ad Hoc Committee on
State Highway Finance and Taxation Studies

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A Highway Taxation Cost-Benefit Analysis

Bertram H. Lindman

Consulting Engineer and Economist, Washington, D. C.

An important problem in the area of research common to engineers and economists engaged in highway needs and fiscal studies is "who shall pay how much for which highways?" In this study the objective has been to explore this problem in its many ramifications—economic justification of highways as well as taxation, revenue distribution, programming of projects and other important elements of highway financing—in an effort to reach a comprehensive solution. There has resulted a promising method of approach, designated as a "highway taxation cost-benefit analysis." This report is limited, however, to an outline of the development and general application of that approach.

The Needs Study Movement

The highway needs study movement of the post-war era had its origin in California in 1946. During World War II, California like other states had been forced to suspend virtually all highway improvements because of manpower and materiel shortages. At the same time it had experienced the largest influx of people in its history, and at the end of the war faced the prospect of even greater numbers of people. Its highways were not only damaged by neglect but were proving wholly inadequate for the huge volumes of post-war traffic.

Faced with this serious post-war highway problem, the state legislature asked the State Division of Highways and the counties and cities to estimate their highway needs. The lists of highway deficiencies submitted totaled hundreds of millions of dollars. The legislature, through its newly created highway study committee, sought the advice of leaders in the field, brought in disinterested out-of-state engineers and economists as consultants, and marshaled the talent and information available within the state.

The task assigned the consulting engineers was to review the highway deficiencies and to prepare a realistic, balanced program of state-wide improvement needs. The task assigned the consulting economists was to formulate an equitable tax plan for raising revenues adequate to finance the needs program.

Engineering Study

The engineers had to chart their own course much of the way. They used whatever data, techniques and talent were available and, at the same time, developed new data, techniques and talent for their task. They made considerable use of the planning survey data amassed by the California Division of Highways and the U. S. Bureau of Public Roads, and indicated the direction of continued and expanded planning survey work. They searched state and local records for highway, road and street data, and elicited the cooperation of state, county and city officials. The resulting vast accumulation of highway information not only served as the basis for the

study under way, but was made available to all interested agencies and groups.

The engineers developed a study procedure in California which became the model for subsequent studies in other states. This procedure is composed of the following major steps:

1. The reclassification of highways or the establishment of highway systems on the basis of their function or purpose; that is, as rural primary, urban primary, rural secondary, urban secondary, local rural road, and local city street.
2. The analysis of traffic on each road system to determine its volume, composition and operating characteristics.
3. The analysis of each road system to determine which sections do not meet the tolerable standards established for that system and as a consequence are in need of improvement.
4. The application to each road system of the minimum engineering design standards established for that system, and to each section of that system in a higher than minimum traffic bracket, the application of the appropriate higher than minimum design standard.
5. The analysis of maintenance and other operating costs necessary for the improved systems.
6. The development of cost estimates for the improvement, maintenance and replacement of each system.

After completing their study, the engineers prepared and presented to the legislature a comprehensive report of their findings and recommendations covering the highway, road and street needs for all systems for the program period. This report gave the legislature and other interested officials an unbiased, impartial view of state, county and city highway needs (1).

Fiscal Study

The economists retained to make the fiscal study set out to devise an equitable and practical plan for recovering from the taxpayers of the state the long-term costs which the engineers had computed for each of the six highway systems, and an accompanying plan for distributing the tax revenues to those six systems.

There was little precedent for a highway finance and taxation plan of like character or magnitude. In past decades economists had served in numerous capacities in the fixing of taxes for highway purposes. They had worked on the problem of ensuring equitable treatment of land owners and other property owners ever since local governments first imposed assessments and taxes for roads and streets. They had helped to develop equitable highway user taxes. They had been involved in various phases of the controversy which developed over privately provided rail facilities and publicly provided highway facilities. They had made their contributions to the toll road movement. Over the years they had advised government officials at all levels on proper programs for the taxing of highway beneficiaries. But never before had they been asked to undertake solution of a highway financing problem which involved the apportioning to so many beneficiaries the cost of improving so many highways over so long a time.

So the economists, like the engineers, charted a course. As one basis for their study they collected and tabulated all the pertinent highway

finance and taxation data available in the state. Then they devised a fiscal study procedure which could be adapted to the end product of the engineering study and to the taxation methods employed in the state. This procedure needed to be one by which they could:

1. Allocate the engineers' summations of program costs by systems to the taxable highway beneficiaries.
2. Set equitable tax rates for the recovery of the allocated costs from the respective groups.
3. Distribute the revenues among the different levels of government for proper use on the respective highway systems.

Finally, they prepared reports of their findings and recommendations and submitted them to the legislature (2, 3).

The legislature acted upon some of the engineering and fiscal recommendations and launched a state-wide highway improvement program.

Spread of the Movement

As other states experienced traffic crises similar to the one in California, they, too, turned to the "needs" approach. Approximately half of the states have embarked upon similar studies and others have made partial studies. California and several other states which made the earlier studies, finding that actual highway needs were exceeding estimated needs, deemed it necessary to make supplemental studies (4, 5).

Now the federal government is in the process of applying the needs approach to the nation's over-all highway problem. A limited engineering needs study preceded the launching of the National System of Interstate and Defense Highways and, as the result of legislation enacted in 1956, more comprehensive studies are under way for the Interstate System, federally aided highways and all other highways (6).

Review of the Studies

In states which have undertaken them, engineering and fiscal studies have been of great value. The legislatures have gotten comprehensive programs for the improvement and financing of their roads and streets and, in addition, vast accumulations of pertinent factual information. These programs and the accompanying data have proved valuable also to highway administrators, highway engineers and tax officials at state, county and city levels. All were given the opportunity to view the state highway picture in broad perspective, to examine the background information and to adapt pertinent findings to their own problems.

The general usefulness of these studies is indicated by the fact that many states are finding it desirable to meet changing conditions through new studies, and now the federal government has directed that the Interstate System study be re-done at specified intervals (7).

Although it is doubtful if many of the legislators who asked for a totaling of highway needs visualized what heights they would reach, most states looked upon the recommended improvement programs as a real challenge. States not in a position to follow the recommended program in its entirety used it as the basis for partial or temporary solutions to their highway problems. For many states acceptance of the needs program meant entry for the first time into the urban highway field and an initial attempt to solve pressing urban highway problems. As a consequence, most delays which have occurred in carrying out needs programs have been in the urban sections.

Among the less acceptable engineering recommendations were those for the re-classification of highways in accordance with their predominant purpose or function. Most legislatures rejected or modified them in such a way as to undermine the foundation for a sound highway program which is the application of proper design standards to properly classified highways. They undermined in addition what was to have served as the basis for more efficient highway administration and a more adequate highway fiscal policy.

The fiscal recommendations were generally not as well received as the engineering recommendations, but this fact is not surprising in view of the more violent opposition which fiscal programs usually draw forth from politically and economically affected factions. In most of the states the legislatures deviated, all too often from some of the more basic recommendations dealing with the allocations of cost for tax purposes and the distributions of revenue to highway systems. In a few states the legislatures shelved or rejected the economist's recommendations and substituted their own programs.

The Problem Area

A review of several years of experience with highway needs and taxation studies indicated the existence of basic weaknesses in the fiscal studies, particularly in the vital area of the allocation of highway costs. This review indicated further that these weaknesses stem largely from the diversity of analytical processes developed.

The fiscal programs, in contrast to the engineering programs, represent the work of many consultants. Most of them took as the beginning point of their studies the engineer's program costs, and as the end point, his re-classified highway systems. Otherwise they followed a variety of courses with the result that they have produced, instead of a generally uniform type of highway financing program, a wide diversity of programs. In the allocation of highway costs for taxation purposes they adopted a multiplicity of theories and concepts from which they developed a multiplicity of procedures.

Procedures for apportioning costs between motor vehicle users and other taxpayers were based for the most part on the following:

1. Predominant purpose or use, reflected in highway classification.
2. Added costs occasioned by motor vehicles.
3. Relative benefits.
4. Earnings credit.

Procedures for apportioning costs among classes of motor vehicles were based on the following:

1. Relative use measured by ton-miles of operation.
2. Costs caused, or incremental costs.
3. Cost-function.
4. Across-the-board increases.

Some economists gave consideration to such factors as ability, capacity and/or willingness-to-pay, but did not incorporate them into their procedures or mathematical formulas.

Economists who made some of the more recent studies, concluding apparently from the wide variety of solutions theretofore offered that there was no possibility of devising a standardized procedure, felt free to devise entirely different procedures or to continue historically established apportionments.

The engineers became aware of the growing disparity in cost allocation procedures when they tried to anticipate and make provision for the economists' data requirements. They had developed a standardized procedure for setting up highway needs programs which yielded standardized data. But when different economists began asking for refinements in those data to facilitate their cost allocation work, the engineers found compliance most difficult. In some instances their work schedule did not permit compliance and in others the engineering data did not lend themselves to presentation in the form requested. Eventually the very diversity of requests became a major problem.

Recognition of this situation had led engineers and economists to the conclusion that before the engineer can provide the economist with the information he needs, a standardized fiscal analysis should be developed.

Effect of Recent Federal Legislation

Recent federal legislation, particularly the extensive legislation of 1956 which is having such a widespread effect upon the state highway study movement, has been an important consideration in this study.

Included in the 1956 legislation are two major financing provisions which are radically altering state highway financing. One is the adoption of federal highway user taxation to finance the Interstate System and all other federally aided highways, and the other is the establishment of the federal share of Interstate System financing at 90 percent and the state share at 10 percent. These two provisions will in all probability make it more difficult for the states to obtain increases in highway user taxation for all purposes except to match federal aid. On the other hand, 90 percent federal financing of the Interstate System will relieve the states of a considerable part of the financial responsibility for those highways which are incorporated into that system.

This legislation also imposes upon the states strict standards for the construction of the Interstate System.

Included in this legislation are several highway study provisions. One is that each state make an engineering needs study in cooperation with and under the direction of the U. S. Bureau of Public Roads. Another is that the Bureau, in cooperation with federal agencies and the states, investigate the feasibility of certain bases of highway taxation and submit its findings to the Congress for its consideration in deliberating the problems of federal highway taxation. Any Congressional action resulting from these federal-state studies will be conditioning factors in any future state fiscal studies.

Nature of the Problem

A considerable amount of effort has been devoted to isolating the problem to be undertaken in the present study and to determining the direction of its solution. This effort was complicated by the necessity of resolving general assignments and specific suggestions from interested parties.

The Assigned Problems

The problem assigned was the very general one of preparing "a report embodying the results of the analysis and evaluation of the state highway finance and tax studies." This problem was narrowed somewhat by the High-

way Research Board Ad Hoc Committee on State Highway Finance and Taxation Studies in its directive "to isolate problem areas in the highway needs studies which affect the highway finance and taxation studies and to indicate areas where techniques and methods can be improved."

Among the suggestions from interested parties which merited consideration in the selection of the problem to be studied was one that an intensive investigation be made of the incremental cost problem with the objective of effecting a better integration of economic and engineering studies in this area and, further, that it be productive of a statement of the specific or additional information which the economist would require of the engineer in order to make an incremental cost analysis. Another suggestion was that this study go beyond an analysis of past studies and procedures to the outlining of the broader studies that will be needed in the future.

The Selected Area

The problem area isolated for analysis as a result of a review of finance and taxation studies was the cost allocation area where lack of agreement on concepts, theories and procedures indicated fundamental difficulties. Consideration was given to the suggestion for an intensive study of the important incremental cost problem but the conclusion reached was that in order to ensure the development of consistent allocation bases its solution should be deferred pending solution of the larger problem of allocating costs between motor vehicle users and other taxpayers. The suggestion for a study of some of the broader aspects of the highway financing problem served as a stimulus to a broad treatment of the cost allocation problem. An analysis and evaluation of state highway finance studies and their supporting data, supplemented by personal experience and observation, pointed up several important phases of the highway finance problem which require more intensive research effort. Among them were the following:

1. The nature of taxes levied for highway purposes.
2. The proper bases (cost allocation bases) for fixing the amount of taxes to be exacted for highway purposes.
3. The limitation of expenditures of special highway tax funds to the purposes intended as means of preventing diversion and dispersion.
4. The quantitative as well as qualitative justification for proposed highway improvements in terms of their benefit-cost ratio, public worth, etc.
5. The relation of highway traffic to such economic measures as levels of personal income and gross national product for purposes of forecasting traffic growth and tax revenue (8).
6. The principles to be observed in determining proper tax rates upon land and other property for local highway needs.
7. The possibilities of taxing for highway purposes the roadside businesses and the land increased in value by limited access highways.
8. The appropriation of general funds for highways.
9. The proper role of toll facilities and their pricing.
10. Acceleration of pay-as-you-go financing of highway improvements by bonding; its desirability, practical extent, timing and methods.
11. The evaluation of the threat of inflation on the highway programs and suggestions for remedial measures.
12. The determination of the relationship, if any, of mass transit deficits to highway financing.

13. The provision and financing of terminal facilities, including parking facilities.

14. The determination of the optimum extent of the Interstate System.

15. The optimum role of each level of government in the financing of highways.

The Selected Problem

The problem selected for study was the development of a comprehensive cost allocation analysis which would cut through differences in fiscal study concepts, theories and procedures and contribute to the development of a needed degree of standardization in cost allocation procedures and of principles which would serve as bases for adequate taxation programs.

Objectives of a Cost Allocation

Out of an analysis of some of the broader aspects of highway financing, particularly the first four in the foregoing list, the major objectives of a cost allocation were established, as follows:

1. It should be equity-directed to ensure a fair schedule of taxes and a proper distribution of tax revenues.

2. It should be economy-directed to ensure that the taxpayers get their money's worth in the engineering and financing programs.

3. It should be administration-directed to facilitate the enactment of a workable system of taxation and revenue distribution and to promote administrative responsibility at each level of government.

When the cost to be allocated is an engineer-recommended, long-term needs program cost, the beginning point of the economist's analysis should be the program cost computed for each highway system, and the end objective a plan for raising and distributing tax revenues in those amounts for the respective systems.

Equity to Taxpayers

The first and most important objective in the allocation of highway costs for taxation purposes is equity to taxpayers, both in the imposition of taxes and in the distribution of tax revenues. The pursuit of this objective requires a thorough understanding of highway taxation as it exists today and of the underlying principles.

In this country the provision of highways has always been one of the essential functions of government. As Dearing states (9, p. 206):

. . . public roads have always been supplied by government as one of the several essential public services. Only occasionally has any significant portion of the responsibility for their provision been entrusted to private enterprise. . . Moreover, the state is required to maintain public roads according to standards fixed by statute and judicial interpretation. And mileage, once designated as "public", can be abandoned only after those parties whose interests are directly affected have been given an opportunity to be heard.

The taxes used in carrying out this highway function in this country are by definition, 61 Corpus Juris 75, either general or special:

Taxes, with respect to the purpose for which they are levied, are also designated as "general"; that is, taxes which are imposed throughout the state or some civil division thereof, for the purpose of raising revenue for the support of the government and for general purposes, and which are levied on the ground of general public benefits, or as "special", that is, taxes which are levied for a special or local benefit for the benefit of a part only of the body politic, and which rests upon the supposition that a portion of the public is specially benefited in the increase of value to the property of the persons against whom the tax is levied.

Taxes which are levied generally throughout a city, county or other area, and the proceeds from which are placed in a general fund and expended for highways and all other general governmental purposes, like certain land and other property taxes, obviously fall within the general tax category.

Those taxes which are levied upon or assessed against landowners within a delimited area, and the proceeds from which are placed in a special fund and otherwise secured for highway or other purposes, and expended for the benefit of the landowners, have long been considered special taxes.

Highway user taxes have not been clearly classified in Corpus Juris as special taxes but belong in that category for the following reasons:

1. They are imposed solely upon owners and operators of motor vehicles using the public highways. Consistently, such taxes are not applied to persons who operate motor vehicles off the public highways or who use motor fuels in vehicles operated off the public highways.
2. They were initiated and have been imposed for the specific purpose of providing for highway users the highway facilities which they require. These requirements arise from the presence of motor vehicles in the traffic stream, their size and weight and their operating characteristics.
3. They closely resemble special property assessments made to provide funds for new highways and bettered highways.
4. Highway user tax revenues are generally secured for their intended use by one or more of the following: (a) statutory earmarking, (b) statutory requirements for their deposit in special trust funds, and (c) constitutional prohibitions against their diversion to other uses.

Of special significance is the fact that the highway burden has been shifted in large part from landowners and the general public to highway users. Before World War I, highway taxing authorities depended primarily on general taxpayers and on landowners for the support of highways. After the war, when forced to seek additional revenues to meet war-increased highway costs, they turned to highway users and have been relying on them more and more heavily ever since. Now all states impose highway user taxes and several have discontinued the use of all other taxes for rural highways. To secure user tax revenues for highway purposes, all but four states have established special trust funds and many have enacted constitutional amendments prohibiting their diversion to other purposes.

The federal government until recently defrayed the cost of all federally aided highways out of general taxes, though it collected large amounts

of tax revenue from motor vehicle users. With the passage of the Highway Revenue Act of 1956 it adopted the highway-user tax concept. Revenues from these taxes are being placed in a special highway trust fund and used to finance 90 percent of the capital outlays for the Interstate System and 50 percent of the capital outlays for all other federally aided highways.

As a consequence of the present heavy dependence upon highway users for the support of highways, much of the economist's equity problem is in the special highway tax field where equity policies and procedures are inadequately established. Here he is faced with equity considerations as between highway users and landowners. Where there is or should be dependence upon general tax revenue for some highway support, he is also faced with equity considerations as between special taxpayers and general taxpayers.

Equity to special taxpayers under the special tax principle requires generally that the cost allocated to them be related to the highway purpose for which the special tax is to be imposed. It requires, among other things, that:

1. The cost, and the consequent taxes, be sufficient for the highway purpose.
2. The cost, and the consequent taxes, be no more than sufficient for the highway purpose.
3. The cost, and the consequent taxes, not serve other than the intended highway purpose.
4. The tax revenues be so earmarked or otherwise secured as to prevent their diversion to other than highway purposes and their dispersion to other than intended highway purposes.

Application of this equity policy to the special taxpayers would automatically leave for the general taxpayers the costs of highway facilities required by some specific governmental activity, and, all other highway costs, if any, not chargeable to a special taxpayer group.

Economy to Taxpayers

The second objective in a highway cost allocation is economy in the handling of taxpayer money. In general, the economist should see that each highway taxpayer gets his money's worth in the engineering and financing programs. First, he should establish the economic interests of the respective taxpayers. Among other things, he should distinguish between needs costs like those included to promote safety which are necessities, and wants costs like those included to prevent dust on local roads which may be merely wants. Then he should attempt to incorporate these interests into his recommended tax and revenue distribution systems. The economic interest of the special taxpayer requires that the allocated costs not exceed the anticipated benefits. To safeguard the economic interests of the special taxpayers he may find it necessary to recommend appropriate legislative or administrative devices.

Administration Directed

The third objective of a cost allocation is that it be administration directed to facilitate and ensure the enactment of a workable system of highway financing. This objective requires that efforts to achieve equity and economy be tempered by efforts to develop tax and revenue distribution

systems into which the equities and economies can be translated. For one thing, refinements in the cost allocation should be limited to those which can be reflected in the method, basis or rate of taxation and in the revenue distribution formula. As stated in the report of the Washington State Highway Cost Commission (10, pp. 54-55):

The degree of preciseness to be attained in any computation is dependent upon the use that is to be made of the results. Since the object of the cost analysis is to develop workable tax rates, the recommended schedule must be practical from an administrative viewpoint. This means that refinements and exemptions introduced in an attempt to reflect special features of vehicle operation must be weighed against the increased difficulty of administration and enforcement. The present schedule is very simple and understandable, and notably so when compared with a complicated railroad classification and tariff. Each step tending to complicate this schedule should be practical as well as theoretically justified, but, of course, this thought should not be interpreted so literally as to prohibit the trying of new methods to meet new problems in a new industry.

From this it is apparent that each proposed modifier or refinement of the cost apportionment must meet the test of being susceptible to reflection as a refinement or exemption in the highway tax schedule. If it is not, that fact alone is justification for not complicating the cost computations further.

This objective requires also that the equities and economies established in the cost allocation, particularly those established for the special taxpayers, be surrounded with whatever practical safeguards are necessary and available. Most states and the federal government attempt to prevent the diversion of highway user tax revenues to other than highway user purposes by establishing special trust funds or by passing anti-diversion amendments. To further safeguard these revenues, some anti-dispersion measure should be devised to prevent their use on roads of primary benefit to other taxpayers. If possible, steps should also be taken to protect the basic equities and economies established in the cost allocation from distortion in the legislature and in each of the units of government entrusted with highway administration.

Bases for a Cost Allocation

One conclusion resulting from this study and from experience in state highway financing studies was that the first most promising basis for allocating program costs to various groups and classes of taxpayers is "costs caused" or "causal responsibility"; the second most promising, "benefits anticipated." The primary reasons for this conclusion are that these bases are acceptable, are susceptible to improved quantification, are applicable to a needs program and to special taxpayers, and can be combined advantageously.

Acceptable

Costs caused and benefits anticipated are both generally accepted bases for allocating highway costs for taxation purposes, having been used in state highway finance studies and in national transportation studies. Both have also had recent Congressional acceptance as evidenced by Section

210 of the Highway Revenue Act of 1956 which directs that a study and investigation be made of the costs attributable to, and the benefits derived by, each class of highway user, and of any direct and indirect benefits to other classes of highway beneficiaries.

Causal responsibility and benefits have had long acceptance by economists as sound bases for allocating overhead or joint costs. In 1923, Clark, the recognized authority on the subject of overhead costs, in "The Economics of Overhead Costs," set forth causal responsibility and benefits as two of "four logical bases on which overhead costs may be apportioned." Cost caused or causal responsibility is particularly applicable to a highway needs program cost which represents planned outlays for a future period, not previously incurred costs. As Clark states (12, p. 304):

Let us look in more detail at some of the problems of highways. Here the paradox of overhead costs assumes an extreme form. Before a road is built, it is rational to say that the traffic which benefits should bear the overhead cost and that if it cannot bear it, the outlay is probably not justified. But once a well-paved road is built, reasonable use costs nothing at all, and any charge which limits the amount of such traffic would result in unused capacity and the loss described by the phrase, "idle overhead." Yet certain kinds of traffic do break down the roads, and should pay accordingly or be prohibited.

Furthermore, as transportation economists generally agree, this basis best fulfills the transportation objective of maintaining taxation neutrality between highway transportation and competing means of transport.

Neither of the other two bases offered by Clark, "ability-to-pay" and "stimulus to improved utilization," is as generally applicable to the problem as the first two, under present conditions of a high level of economic activity and acute highway congestion, though either may be applicable in a limited way in certain exceptional situations.

Availability of Data

Costs and benefits are particularly promising bases for allocating the costs of a highway needs program because of the cost-causing, benefit-conferring nature of such a program. The engineer first studies all the highways of a state to determine what improvements should be made over some designated future period to meet the needs of highway users, land-owners and the public, or to serve the purposes of statutory or administrative provisions. Then he selects designs which in his professional opinion or judgment will meet those needs or serve those purposes. Eventually he calculates the costs of the selected designs for projects, highways and systems; totals them; and arrives at the needs program.

In his decision-making process the engineer uses detailed procedures based on long-established engineering principles, research and practical experience. By an appropriate probe using these procedures the economist can ferret out many of the costs established for the several beneficiary or taxpayer groups and some information as to the benefits anticipated for them. With this cost and benefit information in hand, he can proceed with whatever additional analyses of costs and benefits he deems necessary.

Potentialities for Improvement

The cost and benefit bases can both be improved in precision and accuracy. As a consequence of their past use, some procedures are well established and considerable data have been developed. In anticipation of their future use, considerable effort is going into the improvement of procedures and the refinement of data. One objective of this study has been to point out avenues of improvement and refinement.

Considerable research effort is going into the development of incremental cost procedures and data as the result of attempts to re-evaluate the highway cost responsibility of trucks. A series of road tests has been undertaken to determine the actual effect of different types, sizes and weights of vehicles on pavements. The ones in Maryland and Idaho have been completed and the one in Illinois is still under way. The Highway Research Board Committee on Highway Taxation and Finance and its Committee on the Incremental Method of Motor-Vehicle Tax Allocation have spent several years developing analytical procedures for determining the cost caused by different types, sizes and weights of vehicles. The Highway Research Board Committee on the Economics of Motor Vehicle Size and Weight is also developing data bearing on the problem. All this research should yield considerable valuable data for use in a "cost caused" analysis for trucks.

Research efforts are also being directed toward the benefits of improved highways. One series of studies deals with the economic impact of improved highways and the consequent benefits to land and property. Other studies deal with the benefits to highway users in the form of reduced accidents and vehicle operating costs.

Applicable to Special Taxpayer Problem

Costs and benefits are more effective than other known bases in dealing with the pressing current highway financing problem which, as previously indicated, is one of effecting a fair and economic apportionment of costs to highway users and other special taxpayers.

Owners of land and property have for many years petitioned for local road and street improvements with the understanding that the costs they occasioned would be assessed against them. These costs have long been based on benefits measured by the frontage rule, the area rule or the zone-and-area rule (13, 14).

Certain classes of motor vehicles which have damaged highway pavements or which require extra highway facilities have for many years been subjected to special charges. The first differential charging of highway costs to trucks followed the widespread damaging of highways by trucks during World War I. Trucks in increasing numbers, equipped with solid rubber tires, hauling heavy loads of war supplies had damaged and broken the pavements. To encourage the replacement of solid tires with pneumatic tires and to obtain needed revenue, heavier charges were imposed on trucks with solid tires. In time, as pavements were constructed with sufficient strength to carry heavier wheel loads, attempts were made to charge the costs of the added facilities to the vehicles responsible for them.

The recurrence of widespread highway damaging during World War II indicated that some of the additional highway facilities provided for trucks were inadequate for the second war-increased volume and weight of trucking. As a consequence, greater strength is again being built into the highways,

and truck weight limitations are being more strictly enforced. And, as previously mentioned, research into the problem of the cost responsibility of trucks is going forward.

The present trend toward special highway user taxes as a means of financing highway needs programs makes it imperative that benefits anticipated also be brought in as a basis for allocating costs. Recent state and federal legislation has imposed so much of the needs program cost on highway users that it is time to look into the possibility that this group is already taxed unjustly. Legislation in certain states has saddled them with some local roads that appear to be of greater benefit to land and property. Federal legislation presently imposes upon highway users throughout the country the entire federal aid highway load. This includes regular federal aid, which for forty years had been considered a general taxpayer responsibility, and 90 percent of the cost of the National System of Interstate and Defense Highways which, as the complete name indicates, was planned in part to meet national defense needs.

Another reason for introducing the benefit basis is the practical one of supplementing or checking the cost-caused findings. Regardless of the soundness of the cost basis and the prospects of its application with reasonable accuracy, the fact remains that computations of this kind are subject to question and ought to be verified by other findings.

The selection of costs and benefits as primary and secondary bases, respectively, does not preclude the use of other bases to modify the findings to allow for changed economic conditions, to exempt for specific reasons, or otherwise to bring greater equity or economy into the cost allocation. For example, it may be desirable to give some consideration to "stimulus to improved utilization" in the fixing of tax rates, even though much of the existing highway plant is congested and in need of large capital outlays. One possible way to do this is to issue special licenses for the privilege of operating at lower than regular rates on congested highways during off-peak hours. Likewise, it may be desirable to give some consideration to taxpayer ability-, capacity-, or willingness-to-pay, or to value of the service to the taxpayer, even though economic activity is well above the depression level. Under certain conditions it may be desirable to supplement costs and benefits with "use". Economists engaged in past state highway financing studies, when faced with inadequate information regarding costs caused by various classes of highway users, have frequently turned to the "use" basis. The unit of use most frequently employed is one combining weight and distance; namely, the ton-mile. Clark classified "use" and "benefits" together, noting that both have "something to do with ability to pay, and something to do with responsibility" (12, p. 32).

Costs and Benefits Combined

One of the foremost reasons for selecting costs caused and benefits anticipated was their value in combination. A fundamental principle of engineering economics is that for a project to be economically justified the benefits must exceed the cost and, further, that the project which provides the most benefits in relation to its cost has the greatest economic justification. This principle has had wide application throughout the engineering world.

The highway engineer applies this principle to the extent of establishing benefit-cost ratios for alternative projects under consideration

and selecting the one with the best ratio. The procedure, as set forth in the manual of the AASHO Committee on Planning and Design, "Road User Benefit Analyses for Highway Improvements," is to make (15):

A comparison of the relation of annual road user savings to the annual capital costs for the logical alternates in location and design that have the same over-all traffic movements on the highway or connecting highways affected. The method results in benefit ratios or factors whereby the various alternates considered are rated with respect to one another.

The railroad engineer has long used benefit-cost analyses to justify the improvements he recommends. To the extent that he justifies recommended capital outlays for improvements in railroad alinement and facilities by comparing the cost of financing and amortizing the investment required with anticipated dollar savings in operating costs over some specified period of years, his problem is similar to that of the highway engineer.

Benefit-cost ratios are also widely used in the public enterprise field. For the justification of waterway projects, the Subcommittee on Benefits and Costs of the Federal Inter-Agency River Basin Committee has prepared a manual entitled, "Proposed Practices for Economic Analysis of River Basin Projects."

Today in the rapidly developing science of operations research a similar analytical procedure, termed an effectiveness-cost ratio, is used. By this procedure it has been shown that, in terms of cost, nuclear explosives are more effective for military purposes than conventional explosives. The popular expression for this conclusion is that nuclear explosives give "more bang per buck." A comparable expression for the improved highway might be "more saved lives per dollar."

In the field of economics, value and cost comparisons are all important factors. According to Clark (12, p. 17):

The backbone of the science of economics is the balancing of value against cost. This sets up a test by which to judge any activity—the producing of any goods or the rendering of any service—in order to prove if it be economically self-sustaining or no. Other activities may be worthy, charitable, public-spirited, even vitally necessary to the public welfare or the public safety, but they are not paying business and they are often thought of as a variety of poor relations; dependents which must, in one way or another, be supported by business which does pay. People are inclined to think of such things as not economic activities at all. They are often very nice things to have, but they are not part of the problem of Economic Efficiency.

Economic efficiency consists of making things that are worth more than they cost, and it is the peculiar characteristic of private business, under a competitive system, to seize and exploit any opportunity to achieve this desirable end. Thereby—so runs the argument—it tends to produce as much of everything as can be produced without driving value below cost, and any more would not be economically worth producing.

The suggested adaptation of this principle of engineering economics is that the economist make comparisons of the costs and benefits established for the respective taxpayer groups as a means of:

1. Determining the costs allocable to the respective taxpayer groups.
2. Preserving the equities and economies of the cost allocation both in enacting legislation for the highway needs and highway financing programs and in administering them.
3. Measuring the over-all economic worth of the highway needs program, or any portion of it.

Cost-Benefit Analysis

The method proposed for applying costs and benefits as bases in a highway cost allocation is a "cost-benefit analysis". In concept this method does not differ in any fundamental respect from the engineer's benefit-cost ratio, but it is more complex to permit its adaptation to different taxpayer groups and its application to individual highway projects, groups of projects or highway systems. The words "cost" and "benefit" are reversed to show that cost is the primary factor and benefit the secondary factor.

In the making of cost-benefit analyses there are three major steps as follows:

1. To search out by means of a probe of the decision-making processes underlying the needs program the program costs included for each beneficiary or taxpayer group.
2. To make an independent calculation of the benefits of the program to each beneficiary or taxpayer group.
3. To compare the costs and benefits calculated for the respective taxpayer groups and establish the cost properly chargeable to each.

Step 1

The first step can most effectively be accomplished by a causal responsibility analysis of the decision-making processes underlying the needs program. This is a procedure by which costs are traced through the person or agent who established the cost in the program to the person or agent who initiated the cost-causing action. By this procedure the economist relates what the engineer has built into his program to the taxpayer groups for which the costs were caused or for which the benefits were anticipated.

The engineer decides upon certain designs and incorporates them into his program because in his professional opinion or judgment some vehicle characteristic, traffic characteristic, taxpayer use or governmental activity requires them. Or he incorporates designs, improvements or routes in compliance with the wishes of some taxpayer group transmitted to him by legislative or administrative direction. In either event, he establishes costs for the respective taxpayer groups.

A probe of this decision-making process is facilitated by the fact that most program costs are established in the carrying out of engineering procedures and the applying of engineering standards. The "needs" engineer has developed special procedures for classifying highways into systems, standards for determining which highways are intolerable and standards for new highways, in all of which traffic counts are an important, if not the key, factor. The economist can either ask the engineer to break down these

procedures and separate out the desired information, or attempt to understand them and separate out the desired information himself.

The more elusive costs assignable to highway users, other special taxpayers and general taxpayers are usually established as the result of engineering decisions based on practical experience, or as the result of legislative or administrative decisions based on legislative and administrative objectives. Examples of general taxpayer costs are those incurred for such governmental activities as national defense, mail delivery, the transportation of school children, and costs of certain area development roads. An example of general taxpayer sustaining costs are those incurred for continuing in operation community roads built to provide rural areas with the advantages of community life. While these costs are difficult to ascertain, the economist may be able to elicit some of them from the engineer. Otherwise he will need to resort to laws, records or hearings, departmental documents and library sources.

For most cost information the economist need only probe current or recent decision-making since most projects comprising a highway needs program are for new highways and the improvement or betterment of existing highways, and the costs of these projects were established in that program. But for some cost information he may need to probe the decision-making of the past since some projects in needs programs are for the replacement-in-kind of existing highways, the costs of which were established in past highway programs (2, pp. 103-104).

The success of the economist's probe of the decision-making process will depend in large measure on the effectiveness and diligence of his questioning (16, pp. 151-171). Most of his questions will fall within the province of the engineer, but the few that fall within the provinces of legislators and administrators can be equally as important. Among the latter are questions relating to the selection of routes for improvement, the classification of highways into systems, and the improvement of roads to meet military, school bus, mail truck and other governmental requirements. While the probe of legislative and administrative decisions may not produce as specific and accurate results as the probe of engineering decisions, the mere knowledge that a particular decision was made by a particular person or agent for a particular purpose may suffice to establish the cost-caused relationship.

A cautionary word should be injected at this point. In probing the decision-making processes underlying a needs program, the economist's objective is to seek out the causal responsibility for costs established in that program and, eventually, the taxpayer for whom the costs were caused. He is not to assume the role of the engineer, the legislator or the administrator and make engineering, legislative or administrative decisions or changes in their decisions. But should he find what he believes to be a serious error, he probably should report it to the proper official for reconsideration, but not allow that official's action to divert him from his cost-caused analysis.

Step 2

The second step in an application of the cost-benefit analysis is to compute the probable benefits of the needs program to the different taxpayer groups for use in conjunction with the cost findings. This compu-

tation may be based in part on factual data derived from engineering tests, surveys, research and like sources.

Before a benefit computation is started it is important to note that special taxpayer benefits are for the most part economic in nature and subject to quantification, whereas general taxpayer benefits are only partly economic and largely political, military or sociological in nature and subject to evaluation as a public good along with policing, education, parks and the like. Furthermore, because of the importance of special taxpayer benefits in the solution of the special taxpayer problem, the computation of such benefits is of considerably more concern in this study than the computation of general taxpayer benefits.

Considerable information on motor vehicle benefits is obtainable from engineering sources since engineers consider such benefits in establishing design standards and at times in choosing between alternate improvement designs. According to the AASHO report, "A Policy on Geometric Design of Rural Highways," the engineer is required to consider road user benefits along with value of highway services and benefits to state and community and to land in establishing design standards (17, p. 108). The road user benefits to which he is required to give weight when he selects a particular design are, according to the AASHO manual, "Road User Benefit Analyses for Highway Improvements" (18, p. 2):

Direct benefits to road users in the form of reduced vehicle operating costs and saving in time on improved highways.

Benefits to road users in the form of increased comfort and convenience.

Additional benefits "in the form of over-all accident reduction" are mentioned, but no instructions are given as to their evaluation. However, research into this type of benefit has progressed to the point where it should begin to yield sufficient information to round out the motor vehicle benefit picture. Possibly such considerations as increased convenience and reduced irritation should be included.

Information on the benefits of highways to land and property can also be obtained from the engineer, even though his procedures for evaluating them are not as definitely set forth as his procedures for evaluating motor vehicle benefits. Many years ago considerable effort went into the development of procedures for assessing highway costs against benefited land and property owners. More recent studies have been made of the effect of free-ways on land values. Other studies of the economic impact of improved highways on land and property are under way.

Some information on the economic benefits to the general public of postal and school bus routes, park roads, national defense highways, highways for the development of new areas, and routes connecting state capitals and county seats may be obtainable from engineering and other sources, and used to justify the cost of such routes, roads and highways. Information on the general and intangible benefits of highways in terms of travel, transportation, commerce, community life and national life is neither readily available nor necessary for the present study. They are mentioned merely by way of pointing to a field of inquiry which would have significance in what is an essentially different problem; namely, evaluating the worth of highway projects or groups of projects in relation to the worth of other governmental or public enterprises.

Step 3

The third step in the cost-benefit analysis is to determine from comparisons of the costs and benefits computed for the respective taxpayer groups, the cost properly chargeable to each for tax purposes. Since the costs and benefits can be computed project by project, cost-benefit comparisons can be made for projects, groups of projects, systems, or all systems comprising the program.

Cost Assignment Rules

The two basic cost assignment rules developed in this study are as follows:

1. That each special taxpayer group be held responsible for the highway costs incurred in its behalf, but only up to the limit of the economic benefits which will accrue to it.
2. That general taxpayers be held responsible for all other costs in excess of those assignable to special taxpayer groups.

The first rule is based on the conclusion that in using its special taxing power, it is proper for the government to recover from special beneficiaries of a highway program those costs incurred to provide facilities for their special benefit; but it is unjust to recover more than the incurred costs, and economically unjust to recover incurred costs in excess of accruable benefits. Therefore, for each special taxpayer group the quantified costs constitute its tax responsibility, unless they exceed the quantified economic benefits, in which event the quantified economic benefits constitute the upper limit of its tax responsibility. In this rule the notion of the government including a profit of any kind in its special taxes is definitely out.

All cost-benefit comparisons in which costs exceed benefits are deemed unfavorable and proper subjects for examination in the interest of equity and economy. In such an examination, inquiry should be made into such possibilities as the following:

1. That some special beneficiary group may have been overlooked in the determination of costs and benefits.
2. That the project may have been designed to provide services not properly chargeable to special taxpayers.
3. That the project may not have been designed to provide the most economic service or benefit to the taxpayers involved.
4. That the project may include for a special taxpayer group or class costs not justifiable in terms of engineering economics.

If the findings indicate problems outside the province of the fiscal study, they should, as previously mentioned, be referred back to the engineers for re-evaluation and, if necessary, to the legislature for policy action.

The second rule is based on the conclusion that, since the provision of highways is an essential function of government, all program costs not chargeable to highway users, property owners or other special taxpayer groups, or scheduled for financing through tolls, are the tax responsibility of the general taxpayer and recoverable from local, state or federal general funds. Costs specifically incurred to further the delivery of mail, the transportation of school children, the national defense and other governmental activities are obviously chargeable to the general taxpayer. Any

costs incurred for no specific group or activity must be presumed to have been incurred for the general public and to be chargeable to or recoverable from the general taxpayer. Any costs incurred for, but not chargeable to or recoverable from, a special taxpayer group must be presumed to be in the nature of a subsidy and also chargeable to the general taxpayer.

The residual nature of most program costs chargeable to general taxpayers precludes the necessity of using cost-benefit comparisons to establish such costs. However, comparisons of the cost and economic benefit of improvements made to further some specific governmental activity may prove useful in demonstrating to budgetary officials and the legislature the worth of these improvements in relation to other activities sharing in general tax funds. But these and any other comparisons of the cost and benefit of highways to general taxpayers fall within the general tax field and are beyond the scope of this study.

Interim Application

Full application of the cost-benefit analysis in the financing of a state or federal highway needs program must of necessity be deferred until the requisite methods, procedures, techniques and data have been completed. Some can be developed rather readily, but others may take considerable time. The applicability of the cost-benefit analysis to individual taxpayer groups and to individual engineering projects makes possible partial applications for immediate or interim solving of certain problems.

For example, while the analyst is making the procedural refinements necessary to separate out the costs and benefits for all special taxpayer groups, he could approximate them for highway users. This he could do by segregating the costs caused by highway users in a sampling of projects and obtaining from them the range of probable results. By expanding these figures for the six systems he could provide a tentative highway user cost figure. Then he could make a comparable calculation of benefits accruable to highway users to serve as the upper tax limit for that group. Reasonably accurate highway user costs would also serve as a major contribution to a determination of the increments of cost occasioned by the various classes of motor vehicles in the highway user group. And reasonably accurate highway user benefits could be used to quantify the benefits for the various classes of motor vehicles.

Another partial application might be made to some particular local, state or federal highway system. Information on the extent of the costs and benefits of a particular system to highway users and other special beneficiaries would shed considerable light on the problem of financing that system. One immediate possibility is the Interstate System. According to Section 210 of the Highway Revenue Act of 1956, the Congress intends to reconsider the question of equitable taxation of users and other beneficiaries of federally aided highways. This task might be facilitated by subjecting the Interstate System and other federally aided highways to the cost-benefit analysis.

Application to Continuing Costs

The cost-benefit analysis constitutes a basis for apportioning for taxation purposes the costs of all projects included in a needs program-- costs for the construction and continuance of entirely new highways, for the betterment and continuance of old highways, and for the continuance of

old highways. It was designed primarily to allocate the costs of new and bettered projects and is applicable to them as outlined, which is briefly as follows:

1. To determine from engineering and other information what costs each beneficiary or taxpayer group caused or is otherwise causally responsible for.
2. To determine what benefits each beneficiary or taxpayer group can anticipate in terms of savings and other economic advantages accruing from the use of new facilities as compared with the use of existing facilities.
3. To compare the computed costs and benefits and assign cost responsibility in accordance with the two cost assignment rules.

When the analysis is extended to the continuing costs of old projects it becomes somewhat more difficult and complex. For one thing it becomes necessary to make certain distinctions in the treatment of two types of continuing cost. First there are the abnormal costs of repairing, prematurely replacing and otherwise specially maintaining a project subjected to misuse, excessive wear or damage. These costs, whether estimated and included in a needs program or unanticipated and incurred periodically throughout the life of a project, are obviously caused by those who misuse, excessively use or damage the project and are therefore directly assignable to them. Furthermore, these costs would seem to be directly assignable without regard for the benefits provided by the project.

Then there are the normal costs of maintaining, replacing-in-kind and otherwise continuing a project in service. These costs are caused by those who cause or are causally responsible for the initial construction or any subsequent betterments of a project, and are assignable to them in the same proportion as the construction and betterment costs. Furthermore, these costs become a responsibility at the time a project is built and remain a responsibility until the project is officially abandoned. In other words, causal responsibility for a project extends to the normal maintenance and replacement costs as well as to the initial construction and subsequent betterment costs.

For extending the cost-benefit analysis to continuing costs the rules of assignment are supplemented by the following:

1. Assign responsibility for any abnormal continuing costs of a project to the beneficiary or taxpayer groups which cause or are otherwise causally responsible for them.
2. Assign responsibility for the maintenance, replacement-in-kind and other normal continuing costs of a project to the beneficiary or taxpayer groups which cause or are otherwise causally responsible for the initial construction and any subsequent betterment of such project and in the same proportion as the construction and betterment costs.

A problem which can be anticipated in extending the analysis to the normal continuing costs is that of maintaining reasonable consistency in the treatment of such costs on new projects, and the additions and betterments to old projects. The task is simply one of taking the assignment of construction, or betterment costs made in accordance with the cost-benefit analysis and the cost assignment rules and then assigning the estimated continuing costs proportionately.

In the case of old projects, and the parts of old projects incorporated into betterment projects, the task becomes one of first reproducing

the original assignments of construction costs and subsequent assignments of betterment costs by the application of the cost-benefit analysis and the cost assignment rules, and then apportioning the estimated normal continuing costs proportionately. This would require an historical investigation of each project from the time it was originally constructed. The analyst would first attempt to fix the causal responsibility for the initial cost of the project, taking into consideration engineering judgment and other factors reflected in the decision-making process at the time it was built. Next he would attempt to compute the benefits anticipated in terms of economic advantages and savings by comparing the then new facilities with those which preceded them. Then he would compare the computed costs and benefits, apply the cost assignment rules and arrive at an approximation of the original cost assignment. If during subsequent years the project was bettered by reconstruction, and additional costs were occasioned and new benefits provided, he would recompute the costs and benefits and revise the original cost assignment. This latest cost assignment would constitute the formula for apportioning the normal continuing costs of that project.

Such an investigation if extended to all old projects and portions of old projects continued in the needs program would add up to a difficult and time consuming task. Actually there may be some projects on which the causal responsibility for continuing costs may be so readily apparent that no detailed investigation would be necessary. There may be other projects which have had a major re-building on which the residue of the old project and its continuing cost are so small no detailed investigation would need to be made. For some types of projects an investigation of a sampling may be sufficiently revealing to permit its use in place of a complete investigation.

Before the economist undertakes the difficult and time consuming task of extending the cost-benefit analysis to the continuing costs of old projects he should decide whether the effort involved would be commensurate with the total cost allocation effort and with the probable results in terms of more equitable taxes and, if not, whether he should modify or curtail this portion of the analysis.

The continuing costs—normal maintenance and replacement-in-kind—of old projects are a relatively minor part of the over-all cost allocation problem. Normally they represent a small portion of the engineer's total estimated outlay which is to be allocated. Further, these costs require only one important decision in the allocation study and that is how to equitably assign them, whereas the costs of new and bettered projects require, in addition, decisions as to their economic justification and, in some instances, decisions as to sources of additional revenue. These facts suggest that old project costs merit relatively less effort than new and bettered project costs.

A decision as to whether the effort to extend the analysis to the continuing costs of old projects would be commensurate with probable results requires an investigation of highway taxation and its development in the state under study, covering among other things:

1. Assignments of continuing cost which are fixed by legal covenants between units of government and special taxpayer groups and cannot therefore be changed. Such assignments are commonly found in city ordinances under which a city covenants that it will maintain and re-pave streets which

property developers and owners pave or have paved to prescribed standards. Extension of the cost-benefit analysis to street projects involved in such assignments would obviously serve no useful purpose.

2. Assignments of continuing cost which have been incorporated into state statutes, many during the past quarter of a century as the direct or indirect result of highway cost allocation studies, and which cannot be changed without considerable difficulty and trouble. More specifically: (a) Assignments resulting from properly conducted analyses of costs caused—the best of the four accepted bases for allocating overhead costs—which probably were reasonably equitable at the time they were made, except for any charges to special taxpayers in excess of benefits, and have remained so. Extension of the cost-benefit analysis to highway projects involved in such assignments would probably be of limited usefulness. (b) Assignments resulting from properly conducted analyses of benefits anticipated, ability-to-pay or stimulus to improve utilization—the three other accepted bases for allocating overhead costs—, singly or in combination, which may have been reasonably equitable under conditions prevailing at the time they were made but may have become inequitable under changed conditions. Extension of the cost-benefit analysis to the involved projects would raise troublesome theoretical questions and produce results of doubtful value. (c) Assignments resulting from improperly conducted analyses, which in all probability were inequitable for one or more taxpayer groups and have remained so. Extension of the cost-benefit analysis to the involved projects would nevertheless serve useful purposes only if there were a significant degree of inequity and promising prospects for remedial action.

3. Assignments of continuing cost which were effected as depression, wartime or other emergency measures but never readjusted or terminated and as a consequence may have served to relieve some special taxpayer groups of their proper tax responsibilities and to burden others with more than their proper tax responsibilities. A prime example is the property tax which was de-emphasized during the great depression of the 1930's when it proved burdensome to the taxpayers, and which continues de-emphasized in several states in spite of present high levels of business activity and sustained inflationary trends. If the prospects of adjusting such assignments are promising, the projects involved in such assignments should definitely be subjected to a cost-benefit analysis.

At this point it might be well to inject the cautionary thought that any decisions made with regard to the continuing costs of old projects will most likely establish precedents, either good or bad, for the continuing costs of new and bettered projects.

Extension of the Analysis

The cost-benefit analysis may also serve as an effective means of preserving the equities and economies of the cost allocation through legislative deliberations on the proposed program and administrative handling of the enacted program. After completing his cost allocation and incorporating his equity and economy findings into an administratively feasible highway financing program, the economist will present his proposals and recommendations to the legislature. Here he faces the very real possibility that his carefully balanced program will be changed or modified. After the legislature has enacted the necessary legislation and passed the program on to the administrators, he faces the possibility that it will be adjusted. But if he can impress legislators and administrators with the significance

of the cost allocation he may be able to prevent changes, modifications and adjustments which will distort or completely destroy his equity and economy efforts.

Among the situations likely to arise in the legislature is that some special taxpayer group will effectively oppose payment of costs chargeable to it, or that other demands upon the general fund will be so pressing as to curtail the funds available to meet the costs chargeable to general taxpayers. An expedient solution would be to give priority to projects of maximum benefit to special taxpayer groups willing to pay their costs and to defer, or withdraw from the program, projects which have costs occasioned by non-paying special or general taxpayers, but this would have the effect of destroying the engineer's balanced highway program. A preferable solution might be to find another taxpayer group which would rather assume more than its assigned cost than have the project deferred or abandoned—either another special taxpayer group for which the project would provide benefits in excess of costs, or the general public for which the project would provide substantial general benefits.

It is suggested, therefore, that the cost-benefit analysis be extended for the use of legislators and administrators in solving the problems which arise in enacting and carrying out the financing and engineering programs. To assist in this, the economist could include in his report to the legislature a statement of the unifying philosophy underlying his cost-benefit analysis; a clear explanation of his cost-benefit findings, particularly those for special taxpayers; and a draft of a legislative provision covering the use of the analysis by administrators in programming highway projects.

Engineering Cooperation

Adoption of the cost-benefit analysis as a basis for planning the financing of a highway needs program would necessitate considerable engineering data not heretofore requested. It would require that the engineer compute the costs incurred for each taxable highway beneficiary group on each project, or sampling of projects, on each system. It would also require that he assist the economist in his computation of benefits accruable to the different groups by making available all procurable benefit data.

The major groups subject to special taxation for highway purposes are motor vehicles and land, but further research may produce other groups.

Both major groups may require reclassification. Motor vehicles which cause extra costs and/or receive special benefits are now classified for taxation purposes in numerous ways, depending upon the tax structure of the state. The compilation of cost and benefit data for these special classes of motor vehicles could be facilitated by bringing them into conformity with traffic count and any other classifications normally used in engineering procedures. Consideration of the desirability of reclassifying the land group must await a re-examination of the entire problem of land taxation.

The degree of refinement sought in engineering data should be consistent with normal highway engineering design procedures and highway taxation practices. As previously stated, requests to the engineer for refinements beyond those established for his engineering economics and design purposes

should be limited to those which can be reflected by a change in the tax rate, as an exemption, or by other treatment in the highway tax schedule.

Considerable research will be required to develop the proposed cost-benefit highway taxation analysis. Since it is an adaptation and refinement of the engineer's benefit-cost ratio, the logical starting point is that ratio. For many years active research on the subject of "economic justification in terms of benefits derived from road improvement" was carried on by the Highway Research Board Committee on the Economics of Highway Design. A revival and adaptation of this type of research might constitute a major contribution to the development of the proposed cost-benefit analysis.

SUMMARY

To summarize, the method of analysis outlined in this paper is one which:

1. Is integrated with the highway improvement program developed from a state-wide engineering study of highway needs.
2. Is based on the legal definitions of general purpose and special purpose taxes.
3. Is based on economic principles for the allocation of overhead or joint costs, in accordance with costs caused and benefits anticipated.
4. Is based on the engineer-economist's benefit-cost ratio for the justification of proposed expenditures.

The method can be used:

1. By the economist to develop a highway financing plan resolving such problems as the following: (a) Who shall pay how much for highways? (b) How much highway revenue should be distributed to each governmental administrative unit? (c) What constitutes diversion and dispersion of highway funds and how can they be prevented?
2. By the legislature to determine the effect on the economist's proposed highway tax levies and revenue distribution plan of contemplated changes or modifications in the financing program or in the engineering program.
3. By the administrator to establish the relative priority of projects to be incorporated into his annual highway improvement program.

The cost-benefit analysis is designed as the basis for a state highway financing program, but can just as effectively serve as the basis for the new federal highway financing program. That is, it was developed in response to demands for a more effective approach to the financing of state highway needs programs but is so basic in concept as to be applicable to the comparable, although more extensive and complex, problem of financing the new federal highway needs program and, more particularly, the new National System of Interstate and Defense Highways.

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THE NATIONAL ACADEMY OF SCIENCES—NATIONAL RESEARCH COUNCIL is a private, nonprofit organization of scientists, dedicated to the furtherance of science and to its use for the general welfare. The ACADEMY itself was established in 1863 under a congressional charter signed by President Lincoln. Empowered to provide for all activities appropriate to academies of science, it was also required by its charter to act as an adviser to the federal government in scientific matters. This provision accounts for the close ties that have always existed between the ACADEMY and the government, although the ACADEMY is not a governmental agency.

The NATIONAL RESEARCH COUNCIL was established by the ACADEMY in 1916, at the request of President Wilson, to enable scientists generally to associate their efforts with those of the limited membership of the ACADEMY in service to the nation, to society, and to science at home and abroad. Members of the NATIONAL RESEARCH COUNCIL receive their appointments from the president of the ACADEMY. They include representatives nominated by the major scientific and technical societies, representatives of the federal government, and a number of members at large. In addition, several thousand scientists and engineers take part in the activities of the research council through membership on its various boards and committees.

Receiving funds from both public and private sources, by contribution, grant, or contract, the ACADEMY and its RESEARCH COUNCIL thus work to stimulate research and its applications, to survey the broad possibilities of science, to promote effective utilization of the scientific and technical resources of the country, to serve the government, and to further the general interests of science.

The HIGHWAY RESEARCH BOARD was organized November 11, 1920, as an agency of the Division of Engineering and Industrial Research, one of the eight functional divisions of the NATIONAL RESEARCH COUNCIL. The BOARD is a cooperative organization of the highway technologists of America operating under the auspices of the ACADEMY-COUNCIL and with the support of the several highway departments, the Bureau of Public Roads, and many other organizations interested in the development of highway transportation. The purposes of the BOARD are to encourage research and to provide a national clearinghouse and correlation service for research activities and information on highway administration and technology.
