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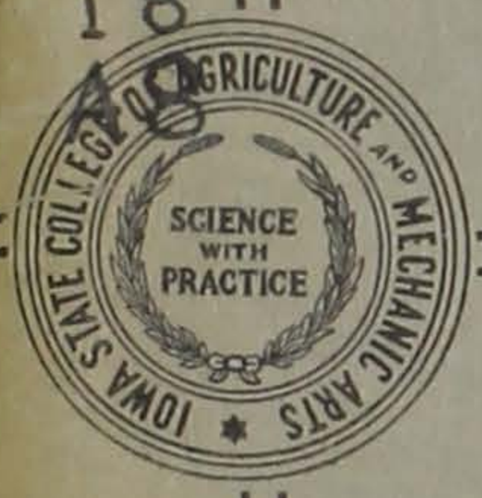

Analysis of Highway Costs and Highway Taxation With an Application to Story County, Iowa

By
E. D. ALLEN

IOWA ENGINEERING
EXPERIMENT STATION

BULLETIN 152
1941

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Analysis of highway costs and highway taxation with an application to Story County, Iowa.

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Bulletin 152 September, 1941

Analysis of Highway Costs and Highway Taxation With an Application to Story County, Iowa

By

EDWARD D. ALLEN

Research Assistant Professor of Industrial Economics

IOWA ENGINEERING
EXPERIMENT STATION

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LETTER OF TRANSMITTAL

T. R. Agg, *Director*
Iowa Engineering Experiment Station
Iowa State College
Ames, Iowa

Dear Sir:

I am transmitting herewith a manuscript entitled "Analysis of Highway Costs and Highway Taxation With an Application to Story County, Iowa." This analysis has been made as Project 212 of the Iowa Engineering Experiment Station, and represents the completion of this project.

The study would not have been possible without access to a great deal of factual information on highway investment, highway costs, and highway traffic. For access to such data and for help in organizing it, I am indebted to the Statewide Highway Planning Survey of Iowa, a joint project of the Iowa State Highway Commission and of the Public Roads Administration, conducted by Mark Morris and W. O. Price. I am equally indebted to Sam Steigerwalt, county engineer of Story County, for explanation and clarification of the highway records of Story County.

I also wish to acknowledge the assistance of Robley Winfrey and E. S. Lynch in clarification of some of the engineering and economic aspects of the study.

Respectfully submitted,

Edward D. Allen
Research Assistant Professor of Industrial Economics

Ames, Iowa
March 31, 1941

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ABSTRACT

This bulletin investigates two fundamental aspects of highway economics: (1) The nature of highway costs and their relationship to tax policies, and (2) the allocation of these costs among various groups of beneficiaries, especially between vehicle users and general taxpayers, and among various vehicle classes. Major theories of highway finance are analyzed and the economic costs of rendering highway services are discussed. It is emphasized that comparisons of costs and revenues for the entire highway plant must be made to determine whether existing highway tax structures are adequate to cover economic costs. Questions of highway tax policies that emerge when revenues are greater or less than costs are examined.

The major portion of the bulletin is devoted to a study of highway costs, revenues, and cost allocations in Story County, Iowa, up to 1939 and to a presentation of the 1938 investment value of the entire highway and street plant. An effort was made to avoid factual deficiencies of previous highway-cost studies. Capital investment was obtained for the mileages of each road and street system for 1913-1938 by a study of all records of original investment cost. Retirements were determined and deducted from the plant account, and depreciation rates for each component of highway investment were determined only after observation and study. Annual depreciation and interest on unamortized investment were determined from the investment in highways and streets, and were added to cash outlays for maintenance, administration, and traffic control to obtain annual economic costs for the entire system.

Total annual costs in Story County were compared with tax contributions by general taxpayers and vehicle users to determine whether each group paid its fair share of annual costs in 1938. Similar comparisons were made for various vehicle classes (heavy trucks, light trucks, busses, and passenger cars). To make these comparisons, fair methods of cost allocation were devised by intensive analyses of highway benefits to various groups, of highway costs that various groups may occasion, and of cost allocations employed in previous studies.

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SUMMARY AND CONCLUSIONS

Highway Costs and Public Policy

Highway costs and highway-tax policies constitute two separate, though related fields of inquiry. Costs include depreciation, interest on unamortized investment, and expenditures for maintenance, administration, and traffic control. When a comparison of costs and revenues for all road systems reveals that revenues are equal to or in excess of costs, the relative merits of continued capital improvements of the highway plant, diversion of highway-tax revenues to nonhighway purposes, or reduction in highway-tax rates should be examined.

If, however, analysis shows that current revenues do not cover current costs for the entire plant, the question of tax policy is whether current beneficiaries should be compelled to pay increased amounts for highway services. Highway services can be maintained at existing levels even if revenues are insufficient to earn any net return on past investment. On the other hand, relatively little inequity results when vehicle users (and each class of vehicle users) are required to pay sums sufficient to cover their share of costs. Moreover, to require these payments promotes an economic allocation of resources between highways and other forms of transportation. There is no merit in requiring general taxpayers to pay more than is sufficient to cover their share of current depreciation, maintenance, and administrative costs.

Cost Allocation and Public Policy

No precise cost allocation between general taxpayers and vehicle users can be determined on the basis of economic reasoning. It is logically possible to view the highway function from any or all of four viewpoints: (1) As a general governmental function to be financed by general taxation, (2) as a special governmental function to be financed by vehicle-user taxes, (3) as a public business enterprise, with vehicle-user taxes regarded as prices or fees paid for road use, or (4) as a combination of a governmental function and a public business enterprise. Since a mixture of social and individual benefits flows from highways, the relative shares in highway support assigned to general taxpayers and to vehicle users necessarily will depend upon the relative importance assigned to each of these major types of benefit. Use of the public-business viewpoint, which emphasizes the support of highways by vehicle users, tends to prevent subsidization of highway transportation by general taxpayers and to encourage efficient expenditure of highway funds.

It is desirable to charge each vehicle class—heavy trucks, light trucks, busses, or passenger cars—with that portion of total highway costs which it occasions, but lack of exact information concerning variation in highway costs between vehicle classes renders this method impracticable. As a substitute, costs may be allocated with reasonable fairness on the basis of benefits received. A practical measure of benefits is some physical unit of service, such as a ton-mile of travel.

Cost and Revenue Relationships in Story County and in Iowa

Highway-tax revenues from all sources were more than sufficient to cover annual economic costs of public highway services in Story County, Iowa, during 1938. Both vehicle users and general taxpayers contributed sums more than sufficient to cover their fair share of total costs. There was no subsidization of motor-vehicle users by general taxpayers. Since revenues exceeded costs, substantial sums were available for net capital improvements. There is sufficient economic merit in the continued improvement of motor roads in the county to warrant continuance of present vehicle-user taxes.

Owners of passenger cars and light trucks contributed more per ton-mile of use of Iowa highways in 1937 than owners of heavy trucks and combinations. This situation, which still prevails under 1941 laws, could be altered either by a relative increase in the license fees paid by heavier trucks and combinations or by the assessment of a ton-mile tax falling upon owners of heavy trucks and combinations only.

Analysis of Highway Costs and Highway Taxation With an Application to Story County, Iowa

INTRODUCTION

During the past 30 years United States governmental units have embarked on a program of rapid expansion in highway expenditures. Fundamentally, this expansion has been the result of an increased demand for transportation services because of the development and growing use of motor vehicles, although the increasing use of motor vehicles has, in turn, been stimulated by road improvement. The national level of highway expenditures has now risen to approximately 2 billion dollars a year, and highways and streets are provided for the users of more than 30 million motor vehicles. Iowa has participated in this national trend, and in recent years payments for roads and streets in this state have been between 40 and 50 million dollars annually exclusive of debt retirement and have constituted, along with expenditures for education, one of the two major types of state and local expenditure.

With the motor-vehicle era now entering a stage of maturity, and with annual taxation and benefits impinging on groups of diverse and often opposing interests, questions of public policy that were only partly apparent during the earlier years of rapid road improvement have now captured public attention. Although they involve economics, the main issues are not subject to settlement solely by economic analysis, for they undergo continuous adjustment and change through political decisions. Such issues range all the way from determining what unimproved secondary roads merit some degree of improvement, to determining the relative spheres of transportation service which should be occupied by rail or truck transport. Three of the major problems may be stated as follows:

1. How much should the various groups of beneficiaries pay for the continuing support of the expensive highways and streets already constructed?

2. How shall sums raised through vehicle-user taxes be distributed between highway and nonhighway uses, among various road and street systems, and among various political units ad-

ministering a given class of roads?

3. In the future, what total amount should be raised for highway purposes, against what groups and in what proportion should the costs of further capital improvements be charged, and what criteria should be adopted in the programming of expenditures?

Many studies have been made of the first of these questions in recent years by such special-interest groups as the railroads and highway-user associations, as well as by the federal government and certain state highway departments. Some of these studies purport to show that general taxpayers are subsidizing motor-vehicle users; some assert that although vehicle users as a class are paying their full share of highway costs, owners of passenger cars are subsidizing trucks and busses; and some claim that motor-vehicle owners as a group are overtaxed.[1] These studies have not been based on adequate, complete highway cost and traffic data, thus their conclusions may be subject to question.

Such discussion evidences that the motor-vehicle era has reached a stage of maturity in which emphasis is shifting from borrowing to taxation and in which taxation falls on a total number of vehicles that is no longer growing rapidly. In contrast, the prime emphasis during the period 1915-1930 was on the construction of state highway systems connecting all important towns and cities. Borrowing was relied upon to pay a large share of the improvement costs, vehicle-user taxes were still in the stage of development and were falling on a rapidly rising number of vehicle owners, and national income was rising. In consequence, there was little about the earlier period of expansion to cause much interest in the nature of highway costs and their allocation among different groups of beneficiaries.

Even when tax burdens are not in dispute, legislatures, organized vehicle-user groups, and highway administrators often differ over the *use* of highway-tax funds. Such controversies also have been largely the result of maturity in the motor-vehicle era. With some kind of all-weather surface provided for the trunk highways and much of the secondary mileage in many states, legislatures have been increasingly tempted to dedicate portions of vehicle-user tax revenues to other public purposes.

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[1]Federal Coordinator of Transportation. Public Aids to Motor-Vehicle Transportation. U.S. Government Printing Office, Washington, D.C. 1940.

Breed, C. B., Clifford Older, and W. S. Downs. Highway Costs. Association of American Railroads, Washington, D.C. 1939.

Glover, V. L. A Study of Highway Costs and Motor-Vehicle Taxation in Illinois. Illinois Division of Highways, Springfield, Ill. 1938.

Missouri Highway Department. Study of Missouri Highway and Street Costs. Missouri Highway Department, Columbia, Mo. 1937.

Oregon State Highway Department. An Analysis of the Highway-Tax Structure in Oregon. Technical Bulletin 10, Oregon State Highway Department, Portland, Ore. 1938.

Dillman, G. C., John S. Worley, D. Philip Locklin, and G. Lloyd Wilson. Highway Costs and Motor-Vehicle Taxation. Illinois Highway Users Conference, Chicago, Ill. 1939.

Stocker, H. E. Is Motor Transportation Subsidized? National Highway Users Conference, Washington, D.C. 1939.

For the entire country, the diversion of highway-user revenues to nonhighway purposes increased from $7,179,000 in 1925 to $158,284,000 in 1938, from 1.8 to 13.5 percent of user revenues. Thirty-seven states diverted revenues to nonhighway purposes in 1938.[2] Such diversion arouses opposition from highway administrators, who contend that continued improvement of the highway plant is vital to the welfare of the motoring public and that replacement requirements are being overlooked. It also arouses opposition from organized vehicle-user groups, who assert that highway-user taxes are equitable only when spent for highway purposes and should be reduced if not spent for such purposes.

Another aspect of the use of highway funds relates to the allocation of user-tax revenues among road systems. The competition of various systems for a portion of these revenues is on the increase. Urban localities find a grievance in the fact that while 25 to 35[3] percent of the total traffic on all roads and streets is carried by urban streets in most states, and while many urban vehicle users do all or nearly all their driving on city streets, user revenues allocated to urban streets are relatively small. Thus, in 1937, of $1,195,000,000 net vehicle-user imposts distributed by the states, only $43,124,000 went for work on city streets, exclusive of urban extensions of rural trunk highways, and grants were made to urban localities in only 15 states.

Rural residents also are becoming increasingly articulate in their insistence that, with the state trunk roads substantially completed, an increasing portion of user revenues be provided for secondary road systems. Such pressure has been strengthened by recent grants of the federal government for secondary roads, contingent upon the matching of these grants by each state. In Iowa the result was passage of a 1939 law which placed a ceiling of $16,000,000 on expenditures for primary roads out of current state user-tax sources.[4] All revenues over this amount were allocated to improvement of the secondary system. However, state highway authorities pointed out the need for continued large-scale expenditures on state trunk roads to modernize and further improve them for a growing volume of traffic.[5]

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[2]Iowa was not one of the 37 states which so diverted highway-user revenues in 1938. All Iowa user taxes have been pledged to highway purposes since 1915.

[3]Such traffic was reported to be 30.8 percent for 17 widely separated states by H. S. Fairbank in a recent paper entitled "Utilization of the Planning Survey." The figure for Iowa in 1936 and 1937 was 31 percent. Iowa Statewide Highway Planning Survey. Report of the Road-Use Survey. Table 27-SA. Iowa State Highway Commission, Ames, Iowa. 1938.

[4]This amount was increased to $17,000,000 by 1941 legislation. If receipts from user-tax revenues continue at the 1940 level, this law will provide about $3,000,000 annually for secondary roads in the state.

[5]A recital of the physical and financial needs of such a program for the primary road system of Iowa is found in the following reference: Iowa State Planning Board, Transportation Committee. Report and Recommendations of the Subcommittee on Secondary Roads. Iowa State Planning Board, Des Moines, Iowa. 1939. The committee estimates that the amount required to provide a really adequate primary road system is $124,215,000 and that, with existing revenues, 16 years would be required to complete such a system.

Problems of finance likely to arise in the future are naturally not the subject of as much controversy. Furthermore, it seems clear that if acceptable bases of taxation can be determined for allocation of costs of the highways already built, the financing of future capital improvements will be partly on that basis. But certain issues will still remain. There will be the continuing problem of developing tests whereby the public may decide whether an added dollar spent for highways will yield greater benefit than if spent for other public or private purposes. As current programs of debt retirement are completed and reconstruction programs become heavier year by year, there will be decisions to make between taxation and borrowing as a means of financing capital outlays. With a large mileage of all-weather, hard-surfaced highways completed, but with the accident toll high, the merits of programming expenditures of state funds with primary reference to safety considerations may well take precedence over the older objective of savings in vehicle operating costs. If federal funds continue to flow to highway commissions for expenditure under efficient conditions and to relief labor for expenditure under inefficient conditions, decisions as to objectives and methods of spending federal funds on highways will be necessary.

All this, of course, is only a partial recital of present and future problems in the field of highway policy. With so large an area of disagreement in so important a category of public expenditure and taxation, it has seemed worthwhile to extend the numerous studies of the Iowa Engineering Experiment Station in the field of highway economics to some of the present pressing problems, especially those on highway costs and their allocation. This bulletin, therefore, has two primary objectives:

1. The examination of basic theories of highway finance and highway costs in order (1) to reveal the fundamentals of cost allocation, and (2) to make clear the current basic assumptions of various groups in present highway controversies.

2. The application of these theories by a factual study of highway economics for a highway unit embracing all major classifications of roads and streets and covering substantially the entire motor-vehicle era. For this purpose, Story County, Iowa, has been selected, and the period from 1913 through 1938 has been studied.

GENERAL THEORIES OF HIGHWAY FINANCE

There are three theories of the function of the government in providing highways; each produces its logical counterpart in the kind of public revenue system which is indicated as a means of financing expenditures. These theories either underlie current thought about highways, are incorporated into existing revenue

systems, or both. Briefly, the theories presume that the highway function of government is essentially:

1. A general activity of government conferring indivisible social benefits.

2. A special governmental activity occasioning costs for and conferring benefits upon distinct groups or individuals.

3. A business enterprise whose services, provided by the state, confer benefits on private vehicle users and are to be financed through fees or prices paid by these users.

In each type of governmental activity it is generally possible to isolate both social and individual benefits, but the social benefits are considered to be predominant in the first theory, while individual benefits are considered to be predominant in the last two theories.

Associated with these theories of public function are four theories for the distribution of governmental costs through taxation: (1) The ability-to-pay theory, (2) the benefit theory, (3) the privilege theory, and (4) the cost-of-service theory. The ability-to-pay theory specifies that governmental costs are incurred for the general welfare, are a collective obligation of society, and should be distributed among the individuals comprising the social unit in a manner which imposes the least hardship. The least hardship is thought to be involved when each individual contributes according to his ability, which usually is considered to vary with his net income[6] or the value of his property.

According to the benefit theory, governmental costs should be charged against each individual taxpayer in proportion to the benefits which he receives from the conduct of public functions. Under the cost theory, the cost of the service rendered to individual taxpayers, and not the value of the service, would be the criterion of governmental cost allocation among the members of society. That these last two theories would not always lead to the same tax schedule can be seen by assuming that two trucks of a gross weight of 10 tons each, one carrying only coal and the other only high-priced merchandise, use the same highways. To the extent that these trucks occasion highway costs, the allocated costs would be equal. However, in these two instances, the economic value of service rendered by the state in providing the highway would be quite different in terms of the highest tax that the trucks could bear without being forced off the highway. Both theories assume that (1) governmental functions involve measurable benefits or costs to individuals and that (2) governmental services should generally be sold to individuals in the way in which government-owned utilities sell units of electricity or water.

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[6]Properly adjusted for number of dependents and for exemption of a certain minimum standard of consumption.

The privilege theory is really a variant of the benefit theory. It is argued that legal privileges conferred by government, such as the privilege of doing business as a corporation or of using the public highways, confer special benefits that could not be enjoyed except by governmental permission, and hence warrant special taxes. The special benefit is not believed to come from any positive governmental service but rather from the permission to do something not otherwise legally permissible.

All the theories of taxation are linked with one or more of the theories of public functions already stated, and consequently are now examined in relation to taxation theories, particularly as applied to highways.

Highways as a General Governmental Activity

The basic concept of the government in a private-enterprise economy (that of an agency for performing those functions which private enterprise is either unwilling or unable to perform in the social interest) is revealed in the concept of general governmental activities. The element of indivisible social benefit is so preponderant in some general governmental activities that private enterprise is unthinkable, for example, in the maintenance of a military establishment or a judiciary system. There are other activities which the government has had to assume because private enterprise proved unable to protect the public interest. An illustration of such an activity is the conservation of natural resources. Finally, there are those general activities where clear supplementary individual benefits exist, but where the social benefit still is considered paramount, such as fire protection and education.

Highways themselves have long been held to confer important social benefits. Until the coming of the motor-vehicle era they were regarded as conferring only supplementary individual benefits (much as do education and fire protection) except for the brief toll-road period in the early part of the nineteenth century. The maintenance of a system of rural unimproved roads, for example, was regarded as necessary to provide a means of intercourse between various parts of the community and to provide means of access to property. Even improved roads sometimes have been analyzed primarily from the viewpoint of social benefits. It has been pointed out that road improvements promote education (both because they stimulate travel and make possible the consolidated school), recreation and health, the breakdown of rural isolation and urban congestion, better postal service, and national defense efforts.

Acceptance of the general benefit theory has important implications for taxation. Where the social benefits of general gov-

ernmental activities are indivisible, the most logical theory of taxation is the ability-to-pay theory.[7] The benefit and cost theories of taxation cannot be applied even if it is desired to do so, since a method of measuring the costs or benefits attributable to an individual has not been devised.

To the extent that social benefits are recognized in a system of highway taxation, such taxation should be of a general nature on the ability-to-pay principle. More precise objectives of highway taxation which follow from this point of view are: (1) The promotion of national defense, internal administration, and communication; (2) the promotion of public health, recreation, community life, and employment; and (3) the utilization of natural resources by promoting the exploitation of land, minerals and timber.[8]

Preceding the motor-vehicle era, communal benefits and general taxation within local units of government were accepted as the bases of highway finance, as is shown in Appendix A. While the emphasis shifted sharply to special benefits and vehicle-user taxation after 1910, the general benefits conferred by highway expenditure are still used to justify some general taxation for local roads and streets. This theory also underlies much of the philosophy of federal highway programs. From its inception in 1916 until 1933, federal aid was based on the social ends of improved national defense and post roads, although in concentrating on the construction of a network of trunk highways partially supported by federal aid, the program actually conferred large special benefits on millions of private-vehicle users. Since 1933 the social objectives have been broadened to include unemployment relief through federal relief expenditure on secondary rural roads and city streets and to stimulate the capital-goods industry through large emergency grants to state highway departments as a means of speeding general recovery. During the fiscal years 1936 and 1937 the Works Progress Administration spent more than 1 billion dollars for highway and street projects. During the fiscal years from 1931 to 1937, Congress appropriated more than $1,200,000,000 for emergency federal-aid work on highways by the various state highway departments.

On the revenue side recent federal highway finance presents a rather confused picture. The increase in federal grants or direct spending for roads and streets since 1931 has obviously occa-

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[7] This does not mean that all taxes levied and collected by governments for their general functions follow the ability-to-pay principle. Unfortunately, expediency finds an important place in our tax systems, both federal and state, and many types of commodity taxes are levied on necessities, and bear with relative severity on the lower-income groups in society. But expediency can scarcely be elevated to the status of a taxation theory, and the conclusion as to the desirable way to finance ordinary governmental activities remains.

[8] Owen, Wilfred, and Bertram Lindman. Motor-Vehicle Taxation Rate-Making. Personal communication. 1939.

sioned a portion of the federal deficit financing. As such it has not been supported, in the immediate sense, by tax revenues at all, although it rests in the last analysis on the tax power. From 1933 to 1941 the federal government collected excise taxes (as a part of its general excise-tax program) on the sale of motor vehicles, parts, accessories, gasoline, and oil more than sufficient to finance its federal-aid grants to the states. Continuance of these excise taxes must be regarded either as having no connection whatsoever with federal aid, in which case such taxes are contrary to the ability-to-pay theory, or as being occasioned by and related to continued federal aid. In the latter case the logic of federal aid must rest largely on the special benefits which it confers on motorists, rather than on its avowed social benefits. Legally such tax revenues are not earmarked for highway purposes, but examination of hearings on federal-aid highway acts leaves no doubt that because these excise taxes eventually are paid by motorists, they play a part in influencing Congress to vote appropriations for highway purposes.[9]

Highways as a Special Governmental Activity

In contrast to general governmental activities, there are activities which are undertaken for the benefit of distinct groups within society. Often they are undertaken in response to pressure from these groups. These are called special governmental activities. A city, for example, may undertake the paving of a street in a new subdivision at the request of property owners along that street; and a county may register a deed, sell a hunting permit, or grant a marriage license.

Early in the motor-vehicle era the expansion of public expenditures for the improvement of rural roads was recognized as being undertaken largely at the insistence and for the immediate benefit of the growing motoring public. Consequently, the construction and maintenance of improved highways assumed the characteristics of a special governmental activity. It therefore was recognized that vehicle users could be asked to bear a large share of highway costs. The benefits which have accrued to vehicle users as a group are substantial. They include reduction in vehicle operating costs; constant access to all portions of the community (whether for commercial, educational, medical, social, or other reason); saving in time; and an increased possible range of movement.

Somewhat later it began to be recognized that larger and heavier vehicles incur greater highway costs and derive greater benefits from highway use. Thus the basis was laid for applica-

[9]U.S. House of Representatives, Committee on Roads. Hearings on Federal-Aid Highway Act, January 25 to February 9, 1938. p. 24-25. U.S. Government Printing Office, Washington, D.C. 1938.

tion of the cost-of-service and benefit principles to various classifications of vehicles as well as to motor vehicles as a group; and the benefit theory, cost-of-service theory, and privilege theory all have found application in systems of highway taxation. The benefit theory has been used to justify collecting sums from vehicle users sufficient to cover their fair share of annual highway costs. This was accomplished through such devices as motor-fuel taxes, license fees, and mileage taxes.

Benefit and cost theories have been applied in systems of vehicle-user taxation to distinguish between the use of highways by passenger cars and light trucks, and by heavy trucks and busses. The registration or license fee—to cite a specific type of vehicle levy—has been regarded as a privilege fee for the right to use the public highways, as a stand-by charge to cover the costs of highways built and ready for service, and as one method of compelling larger and heavier vehicles to pay their full share of highway costs.

Prior to and throughout the motor-vehicle era the special assessment on specially benefited property was continuously used to finance the improvement of property-access streets and roads. This constitutes another illustration of the financing of special governmental activities according to the benefit principle.

During the past quarter century the acceptance of the special-benefit character of highway improvements has resulted in a tremendous increase in highway-user tax revenues available for rural highway purposes. From 1921 to 1937 such revenues increased from about 120 million dollars to more than 819 million dollars according to the National Highway Users Conference. General taxation has supplied a decreasing portion of the revenues for rural highways. Tax rates for heavier trucks, for-hire trucks, and busses have increased. Iowa experience in this respect is summarized in Appendix A.

Highways as a Business Enterprise

Until recent years, most students of highway finance have been content with the concept of the highways as essentially a special governmental activity. Beginning about 1932,[10] however, there emerged a concept of highways as a business enterprise—the conduct of a transport facility or public utility primarily in the interests of traffic. From this point of view, the state acts as a representative of the people, invests capital in and maintains the highways, and sells the business services which it provides to vehicle users at prices paid in the form of vehicle-user taxes.

This concept is apparent in many recent developments. First,

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[10] Peterson, Shorey. Highway Policy on a Commercial Basis. *Quarterly Journal of Economics*, 46:417-443. May, 1932.

there is an increased emphasis on highway planning as a guide to the efficient expenditure of highway funds. This is evidenced in the highway planning surveys conducted in 46 states under the auspices of the Public Roads Administration from 1935 to 1941. Second, various highway cost studies have been made by such varied groups as highway departments, railroads, and the federal government (footnote 1, page 8). In these studies the adequacy of existing highway-user tax structures has been examined in the light of highway costs defined in the business sense, that is, with depreciation and interest on the entire unamortized investment included. Third, highway economists have given general emphasis to the possibilities of procuring an economic utilization of resources when highway expenditures are tested in the light of tangible, measurable economic benefits and when highway users are made to pay charges for the use of highway facilities which are high enough to exclude any elements of highway-user subsidy.

Proponents of a business concept of the highway plant logically contend that (1) a state's entire highway and street system and its subdivisions are now in many ways a unit of interrelated parts within which there is an extensive flow of traffic among the various urban and rural road systems and on which user revenues actually are earned by the operation of vehicles over every mile of thoroughfare in the state,[11] that (2) users of the highway plant in their own vehicles are enjoying essentially private uses, whether for business or pleasure purposes, and that (3) the annual revenues raised and expended are so large that highway operations must be conducted from the business point of view if sums raised are to be spent wisely and efficiently.

When this concept is adopted, the economic benefits to traffic are stressed in much the same way as when highways are considered primarily a special governmental activity. However, more emphasis is placed on quantitative measures of these benefits as possible guides in determining priorities of new capital projects and in determining the optimum limits of capital outlays as a whole. From this point of view, capital outlays for highways are warranted only as long as a reduction in total transportation cost is obtained, such cost being the sum of annual highway costs and annual costs of vehicle operation. Also apparent is the emphasis already noted on such highway cost elements as depreciation and interest, and on the use of uniform methods of highway accounting as a guide to intelligent forecasts of replacement needs in the future.

The kinds of governmental charges to highway users may be no different than in the case of highways as a special governmental activity, but highway-user taxes are viewed as prices

[11] See Table 35 in Appendix A for an illustration of these interrelationships for Iowa.

paid, either in return for special costs incurred for given vehicle groups, or in return for a variety of services rendered. As such, these prices are expected to provide sufficient income at least to cover all the long-run economic costs involved in public ownership and operation of trunk highways, to provide part of the costs of secondary roads, and to provide additional sums for capital improvements as well if the optimum development of highways and streets has not yet been reached. As already implied, proponents of this theory would minimize forms of highway support other than user revenues because highways are assumed to be of primary benefit to private vehicle users. It is pointed out that even a strictly private business confers social benefits as incidental by-products in the sale and consumption of the commodities or services involved, but that while "most production is socially important, so long as the ordinary demand for the product is sufficiently great that the social by-product is incidentally realized, we are commonly content and do not expand on the social implications."[12] When public operation of highways is considered from the business viewpoint, there is no need to rely on forms of public revenue other than motor-vehicle levies except when measurable economic benefits to traffic from highway improvements are clearly insufficient to cover the added costs of the improvement.

Application of Theories to Different Vehicle Classes

A special problem in the application of these general theories of highway taxation is found in the allocation of highway costs chargeable to vehicle users among different vehicle classes. Fundamental to this particular problem is a recognition of the special character of highway costs. In an ordinary manufacturing business, it is possible to distinguish two types of costs, those which can readily be assigned to a particular unit of production and those which cannot. However, once a highway plant is built, it is difficult to prove that any highway cost is obviously and directly attributable to the provision of highway services for a particular vehicle.[13] Highways are constructed for the purpose of furnishing services to all vehicles jointly, and none of the costs incurred are directly attributable to a particular motor-vehicle movement. This renders the problem of cost allocation among different motor vehicles extremely difficult where the purpose is to assign to each specially benefited vehicle or vehicle class an annual tax burden equal to its fair share of highway costs.

Three major solutions are possible. The first is an attempt to apply the cost-of-service taxation theory by isolating the highway costs attributable to particular vehicle groups, charging

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[12]Peterson, Shorey, *op. cit.*, p. 418.

[13]Clark, J. Maurice. Studies in the Economics of Overhead Costs. p. 304. University of Chicago Press, Chicago, Ill. 1931.

those groups with such costs, apportioning the costs among each vehicle in the group, and apportioning the remaining costs among all vehicle groups on the basis of some common unit such as the number of vehicles or the vehicle-miles traveled. It is reasoned that, while particular costs cannot be directly related to a particular motor-vehicle movement over the roads, it still is possible that certain vehicle groups do incur special costs. Such costs may be entailed through provision of extra facilities for these groups when a highway is built, or through extra maintenance costs when the highway is completed and in use. The case most commonly cited is that of vehicles which are heavier and larger than the private passenger car, but it is possible that even passenger cars have a special responsibility for modern highway costs since in most states passenger vehicles are permitted to drive faster than large trucks and highways designed for fast driving are more costly. The desirability of forcing each group of vehicles to pay its full share of the cost of facilities necessary to accommodate it is attractive from the economic viewpoint if substantial agreement can be reached among engineers as to what special costs are attributable to what classes of vehicles.

The other two cost allocations proposed represent applications of the benefit theory of taxation. According to these proposals, costs chargeable to motor vehicles would be apportioned among classes of vehicles either on the basis of some physical unit of use, such as vehicle-miles or ton-miles of travel, or on the basis of the value of the use of the highways. Physical units of use as a basis for highway-user taxation find special favor with those who view the operation of highways as essentially a governmental enterprise which furnishes services to its users, and with those who believe that the cost-of-service method of allocating highway costs is not practicable. As a physical unit of use, ton-miles of travel gives weight both to distance traveled and to the possibility that heavier vehicles have a greater responsibility for highway costs, even where those extra costs are not directly measurable.

The value-of-service method attempts to differentiate between low-valued and high-valued commodities which pass over the highways and to charge haulers of these commodities on the basis of what the traffic will bear. It is defended as a method which follows logically if service costs for particular vehicles or vehicle groups cannot be determined and if it is assumed to be of public benefit to promote highway utilization by encouraging the flow over the highways of a large and varied stream of commodities. The varying results of these theories of vehicle taxation are examined in some detail in the section of this bulletin studying the highways of Story County.

Summary

An impartial analysis of the general theories of public functions and of taxation with respect to highways has been attempted in the preceding pages. While highway finance can be approached through any of these theories, current public policy gives weight to all of them. General tax revenues continue to be raised for local roads and streets, and perhaps for a portion of the federal aid to highway systems. Special assessments are levied for the construction of urban and rural local-use roads, though to a smaller extent than 10 years ago. The gasoline tax is linked in the public mind with the notion of a payment for special benefits received and for the provision of new capital for further improvement of motor roads. Heavy tax schedules for large trucks and busses are justified by the assumption that costs of highway service for these vehicles and benefits received by them are greater than for passenger cars.

It is obvious, too, that all groups—highway officials, railroads, organized highway-user groups, and highway and engineering economists—recognize to some degree the validity of each of these basic concepts, either implicitly in the kind of emphasis which they give to highway taxation and expenditures, or explicitly, as when they argue for outright adoption of one concept as basic, but not exclusive, for the problems involved. Thus, the Association of American Railroads holds to the public-business or public-utility concept with all its implications for heavy-vehicle taxation. Yet even the railroads recognize the general nature of certain benefits conferred by highways and do not suggest complete support of all roads and streets by vehicle-user taxes or other special imposts. On the other hand, highway-user groups make their own studies to show that highways are not in any sense a public utility, that inclusion of cost elements such as interest on the entire unamortized investment in testing the adequacy of existing tax structures is wrong, and that continuing social benefits of highways justifies the maintenance of general taxation for highways at its present level. Yet these groups, too, recognize the special-benefit character of highways and do not urge the abolition of vehicle-user taxes.

Economists who agree on the desirability of promoting efficiency in highway expenditures to obtain an optimum highway development cannot agree whether the commercial viewpoint should be wholeheartedly adopted for highway policy or whether it is sufficient to refer to highways as predominantly a special governmental activity. In general it may be stated that no complete agreement ever can be reached on the proper and best theory of highway finance, precisely because there are special groups with opposing views and because the public conduct of

highways can be partly viewed from all three basic standpoints simultaneously. Nevertheless, it is important, for the specific issues subsequently to be discussed, to keep these basic concepts in mind, since implicit or explicit acceptance of any one of them as the primary approach to problems of highway economics determines the attitudes on these issues.

HIGHWAY COSTS AND PUBLIC POLICY

Definitions of Cost

In the first section of this bulletin, emphasis was given to the fact that the present major issue in highway finance is that of the nature of highway costs and the allocation of the burden of meeting them among groups in the community. That the nature of highway costs should be the subject of controversy may seem strange to those who are not students of highway finance. To most people it probably would seem reasonable to argue that highway costs must equal highway expenditures during any given period. Since the work of a committee of the Highway Research Board in 1929, however, highway costs have been considered to be the annual sums necessary to provide full payment for the use of resources devoted to existing highways as against alternative forms of investment.[14] These costs include costs of maintenance, administration, supervision, policing, and traffic control; depreciation on all portions of highways subject to exhaustion in service-rendering capacity; and interest on the entire unamortized investment. This report also pointed out that highway costs are but one component of total highway transportation costs; the other is vehicle operating costs.[15]

Several elaborate highway cost studies made in recent years likewise define costs to include full current depreciation and interest on the entire unamortized investment (footnote 1, page 8). Many studies have gone even further and have made taxes foregone an annual cost because the highway property investment is publicly rather than privately owned. Moreover, such studies have been made to test the adequacy of existing vehicle-user tax structures for meeting highway costs. Many have come to the conclusion that highway users are being subsidized, either directly at the expense of general taxpayers, or indirectly at the ex-

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[14]Agg, T. R., Chairman. Report of the Committee on Highway Transportation Costs. *Proceedings*, Highway Research Board (1929), 9:360-368. Washington, D.C. 1930.

[15]Vehicle operating costs, the subject of several studies in the Iowa Engineering Experiment Station, include such fixed costs as interest on vehicle investment, license fee, property tax, garage rent, insurance, and depreciation and such variable costs as those for tires, gasoline, oil, and repairs. Except for vehicle-user taxes, vehicle operating costs are of little direct concern in highway finance, but are of considerable indirect importance in the broader field of highway economics.

pense of competing forms of transportation.[16] The result has been to arouse the opposition of so-called highway-user groups," who have recently published studies of their own to discredit the idea that depreciation, interest other than contractual interest, or tax equivalents are proper elements of highway costs, and to demonstrate that no subsidization of vehicle users exists when costs are defined to include only cash outlays for replacements, maintenance, administration, and traffic control.[18]

In summary, four current interpretations of the term "highway costs" may be found:

1. Highway costs are all expenditures for highway purposes, including capital outlays and debt service, as well as expenditures for maintenance, engineering, administration, and traffic control (popular definition).
2. Highway costs are that portion of total expenditures necessary to maintain the present plant, finance replacements, and meet debt service (definition accepted by highway-user groups).
3. Highway costs are the annual sums necessary to maintain the present plant, provide for its future replacement to the extent that it is used up currently, and cover interest on the entire unamortized investment (Highway Research Board definition).
4. Highway costs are the sums listed in the previous definition plus an amount equal to taxes foregone on the highway investment (railroad definition).

The first of these definitions or identifications differs from the other three in including all capital expenditures as costs. This definition of costs, however, is rejected for two reasons. First, it is just as true with highways as with any other kind of business that annual costs on capital account include only charges to recover that portion of the total service cost of the capital goods used up in a particular year and to pay a return on the investment. Second, current disputes over highway costs do relate to the costs of the plant already built and now in service.

As between the second definition of costs and the last two, the basic difference is between costs as cash outlays and costs as the annual charges necessary to provide full payment for the use of resources devoted to highways rather than to alternative forms

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[16]One important study reached the opposite conclusion: Federal Coordinator of Transportation, *op. cit.* This study includes interest and depreciation but not taxes foregone in highway costs and concludes that, for the period 1921-1938, motor-vehicle users more than paid their way.

[17]The principal organization of the group styles itself the National Highway Users Conference. It is understood to be financed mainly by motor-vehicle manufacturers and road-equipment and road-material companies. In general, its publications are designed for use in combating present or future motor-vehicle road-use charges.

[18]Statements of this position are set forth in the following references.

Dillman, G. C., John S. Worley, D. Philip Locklin, and G. Lloyd Wilson, *op. cit.*

Stocker, H. E., *op. cit.*

Elgen, Riley E. Are Highways a "Public Utility"? National Highway Users Conference, Washington, D.C. 1939.

of investment. Under the third and fourth definitions capital costs do not depend on the particular financial arrangements under which resources have been obtained. Interest as a cost appears as interest on the entire unamortized investment, not as contractual interest only. A depreciation charge is used to reflect annual consumption of capital, rather than debt-retirement payments based on some arbitrary borrowing period. Costs also include charges which may not become actual outlays on highways in the same period, and sometimes never. Depreciation charges on a plant which has ceased to expand might not involve actual outlays on plant replacement for a considerable period, and revenues raised to cover interest on the entire investment in such a plant would be available continuously for other governmental purposes or available for tax reduction in other than vehicle-user taxes. As between the third and fourth definitions, of course, the only difference is the inclusion or exclusion of taxes foregone.

Controversial Cost Elements

That the Highway Research Board committee in 1929 defined costs in a way similar to the third definition above has already been noted, and this might be sufficient ground for flatly accepting this definition and proceeding with the analysis. Recently, however, some experts in the highway transportation field have argued that to recognize such elements as depreciation and interest on investment as elements of annual cost is improper. They assume that to do so would necessarily sanction their inclusion in determining whether existing vehicle-user tax rates are adequate and that to sanction their inclusion in this way would create inequitable taxation. These experts assume that highway costs cannot be identified with long-run private business costs because to do so would create a situation in which taxpayers would be forced to contribute twice for the use of highway facilities, once when they provide such facilities and again when they use them. Other experts accepting the definition of costs given by the Highway Research Board, have not been clear as to just how interest on investment is a cost and what implications its acceptance as a cost has for public policy. In view of current disagreement and lack of understanding respecting these elements of depreciation, interest, and taxes, it seems desirable to examine their relationship to the subject of highway costs and taxation by three approaches:

1. Are depreciation, interest, and taxes on the highway investment elements of highway cost?
2. How may consideration of depreciation and interest as costs aid the understanding of highway problems?
3. How should consideration of depreciation and interest as

costs affect public policy in the field of taxation?

In considering these questions, it may be pointed out that the discussion of depreciation, interest, and taxes under these separate headings has the advantage of separating questions of fact from questions of policy. Interest on investment, for example, may be a cost of investment in public highways under all circumstances, but it does not necessarily follow that those who support highways through general taxation or through payment of motor-vehicle taxes should be compelled to pay sums sufficient to cover such interest on the entire investment. Failure to make this distinction between fact and policy often results in confusion of the issues presented.[19] The questions of fact will here be considered apart from those of policy.

Depreciation

As an element of highway cost, annual depreciation—whether arising from physical deterioration through use, weathering, or other factors, or from obsolescence because of changing concepts of adequate highways—must be accepted. Its importance is emphasized by the gradual rise of highway reconstruction requirements year by year. Its existence as a cost does not depend on whether highways are viewed as a general governmental function or as a business; a gradual exhaustion of service life takes place and must eventually be made good if the service-rendering capacity of a particular part of the highway plant and the plant as a whole is to be maintained.

Interest

As previously pointed out, the Highway Research Board cost formula published in 1929 included interest on the entire unamortized investment as a cost. Despite this, there has subsequently been some confusion, particularly among highway engineers and engineering economists, concerning interest as a cost element on capital owned by the state. There has not been universal acceptance, for example, of the proposition that this item is a true annual charge against public ownership of the highways. Those who deny it, however, have not been able to explain why the capital costs of public investment differ from those associated with private investment in private enterprise, since in both cases the funds are committed to investment purposes by members of a given community. Such lack of understanding calls for careful consideration of the nature of the interest charge. The interest charge may be examined when operation of highways is considered (1) as one of a large number of general governmental functions, or (2) as a business enterprise operated to provide services for motor-vehicle users.

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[19] This confusion seems to characterize the whole discussion of depreciation, interest, and taxes in Dillman, G. C., John S. Worley, D. Philip Locklin, and G. Lloyd Wilson, *op. cit.*

FUNDAMENTALS OF INTEREST. Whenever it is desired to invest present resources to obtain a future increased flow of goods and services, resistance to the commitment of funds (which are the means of procuring real resources) to more or less distant enterprises must be overcome. Such resistance represents the economic cost of investment and finds its monetary equivalent in the interest charge. Three major factors lie behind this resistance: (1) Time preference, the preference which a majority of people are believed to have for present consumption over future consumption of goods and services; (2) liquidity preference, the preference for liquid funds rather than funds committed to investment because of the risk that funds committed to investment today will not be returned in the future; and (3) institutional costs, the operating costs which banks and other investing institutions incur in handling and investing funds.

Economists are not agreed on the relative importance that is to be attached to each of these underlying causes of interest, but they are agreed that some combination of them establishes an interest rate reflecting the scarcity of investment funds. With market rates of interest established, every commitment of funds to some specific enterprise involves, for individuals, the foregoing of alternative interest returns on other possible types of investment. For society it involves the foregoing of an alternative stream of goods and services of another type. Although resolvable into basic real causes, interest appears to individuals or institutions considering investments to be primarily a matter of opportunity cost. It also appears as an opportunity cost to those who are debating whether to save and invest at all, for the cost of expenditure of one's entire income for consumption is the foregoing of an interest return on investments. (Alternatively, the going interest rate reflects the current appraisal of the market on the cost margin involved in restricting present consumption to provide for the future.)

INTEREST AS A COST WHEN HIGHWAYS ARE ASSUMED A GENERAL GOVERNMENTAL FUNCTION. If the state exercises its tax power to obtain funds for public works, such as schools, highways, and public buildings, interest as a capital cost is present in the same basic sense as it is in private investment. Those who supply the funds to the state forego alternative opportunities for their use just as clearly as if they were invested in private enterprise. Most of the funds provided for such public investment would otherwise have been invested in interest-earning private investments or used to expand consumption. However, in public investment compulsion is used to obtain funds, and interest payments are not subsequently made to those who provide the funds. The highways already built can and presumably will be continued regardless of whether current tax income is sufficient to do more

than provide for their maintenance and replacement.

Interest, as an expenditure, appears only when capital has been borrowed, and even default on highway bonds will not affect the continuance of highway services provided by the previous investment. Bondholders cannot force the state to turn over the properties to them under foreclosure proceedings, contrary to the case of a default on bonds by a private business. At the worst, such default would only prevent the state from further extending its highway system through additional borrowing.

The relation of investment return to production is somewhat different for private than for public investments. It is equally true for both that when owned capital has once been sunk in durable plant and equipment, the absence of an investment return will not prevent production from continuing until the capital equipment has worn out. But a private enterprise, unlike a public enterprise, must earn at least the going rate of interest (for enterprises of similar degree of risk) or capital eventually will be withdrawn from the enterprise. If a private firm has borrowed long-term capital funds, and defaults on the interest payments subsequently, it is likely that the creditors will assume control of the business. Even so, they are likely to continue operating the business so long as there is any return over and above out-of-pocket costs. In the long run, however, capital will not be reinvested unless there is a prospect that a return equal to the going interest rate subsequently will be earned.

INTEREST AS A COST WHEN HIGHWAYS ARE ASSUMED TO BE A BUSINESS ENTERPRISE. If the highways are a business enterprise, the state, acting for the public, sells highway utility services to highway users, exacting prices or tolls for these services. As customers, highway users are presumed to obtain value commensurate with the price paid, just as in the voluntary purchase of any utility service or consumer good. In fact, as customers, highway users do lose title to any funds thus committed to the purchase of highway services. Investment of funds thus obtained by the state for further highway improvement represents a use of public funds not legally belonging to highway users.

If the state charges fees (for that portion of highway services deemed to be for the benefit of vehicle users) which are insufficient to provide a net return above depreciation, maintenance, and administration costs, it is clear that highway users are purchasing services below cost and that the general public is meeting these costs by continuously foregoing a return on its previous highway investment. If the state charges fees just sufficient to earn a net return equal to the going interest rate on the previous investment, then interest actually is earned through payments by vehicle users. Where interest as a continuing cost

falls ultimately, however, depends on how the interest income is used. If it is used to finance new types of governmental services, extend old types, or reduce types of taxation other than vehicle-user taxes, the public may be regarded as receiving a direct or indirect return on its previous highway investment and vehicle users may be considered as meeting the interest cost.[20] If it is used to finance further highway improvements, the public continuously foregoes a return on its increasing highway investment, and interest becomes a continuous cost to the public. In this case highway users cannot be regarded as actually contributing capital for investment in the highway utility simply because they pay a sum sufficient to produce a fair rate of return on previous investment, any more than a return on private capital investment can be regarded as a capital contribution by the customers.

Finally, if the state establishes user taxes which yield revenues in excess of a fair rate of return, the state not only is covering full economic costs of operating the highways, but is in addition (from an economic, though not from a legal point of view) obtaining excess returns. If such excess is invested in highways, vehicle users may be regarded as making a capital contribution to this extent. A privately owned and regulated utility, in theory, would be unable to obtain such excess returns. Interest as a cost on such excess is borne by vehicle users who have contributed the capital, but they likewise receive an investment return in the form of expanded services for their benefit. If the excess return is not invested in highways but is used for other public purposes, then interest as a cost likewise falls on the vehicle users, except that in this instance no expansion in special services for their benefit subsequently occurs. Under this general assumption of the highways as a public business, it is clear that in every case interest appears as a cost, either to the general public or to highway users.

Taxes Foregone

Whether taxes foregone (because the public highway investment is tax-free property) constitute an element of highway cost is a further question. Whenever capital which might otherwise have been privately invested is used for public investment, the tax base available to the state shrinks. Although this means that taxes are foregone by the state on such property, it does not mean that tax revenues need be reduced so long as the state is able to levy higher tax rates on the smaller tax base. The state is able to do this so long as the economy remains predominantly a private-enterprise system. Since this has been true

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[20] From the highway user's standpoint, such use of funds constitutes diversion. As such, it is typically protested as unjustifiable by highway-user groups. The analytical elements in the diversion problem are examined later.

throughout the modern highway era, it would appear that taxes not levied on highway property do not constitute in any sense an element of highway operating expense to the state as owner.

Whether amounts equal to taxes on highway property constitute costs to any group is unanswerable unless it is agreed from what viewpoint the conduct of the highway function is to be approached. If highways are regarded simply as one of a number of general governmental functions, and if vehicle-user taxes are regarded as one of a large number of sources of governmental support, then obviously taxes not levied on highway property involve no net costs. The general public simply contributes less through highway taxes and more through other types of taxes. Vehicle users are not believed to receive a net subsidy, since they are regarded as a part of the general public.

Such an analysis, however, is scarcely tenable, since highway-user taxes originally won acceptance because they constituted specific levies on a special group and were used to finance an expanding public function for the immediate benefit of that group. Consequently, it seems more valid to consider highways as a public business enterprise. From this viewpoint, highway-user taxes are really charges for highway use, and the state is considered to be selling highway services to a select transit group composed of vehicle users. Under such a plan, failure to collect sufficient highway-user taxes to equal the property taxes foregone does involve net costs for the general public, which has to pay higher property taxes than would otherwise be necessary to produce a given public revenue for general governmental purposes. Consequently, taxes not levied on highway property are a cost to the general public and a subsidy to vehicle users.

The net cost, however, may not be large. A certain proportion of highway-user taxes which include sums equal to property taxes on the highway investment in the long run would be passed on to the general public anyway. This is true of all commercial highway uses, for prices must reflect all business costs in the long run. Also, all vehicle owners and vehicle users are themselves members of the general public, so that even for nonshiftable highway-user taxes, the amount of net cost involved is doubtful. It can only be surmised that failure to tax noncommercial highway users sufficiently to include highway property taxes does place some net burden on general taxpayers and on all those who ultimately feel the incidence of property taxes. This is because vehicle use is so much more widely distributed than real property, and because accepted economic analysis indicates that the important part of the property tax which falls on land values cannot be shifted. Since the extent of the net cost cannot be measured, the tax equivalent has not been regarded as one of the basic highway costs in the revenue-cost compari-

sons in the last section of this bulletin, but it is introduced rather as a supplementary item to reflect the fact that, to some unknown extent, it is a cost item.

Depreciation and Interest Cost Factors in Highway Analysis

How may consideration of depreciation and interest aid in an understanding of highway finance problems? Most of the elements in the answer can be isolated through a discussion of depreciation. Depreciation analysis will help highway departments predict with some accuracy the annual reconstruction loads which they will face in the future, and will help them arrange their finances in such a way that these requirements may be met. It will help indicate the present value of the public highway investment, an estimate which is required if it is decided to charge vehicle users annual amounts sufficient to include interest on plant investment. It will indicate with some accuracy whether the government is collecting sufficient taxes for highway purposes to maintain the service-rendering capacity of highways.

This last use of depreciation analysis has been examined for three assumed stages in highway development, where extension and replacement outlays (1) exceed current depreciation, (2) just equal current depreciation, or (3) fall below current depreciation. For all three stages, it will be assumed that (1) highways are financed without resort to borrowing, (2) highways absorb all net receipts from highway-user taxes so that no problem of diversion from highway to nonhighway uses exists, and (3) highways are financed by general taxpayers, vehicle users, and others in proportions which are accepted as a fair allocation of the total tax burden.

Depreciation analysis of all highway fixed capital assets is necessary to discover which of the three stages represents current development. The common present assumption is that net additions are continuously being made to the capital value of our highway and street plant. However, it is possible that a broad depreciation analysis for the entire highway plant may disprove this. It seems likely, of course, that for those portions of the highway system financed exclusively or largely from vehicle-user revenues (such as a system of state trunk highways), the annual outlays for extensions and replacements have continued to exceed current depreciation on highways already constructed. On the other hand, it is probable that for the streets of many urban communities and for secondary local roads, current outlays for extensions and replacements fall considerably below current depreciation. This certainly would be true for those urban communities of essentially static population which carried through an almost complete program of

street improvement 10 or 15 years ago when urban street outlays were at their peak in Iowa.

If analysis shows that the public highway plant is being operated in the first or second stage, then in effect highway beneficiaries (general taxpayers, vehicle users, and others) already are being charged sums sufficient to cover, or more than cover, annual depreciation. Such a policy is not objectionable, of course, so long as it is considered to be in the public interest to maintain or expand the service value of the highway plant. With either of the first two stages of highway development the question of charging for depreciation in current highway tax levies does not become a recognized question of public policy because annual tax levies are not made in excess of current expenditures and no accumulation of cash depreciation charges is involved, with its attendant problems of fund management.

Analysis, however, may show that the highway plant is currently in the third stage of its development and that present beneficiaries are not meeting all present costs. While this situation probably does not exist for all road and street systems which comprise the highway plant, it may exist for highways as a whole. If so, it then becomes a matter of public policy to decide whether full depreciation should be charged against current highway and street beneficiaries.

The value of depreciation analysis in this respect is that it enables one to determine whether a problem of policy actually exists. Such analysis must therefore precede consideration of policy problems in the field of taxation.

The inclusion of interest in the cost analysis is useful in a similar way. Whether existing revenues for highways equal, exceed, or fall below a going interest rate on investment, and whether there is any problem of tax adequacy, can be determined only after a revenue-cost comparison including all elements of highway cost has been made. If current highway tax revenues are equal to or in excess of the amount sufficient to provide a fair return and all such revenues are being devoted to highways, then there is no problem of tax adequacy. However, if vehicle beneficiaries are contributing amounts in excess of a fair return, an issue of public policy *is* presented; namely, whether there is economic justification for investing such excess revenues in further highway improvement. If the added benefits seem to be less than the added costs, and if it is assumed that such excess should be used for highways or not collected at all, then a reduction in highway taxes is indicated.

Depreciation and Interest in Relation to Tax Policy

Only if present beneficiaries are not fully meeting present costs is there a basis for controversy as to adequacy of existing

highway-tax structures. The fundamental question then raised is this: *Should a demonstration that current revenues fall below current costs be accepted as a test of the adequacy of highway-tax structures?* Specifically, under such circumstances should present beneficiaries be required to pay amounts sufficient to cover depreciation and interest on the highway investment? Those opposed to accepting such a conclusion and its implications urge[21] that to accept it is to adopt a false theory of the highway function of government and forces taxpayers to pay depreciation and interest for the performance of only one out of many general governmental functions. From this point of view, the highway function is not fundamentally a public business activity at all but is, at most, a combination of special and general governmental functions. As such, no conclusion as to the inadequacy of current tax revenues based on the foregoing analysis is acceptable, since no more reason is admitted why taxpayers should pay depreciation and interest on account of public investment in highways and streets than in carrying on any other public function. In fact, it is contended that, aside from charges for depreciation and contractual interest on debt, charges for interest on owned capital or for taxes foregone on highway investment would be a meaningless bookkeeping procedure, since tax rates which produce a surplus of revenues for highways automatically produce lower tax rates for other governmental purposes when it is assumed that a given amount of revenue is to be raised.

Opponents of such a public policy also contend that it would involve inequitable double taxation, by forcing beneficiaries of highways to pay twice for capital facilities, once when highways are built and again when they are used. It is further contended that adoption of such a public policy would involve an upward revision in existing tax structures which probably would be politically impossible and economically inadvisable, and would at any rate create a problem of the proper utilization of funds accumulating from depreciation and interest. Politically it is urged that the majority of voters (most of whom are either vehicle owners or members of a vehicle-owning family) naturally would oppose any modification of the tax structure which would impose additional burdens that might otherwise be escaped, or at least postponed.[22]

It is further contended that motorists already are so overtaxed that any further shift toward heavier user taxation might re-

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[21]The arguments which follow generally have been presented on the assumption that to apply the theory of private business costs to the highways would necessarily force an increase in levels of highway-user taxation. Actually this may not be true, but it can only be determined by a comprehensive revenue-cost study, as was previously pointed out.

[22]Apart from any formal recognition of full highway costs as the basis of vehicle-user taxation, the Highway Research Board recently pointed out that since 1932 only 14 out of 330 bills introduced into state legislatures to increase gasoline tax rates have passed.

sult in diminishing returns, that is, might establish a new equilibrium in the demand and supply of highway transport at a point where the demand would be elastic. Even if they were politically feasible and economically advisable, it is contended that increased vehicle-user tax rates might create public cash reserves subject to political mismanagement and dissipation and would ultimately require the investment of funds accumulating from interest and tax charges in other public purposes than highways, thus opening the possibility of a still further waste of resources.

Contrasting with the viewpoint just presented is the opinion shared by those who look upon the operation of highways as a public business enterprise and who argue that it should be public policy to charge full private business costs for highway use. Members of this latter group, however, do not exclude social benefits in considering the composition of a good highway-tax system, and grant that the theory of private business costs need not be applied as a test of the adequacy of general taxation for support of that portion of highway mileage which remains the obligation of general taxpayers. They feel that highways should be supported largely by vehicle users and that prices charged users for the enjoyment of private benefits should reflect the full costs of providing the highway system.

In addition, it is contended that any increase in vehicle-user tax schedules which might be required to cover full current costs would (1) raise no important problems of tax equity, (2) promote an economic allocation of resources, (3) require no public policies that are politically impossible or economically inadvisable, and (4) raise no insuperable problems in the utilization and management of the increased revenues. Since these propositions flatly contradict the viewpoint already presented, their analytical bases must be examined carefully.

If the issue of tax equity is approached from the viewpoint of the highway as a public business enterprise, it may be assumed that the policy in the immediate past has been either to collect vehicle-user revenues just sufficient to cover all costs, including a fair return on investment, or to collect vehicle-user revenues more than sufficient to cover all costs, that is, to provide an investment return in excess of a fair return. In either case, the assumption is made that all revenues so collected have been invested in further highway improvement. The question of public policy is whether *current* vehicle users should be asked to pay prices (taxes) sufficient to cover their share of all current costs, including depreciation and interest on the investment made in the past.

If such a policy is adopted, there is no question of tax equity where users have paid prices in the past just sufficient to cover

all costs. From neither an economic nor legal viewpoint can users be regarded as having contributed capital in the past, since they actually have paid just enough for services received to cover all economic costs incurred. Certainly in private industry, customers are not said to have contributed capital simply because the owners make profits and reinvest them in the business. The case of the public highway enterprise is analogous. In this instance, therefore, it is fallacious to contend (as some have) that purchasers of current highway services would be charged twice for the use of the highways if asked to pay prices which included depreciation and interest on the investment.

A question of tax equity is raised when current users are asked to pay full current costs, provided users in the past have paid prices sufficient to yield excess return, for they may be regarded as having made capital contributions to the extent of this excess return. To compel users to pay depreciation and interest on an investment which they have made does involve a measure of inequity, but the inequity is not great.

In the first place, the composition of the highway-user group is constantly changing, so that some of the current users have not previously contributed to the investment in existing highways and streets. Such present users may be regarded as having an obligation to pass on to future users facilities which are equally as good as those they received. They are further obligated to make an interest payment for the use of capital provided through the state.

Secondly, part of the current users who have come forward from the period when present improvements were made, are business users of various types. They, in theory, have not contributed capital to highways in the past, since highway taxes have appeared to them as business costs which tend to be shifted to consumers or to purchasers of their services. Assuming this to be true, no inequity is involved in charging such users full present costs. If it is objected that consumers are then forced to pay twice for the use of highway facilitites, it may be pointed out that the consumer group is itself a constantly changing one.

Third, insofar as improvements of municipal streets and secondary roads have been financed by special property assessments, vehicle users have not made a capital payment for past improvements. As present beneficiaries, they may be regarded as having a responsibility to do so, insofar as benefits accruing from such improvements are regarded as accruing to vehicle users.

Fourth, insofar as present motor highways have carried over an investment from the days when there were no motor vehicles, the responsibility of vehicle users for meeting the present annual

costs of this portion of the investment is clear.[23]

The only problem of tax equity at all, in fact, appears to be with respect to that group of present noncommercial users of the highways who have come forward from an earlier period of the motor-vehicle era when, through vehicle-user tax rates, they may have contributed amounts in excess of the going interest rate on the then existing capital investment. Qualitatively, such a problem must be recognized. Quantitatively, it cannot be measured, but it is certainly much less serious than the problem commonly posed in the sweeping statement: "To force vehicle users to pay depreciation, interest, and taxes on highway investment is *per se* inequitable."

In defense of the policy of charging vehicle users full business costs, it also may be argued that such a policy would promote an economic allocation of resources between expenditure of funds by the state and the alternative expenditure by private individuals, and between business uses of highways and competing forms of transportation which are entirely privately owned. Thus, it may be contended that if vehicle users as a class were to pay their full share of total costs as defined, pressure for expenditures on highways by this group would be more clearly conditioned on a consideration of alternative benefits to be obtained by private uses of the resources required. It seems clear that business users (both commercial users and private business users) must pay full private business costs for the use of highway facilities if their pricing policies to prospective purchasers of their products or services are to be placed on an unsubsidized competitive basis with the pricing policies of competing forms of transport service, that is, if highway transport is not to be subsidized.

But even if the foregoing arguments in support of a vehicle-user tax policy based on covering all costs (including interest and depreciation) are accepted, certain questions still remain. For instance, would it be politically possible or economically advisable to make an upward revision of user tax structures if such a revision were indicated in some or all states? How could the increased funds which would result be utilized? These eminently practical questions are, in fact, most difficult. Proponents of such a public policy find satisfactory answers elusive. Several states have succeeded in establishing relatively high levels of vehicle-user taxation without serious political repercussions, and

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[23]Even if the public-business viewpoint is not adopted as a point of departure in analyzing these issues in tax equity, the group of arguments just cited apply. Without this viewpoint the arguments apply to all revenues which have been contributed in the past in excess of sums necessary to provide for the maintenance of highway services at the level then existing.

urban voters generally might be induced to favor some upward revision in user tax rates by the promise that urban localities would receive larger amounts of user revenues than they do at present. It could even be urged that the public might be educated to accept a public-business concept of the highway plant, with its implications for a vehicle-user tax policy based on coverage of full costs for the entire highway and street plant. The political difficulties presented, however, are really a potent weakness in the argument now being presented.

Any upward revision which might be required by the adoption of such a highway cost concept is likely to be limited by the gradual acceptance of the idea that it is intelligent and fair to charge current users for current depreciation of roads and streets, and by acceptance of the entire private-business cost theory when applied to business users of the highways. That such popular acceptance would be possible in the case of depreciation follows from the widespread recognition that current highway users are wearing out facilities which must be replaced in the future if even the same amount and quality of highway service is to be maintained. Popular acceptance of the proposal to charge business users full economic costs probably would be possible because of recognition that business users are profit-seeking enterprisers who should be forced to pay their full costs like other businessmen.

That higher user tax rates entailed by adoption of the private-business cost theory might be economically inadvisable apparently is a less serious objection. The required increases would be unlikely to produce substantial diminution in either vehicle ownership or highway use because user taxes are a relatively small portion of total vehicle operating costs,[24] and because there is a lack of available substitutes for the service or benefits obtained through highway transportation. An elaborate study made by Leager[25] bears this out. He investigated increases in gasoline tax rates and license fees in a large number of states for the period 1925-1932, and concluded:

"There is but a slight relationship between changes in the amount of the tax per gallon and changes in the intensive use of automobiles. . . . The tax has not shown any signs of having reached the point of diminishing returns. . . . Further, the extensive use of cars does not depend on a low level of license fees being in force. Like the gasoline tax, the license fee has not reached the point of diminishing returns."

Finally, it is argued that adoption of the private-business cost

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[24]Increased vehicle-user taxes for heavy trucks might reduce the number of these vehicles, but the total number is very small at present.

[25]Leager, Marc C. Financial Management for Highways. Bulletin 8, Engineering Experiment Station, North Carolina State College, Raleigh, N. C. 1933.

theory for purposes of vehicle-user rate making would involve no insuperable difficulties in the utilization and management of the increased revenues which might be involved. Such increased revenues might be reinvested in extensions and improvements of highways and streets and thus raise the current level of expenditures on these systems. Up to the point of an optimum development, that is, the development of highways to the point where the sum of highway costs and vehicle operating costs would be minimized, this method of revenue utilization would represent an economic utilization of resources. If the optimum has been reached, however, interest return would have to be diverted to other governmental purposes or used to reduce forms of taxes other than vehicle-user taxes. Annual depreciation sums might for a time exceed current replacements of the optimum plant already constructed. In this case the traditional problem of the accumulation of public cash reserves and their management would arise. This is an ultimate implication of a policy charging full costs against current users. If past experience is any guide, it is an unpleasant implication.

Advocates of the private-business concept answer this argument by declaring that only under special circumstances would a problem of cash depreciation sums arise, that is, where a highway plant had rapidly expanded to the optimum point before ceasing entirely, and where the highway required no substantial replacement for several years. Such special circumstances are unlikely to be encountered. Highway and street plants as a whole have been improved rapidly but continuously, and for a long time replacement of retirements will involve betterments. It is further argued that it may be possible to educate the public to some of the merits of conducting the highway transport facility on business principles, which might make possible the establishment of safeguards against the dissipation of cash depreciation sums through political manipulation or unwise investment.

Diversion of Highway-User Revenues

It is possible that highway-user revenues, once collected, may not be devoted to highway purposes, but diverted to other public purposes. Such diversion recently has become an important issue in highway finance; as many as 37 states use highway-user revenues for other than highway purposes, and organized highway-user groups protest such diversion as an unfair use of tax revenues originally designed solely for highway purposes.

When the diversion is considered from the viewpoint of the highway function as a public business, it appears that it actually may represent several distinct kinds of situations, some defen-

sible from a standpoint of tax equity, some not. When user revenues produce sufficient income to cover maintenance, administration, and current depreciation, but provide no investment return on the highway investment, diversion seems indefensible if it is the public intention to preserve the service-rendering capacity of the highways. It is clear that depreciation sums in excess of current replacements should be invested in further extensions and improvements unless the plant has reached its ultimate stability. In the latter case such sums should be conserved to meet future replacement requirements.

If user revenues yield sufficient income to provide a fair return on the public investment in addition to sums sufficient to cover depreciation, maintenance, and administration, the investment return should be reinvested in further extensions and improvements until an optimum highway development is obtained. Beyond this point (which probably still is remote in the United States) it is just as defensible to divert highway-user revenues to other public purposes as it is to divert the earnings of municipally operated utilities, as is being done in many communities.

If user revenues produce annual sums in excess of a fair return on the given plant, diversion to nonhighway purposes is to be condemned if it is clear that highway development has not reached an optimum so that continuing capital expenditures are justified. If highway development has reached an optimum point, a reduction in user-revenue tax schedules is then needed, rather than diversion to nonhighway purposes. User revenues diverted under such circumstances cease to be prices or fees justified on the basis of a fair charge for the use of existing highways and become merely types of taxes levied for general governmental purposes contrary to the ability-to-pay principle. As such, there is an *a priori* argument against such public financing, but the problem is one of the entire tax system and is beyond the scope of this discussion.

Finally, when user revenues are designed to produce sums sufficient to give a fair return and, in addition, an equivalent for taxes foregone, revenues equal to the tax equivalent may justifiably be diverted to general governmental purposes. They need not be invested in highways at all, except to the extent that general governmental revenues finance highways.

In summary, diversion may be defended where (1) part or all of fair highway returns are not required to further improve the highway plant, or where (2) user revenues are utilized to collect tax equivalents. Diversion is to be condemned where (1) it utilizes depreciation sums necessary to maintain the capital investment, or where (2) it involves the use of net returns in excess of a fair return.

Conclusions

The major purpose of this section has been to examine the nature and elements of highway costs and to indicate what bearing the concepts of costs may have on public policy in the field of highway taxation. The analysis has shown that:

1. Regardless of highway-tax policies, highway costs include depreciation and interest on unamortized investment, in addition to cash outlays for maintenance, administration, and traffic control.
2. Analysis of current highway-tax revenues in relation to costs thus defined is necessary before any conclusions can be made as to the adequacy of current tax structures.
3. Adoption of the private-business cost theory does not require that this theory be extended beyond a test of the adequacy of vehicle-user taxation to include the adequacy of general taxes raised for highway purposes.
4. Relatively little inequity is involved in basing highway-tax policies on a definition of highway costs as equivalent to private business costs.
5. To adopt the private-business cost concept as a test of adequacy of highway-user tax structures would promote an economic allocation of resources.
6. The private-business cost theory is helpful in analyzing the issues raised by the diversion of highway-user taxes to nonhighway purposes; diversion is defensible in some cases, inequitable and undesirable in others.

This foregoing survey of general theories of highway finance and analysis of highway costs in relation to tax policies make possible the testing of alternative theories of highway taxation through an empirical study of costs and taxation for a highway unit embracing all classifications of roads and streets. This has been done in the succeeding section for the highways of Story County, Iowa.

HIGHWAY COSTS AND FINANCE IN STORY COUNTY, 1913-1938

Introduction

The basic theories of highway finance and highway costs have been examined in preceding sections. In this section these theories are applied through an empirical study for a highway unit embracing all major classifications of roads and streets and covering substantially the entire motor-vehicle era. The specific objectives of the study were:

1. To ascertain the physical and use characteristics of the present highway and street plant of Story County.

2. To investigate the financing of this highway unit to ascertain the relative contributions which have been and are being made by various groups in the community to support the highway plant.

3. To determine all annual highway costs and to investigate the plant investment on all systems.

4. To compare all highway costs and revenues to ascertain whether existing tax revenues, particularly vehicle-user tax revenues, are adequate to cover costs.

5. To study the problem of cost allocation between general taxpayers and vehicle users by (1) investigating the distribution of highway benefits, (2) developing and applying methods of cost allocation which seem fair on the basis of benefit analysis, and (3) determining whether, on the basis of these methods, highway users are being subsidized in the use of the plant being studied.

6. To study the problem of cost allocation among different vehicle classes by (1) considering the relative merits of the increment and ton-mile methods of cost allocation, (2) applying ton-mile analysis to the comparative revenues contributed by various classes of vehicles in Iowa in 1937, and (3) determining whether, on the basis of this analysis, certain groups of vehicle users are subsidizing other groups.

Because of the large number of studies on highway costs and highway finance which have been made in recent years, the merit of an additional study which uses many of the same techniques and investigates the same basic problems might logically be questioned. In the analysis which follows, however, important refinements were attempted which generally were not included in previous studies. It is believed that these refinements strengthen the accuracy and adequacy of the data necessary to support the conclusions reached. The most important of these refinements are listed in the following paragraphs.

1. Capital expenditures were allocated to *present* mileages in each major road and street system. Thus, all expenditures made by the county in early years of the motor-vehicle era on mileage now in the primary system were charged to the primary system. Likewise, all expenditures by the Iowa Highway Commission on present secondary roads were charged to the secondary system. This procedure gives investment data for present mileages which are more accurate than the published figures.

2. Where capital investments of an earlier period had been retired through subsequent improvement programs, such retirements were noted and subtracted from the capital account.

3. A complete separation was made between investment in the

county trunk and county local secondary systems, although prior to 1930 all expenditures for structures on these two systems were combined in published reports. Access to county records made possible the desired separation of investment expenditures.

4. A separation was made between investment in and annual costs of primary urban extensions and of other urban streets, on the assumption that the extensions should be treated as a separate system, since they carry both the through traffic of primary urban roads and the local traffic of urban streets.

5. An investigation was made of the financing of present mileages in each road and street system. In some instances this proved to be a complex task. For example, some primary urban extensions have been constructed in part by a city, in part by the county, and in part by the state over a period of many years. They often were financed in a variety of ways—bond issues, property taxes, vehicle-user taxes, special assessments, and federal aid.

6. The mass of traffic, road-use, investment, and financial data obtained by the Statewide Highway Planning Survey between 1936 and 1939 were constantly available for use in the analysis.

In this study, it would clearly have been best to have studied the entire highway and street plant of the state. Because limited time and financial resources prevented such a course, the Story County unit was chosen. However, to give a broader presentation of the problems of highway use, administration, and finance, a historical study for the state as a whole was made and is included in Appendix A. The county unit chosen is perhaps not as

TABLE 1. COMPARATIVE HIGHWAY DATA FOR STORY COUNTY AND IOWA, 1938

Item	Story County	Iowa
Percentage of total rural mileage in:		
Primary roads	8.57	8.30
County trunk roads	12.91	13.38
County local roads	78.52	78.32
Percentage of rural mileage surfaced:		
Primary roads		
Paved	65.8	59.9
Other surfaces	34.2	38.6
County trunk roads	100.0	82.8
County local roads	70.6	30.5
Average daily traffic per mile on:		
Primary roads		
Paved	1,989	1,017
Graveled	322	334
County trunk roads		
Graveled	146	124
County local roads		
Graveled	38.9	38.6
Unsurfaced	12.8	19.3

typical of average conditions in the state as might be desired because it is further advanced in its program of secondary road improvement than is the state as a whole.[26] In addition, the main arteries of traffic through the county (paved primary roads) carry a much heavier traffic than the average paved primary road in the state (Table 1).

Other considerations, however, overruled the choice of another county that might have proved to be more typical. It was possible to make a complete study of Story County with the resources available, since Iowa State College is located in Story County. Further, it was possible to obtain a nearly complete picture of secondary road improvement and finance back to 1913, something which would have been impossible in many counties of the state. This was because the secondary program in Story County had been carried on by the same county engineer for more than 25 years, and over this period he had kept financial records with scrupulous care.

Description of the Study

The basic method of analysis used in the comparison of highway costs and revenues closely parallels that used in nearly all highway cost studies during recent years. Highway costs (as defined by the Highway Research Board, see page 21) were determined for the various road and street systems. These costs were then compared with the revenues currently available from vehicle-user taxes levied by the State of Iowa, from general tax revenues, and from other general sources in county and municipal governments. This comparison was made to determine whether revenues were adequate to cover economic costs. The allocation of the cost burden between vehicle users, general taxpayers, and others was then considered both through analysis and through use of various cost-allocation formulas. Tentative conclusions respecting the present adequacy of motor-vehicle-user taxes for support of the highway unit under discussion were made and the analysis extended to cost allocation among vehicle-user classes.

Two types of problems were encountered in working with the Story County unit—those inherent in any highway cost study and those peculiar to the choice of a county instead of a state unit.

Gaps in original data constituted one of the problems of the first type. Before 1930, for instance, the townships still constituted highway units. Some of these did not make annual re-

[26]The rather sharp division between northern and southern Iowa in the matter of highway improvement makes the usual notion of an average inapplicable. It would be more accurate to say that Story County is quite typical of conditions in the northern half of the state but unlike conditions in the southern half.

ports to the county on road construction; others made incomplete reports of the manner in which funds for construction purposes had been expended. In urban localities, construction-cost records exist for the most part only where the construction has been financed by special assessments or bond issues, although such construction has represented the major portion of the costs of urban street improvement in Story County. As a result, exact historical costs are not available for some improved mileage. A complete investment account is necessary, however, when depreciation and interest on unamortized investment are included as highway costs. To arrive at such an account, it is possible to use (1) historical or original cost minus accrued depreciation, which may be termed actual investment value; (2) reproduction or replacement cost minus depreciation; or (3) some combination of these two. As indicated by many competent engineers and economists, none of these methods of valuation is completely satisfactory. Replacement cost was chosen for this study because of the gaps in data on original costs. Valuation at replacement cost offered the only possibility of a single, consistent, inclusive valuation base. It therefore has been used throughout the cost analysis which follows, but has been supplemented by valuation at original cost for comparative purposes wherever possible.

To obtain replacement costs of portions of the plant for which historical costs were available, highway construction-cost indices were set up by the use of primary data based on actual investment in the Story County plant wherever possible. Such indices were used to put historical investment on a replacement-cost basis as of 1938.[27] For portions of the plant for which historical costs were not available (chiefly grading and surfacing costs for county local roads built before 1930 and for urban streets improved out of general funds), engineering estimates of the physical quantities represented were obtained, and average unit replacement costs were applied to these quantities to estimate the replacement costs. A minor omission still exists in the data used, since no investment records are available for rural roads prior to 1913, when a county engineer first was appointed, or for urban streets prior to 1910, when Story County street improvement apparently began. However, the portion of present investment in roads and streets which antedates 1910 or 1913 probably is so small that the error introduced by ignoring it is not large.

The valuation of right of way constituted a special problem. Legal precedent exists for including all right of way of regulated transport systems in the valuation base at the value of adjoining property. There seems to be little economic merit in applying this legal dictum to highway right of way. Right of way committed to road purposes by governmental units when the state

[27] These indices, together with explanation of their sources, are given in Appendix B.

was laid out involved practically no public investment. That such right of way involves interest as an annual highway cost appears absurd. Consequently, inclusion of this right of way in the valuation serves no useful purpose. Moreover, to prove that the value of right of way is derived from the value of adjoining land would be impossible. It would seem more plausible that the value of adjoining land is dependent on the means of access to it which the right of way provides. Therefore, none of the right of way assigned to road use from state lands was included in the valuation base used to formulate the conclusions reached later in this section.

Right of way acquired through purchase by governmental units since the motor-vehicle era presents a different aspect. The price paid for such additional right of way reflects a capital investment by the state. As such it has a place in the valuation base used for determining annual costs, either on the basis of original cost or on the basis of replacement cost.

It was necessary to make certain estimates concerning the probable service lives and salvage values of the various highway elements to determine expected annual depreciation rates. Because not all component parts of a highway are affected in the same manner or to the same degree by the forces producing depreciation, it seemed desirable to study each part and assign suitable probable service lives and salvage values to each. The component parts used are right of way; roadway grading or earthwork; small drainage structures; bridges and large structures; roadway wearing surface; roadway base for the wearing surface; and signs, signals, and other traffic control devices.

At present there are only scattered records of the service lives of most highway components, although there are several estimates based on opinion and recollection. Roadway surfaces, however, have been studied in some detail.[28] The estimates of probable service lives used in this study (Table 2) are based on the few published observations and on the judgment of engineers who have specialized in the highway field.[29] Consideration has been given to the age; physical condition; past, present, and probable future traffic; and present general suitability of each road to traffic. It should be noted that if the average

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[28]Marston, Anson. A Mortality Curve Study of the Actual Service Lives of Brick-on-Concrete Pavements in Des Moines, Iowa, 1909-1928. *Proceedings*, Highway Research Board (1934), 14:49-58. Washington, D.C. 1935.

Winfrey, Robley. Preliminary Studies of the Actual Service Lives of Pavements. *Proceedings*, Highway Research Board (1935), 15:47-60. Washington, D. C. 1936.

Winfrey, Robley, and Fred H. Farrell. Life Characteristics of Surfaces Constructed on Primary Rural Highways. *Proceedings*, Highway Research Board (1940), 20:165-199. Washington, D.C. 1941.

[29]For the most part, the estimates were made by Robley Winfrey, research associate professor of the Iowa Engineering Experiment Station, who has conducted extensive studies in the service life of pavements for the Public Roads Administration and the Station, and who is well qualified to make such estimates.

TABLE 2. DEPRECIATION RATES AND SALVAGE VALUES USED IN THE STUDY OF STORY COUNTY HIGHWAYS

Type of asset	Year of construction	Road system	Estimated service life, years	Estimated salvage, percent
Concrete pavement	1914	Urban	32	
	1916	Primary urban	32	
		Urban	36	
	1921	Primary urban	30	
		Urban	35	20
	1922	Urban	35	
	1923	Primary urban	30	
		Urban	35	
	1924	Urban	35	
	1926	Primary urban	35	
		Urban	40	
	1928	Primary urban	35	
		Urban	40	
	1929	Primary rural	30	
	1930	Primary rural	30	25
	1931	Primary rural	30	
	1934	Urban	40	
	1938	Primary rural	35	
		Urban	40	
Brick pavement	1917	Primary urban	40	0
		Urban	40	0
Stabilized gravel	1935, 1936, 1938	Urban	15	25
Earthwork	All	Rural	100	50
		Urban	Indefinite	—
Bridges and culverts:				
Concrete or steel	All	All	60	0
Timber or timber-steel combinations	All	All	40	0
Tiling and drainage	All	All	100	0

life of a particular class of unit is 20 years, there are some that will last far less, and some far more, than 20 years. For specific components of the Story County plant, the following observations on service life and salvage value are pertinent.

1. Estimates of service life for pavements and surfacings are based on published and unpublished data.

2. Estimates of service life for grading and earthwork are based on local traffic conditions and geographical location. The unusually long life assigned is based on the fact that the end of service life comes only with realignment of the road and changes in grade, both of which are expected in only a very limited degree in Story County.

3. Estimates for structures likewise depend on changes in alignment and in grade, but are based primarily on probabilities of deterioration and inadequacy. Service lives assigned are longer than usual in studies of this type, both because changes

in alignment and grade probably will be few in Story County, and because the type of construction used predominantly in the county since 1913 has been of a permanent character.

4. Estimates of salvage values have been made with due regard to local conditions and probable methods of reconstruction and relocation of existing highways.

Theoretical considerations indicated the use of the sinking-fund or the compound-interest depreciation method, but practical considerations dictated the use of the almost universally employed straight-line method (under which investment cost minus salvage, divided by years of service life, gives the annual depreciation charge). This latter method was therefore employed. The different methods all give the same average annual depreciation allowances for extensive properties consisting of many units in stabilized stages of development, providing all retirements are removed from the accounts, and betterments are added as they are made.

A decision also had to be made with respect to the interest rate to be used in determining the annual interest charge on unamortized investment. In accordance with the 1929 recommendation of the Highway Research Board Committee, the current interest rate in state highway financing in Iowa was employed. A weighted average of new and refunding primary-road bonds floated during the period 1935-1938 showed this to be 2.16 percent, but for sake of convenience a rate of 2.25 percent was used. While this rate is lower than has been used on other studies, it not only is in accord with recent highway financing in the state, but reflects the fact that long-term interest rates have fallen in recent years to what appear to be permanently lower levels. To give consideration to the possibility of a rise in interest rates subsequent to 1938, however, costs also were computed on the basis of a rate of 3 percent.

A second major problem arose because a county instead of a state unit was chosen for analysis. This choice complicated both the allocation to Story County of vehicle-user revenues collected by the state, and the allocation of highway costs among different classes of motor vehicles. Allocation of revenues could theoretically have been made according to provisions of the law or according to the relative traffic carried by the Story County roads. The latter basis was chosen, primarily because it seemed desirable to treat Story County as a complete highway unit. that is, as though it were a complete small-scale state. The difference between the two methods can be illustrated by the revenues from the motor-fuel tax. Under the 1938 law five ninths of the revenue went to the Iowa Highway Commission for primary roads and the remainder to counties on an area basis. Under the relative-traffic basis, Story County would be allocated that

portion of the total motor-fuel tax which ton-miles of travel in Story County bear to total ton-miles for the state. Such a basis of allocation is preferable for this study because it actually assigns to Story County the approximate amount of gasoline-tax revenues which arise from travel on its roads and streets. Similarly, motor-vehicle fees collected by the state were allocated to Story County on the basis of relative vehicle-miles, the ton-mile tax on the basis of relative ton-miles, and truck operator permit fees on the basis of relative truck registration.

Similar problems arose in connection with cost allocation among vehicle classes. While a county unit was being studied, it seemed unrealistic to deal only with vehicle revenues contributed by vehicles registered in Story County, since traffic originating and ending outside the county comprised a large portion of total traffic, particularly on the primary road system.[30] On the other hand, annual cost data had been developed only for this county, not for Iowa as a whole. No direct comparisons seemed possible, therefore, between user revenues paid by various vehicle classes for use of the Story County roads and the share in annual costs of this highway plant equitably assignable to each class.

The substitute method employed Iowa registration and user revenue data. User taxes actually paid by each class of vehicle were compared with the equitable share of total user taxes which should have been paid by each class, rather than with its equitable share of annual costs. Such analysis, however, will indicate whether each class of vehicle was paying its fair share of annual costs for use of the Story County plant only if (1) total user taxes allocable to the county cover the share of total costs fairly assignable to all vehicle users, and (2) the vehicles using Story County highways represent a cross section of state registration. The latter condition seems probable, but cannot be verified; the former condition is verified later in this bulletin. In any event, the analysis can show whether, at existing levels of vehicle-user revenues, one class of vehicle user is subsidizing other classes. The analysis was made with these provisions in mind.

It was necessary to have access to large amounts of primary data to conduct the study. The most important sources of such data included (1) the Highway Planning Survey, particularly its sections dealing with road traffic and road use, road life, and highway finance; (2) published reports of the Iowa State Highway Commission for 1913-1938; (3) published reports and investment records of the county engineer of Story County for 1913-1938; (4) special-assessment files of all incorporated municipalities in the county which made use of this method of

[30]Located in the center of Iowa, Story County is a crossroads for a large volume of intercounty and interstate traffic. This is reflected in the greater-than-average traffic volume carried by its primary roads.

financing capital improvements between 1910 and 1939; and (5) the published reports on municipal finances of incorporated municipalities of Iowa for 1910-1938.

Descriptive Data on Story County Highways

A historical summary of the development of Iowa highways during the motor-vehicle era is given in Appendix A. It covers physical plant, plant use, finance, and administration. Most of the generalizations made for the state as a whole for the period discussed apply to Story County as well. In the description of Story County highways which follows, the same general features will be covered, but with the following differences.

1. Much of the traffic and road-use data for present state highways were gathered only on a statewide basis. Conclusions based on these data can be regarded as applicable to Story County, but the county data are not available. It is as true for Story County as for the state as a whole that the present highway use is highly interdependent between systems, that average miles traveled differ for different vehicle classes and for rural and urban vehicle owners, that much of the traffic on urban streets originates and ends there, and that the average trip on rural highways is for a short distance.

TABLE 3. CLASSIFICATION OF STORY COUNTY MUNICIPALITIES, 1938

Size group	Population	Number of incorporated municipalities
150	481	3
250	1,656	4
500	3,219	5
1,000	1,434	1
2,500	3,133	1
10,000	10,261	1

2. The general development of state laws respecting motor-vehicle taxation and highway administration needs no repetition, except where it seems desirable to expand on the treatment given in Appendix A.

3. There are certain aspects of a descriptive treatment for which more and better information is available for Story County than for Iowa. This applies particularly to information concerning expenditures for and financing of urban street improvements, and to the separation of historical investment by systems in terms of their present mileage.

Story County is one of 99 Iowa counties. At the time of this study it had a population of 31,141, representing 1.26 percent of the state total; an area of 576 square miles and 1,057 miles of

TABLE 4. STORY COUNTY HIGHWAYS AND STREETS, 1938

Road system	Mileage			Surface, miles		
	Urban	Rural	Total	Paved	Other surface*	Unsurfaced
Primary	12.3	90.6	102.9	65.7	37.2	0.0
County trunk	7.5	136.5	144.0	0.0	144.0	0.0
County local	6.0	824.0	830.0	0.0	586.0	244.0
Urban	100.6	0.0	100.6	32.6	55.8	12.2
Total	126.4	1,051.1	1,177.5	98.3	823.0	256.2

*All these roads are graveled except a few miles which are cindered.

rural roads, both of which represent 1.03 percent of the state total; and 103 miles of primary roads, or 1.08 percent of the state total.

In 1930 its population was divided between rural and urban areas in the ratio of 35.2 and 64.8 percent (the state ratios were 41.6 and 58.4 percent), while vehicle registration was divided in the ratio of 25.5 and 74.5 percent. Rural population was 10,957 in 1938; a classification of population within urban areas is given in Table 3.

The complete highway plant with which this study deals is summarized in Table 4, which shows the mileage in the various systems, and the degree of improvement of each system and of the total mileage. This table shows that by the close of 1938 the entire primary and county trunk mileage, nearly the entire urban mileage, and more than 70 percent of the local county road mileage had been given some type of all-weather surface. This indicates that Story County is nearing the end of what may be called a road-improvement program sufficient to meet the minimum demands of vehicle users and the community. In this respect, as has been pointed out previously, Story County is typical of the counties in the northern half of Iowa but much farther advanced in its secondary road program than southern Iowa. This is largely because the per capita wealth (as measured by assessed property value) is higher than in the southern half of the state. Also contributing to this situation is the fact that road construction costs are lower in northern Iowa because gravel deposits are more abundant and the topography is more regular.

The bulk of road and street improvement in both Story County

TABLE 5. IMPORTANT CHANCES IN THE RURAL ROADS OF STORY COUNTY, 1920-1938

Year	Primary rural roads, miles			County trunk roads, miles			County local roads, miles		
	Paved	Graveled	Total	Graveled	Unsurfaced	Total	Graveled	Unsurfaced	Total
1920	0.0	31.0	64.4	58.8	70.7	129.5	0	841	841
1930	43.7	21.8	65.5	139.3	0.0	139.3	220	612	832
1938	63.5	27.1	90.6	136.5	0.0	136.5	586	244	830

and Iowa has come since 1920, although between 1910 and 1920 about 100 miles of rural road in Story County were surfaced and a few miles were paved in the larger urban communities. During 1920-1938, 63.5 miles of primary rural road were paved and 648 miles of rural road on all systems were graveled. In addition, nearly all the 41 miles of urban street pavement were laid during this period. Table 5 summarizes the changes since 1920.

Total expenditures during 1910-1938 for all highways and streets in Story County were in excess of $13,400,000. If debt retirement is excluded to avoid double counting, expenditures totaled $12,915,000. General tax revenues furnished 42.66 percent of the funds for these expenditures; vehicle-user taxes, 26.45 percent; special assessments, 14.78 percent; net borrowing, 9.18 percent; federal aid, 5.65 percent; and miscellaneous sources, 1.28 percent.

TABLE 6. METHODS OF FINANCING HIGHWAY AND STREET EXPENDITURES IN STORY COUNTY BY 10-YEAR PERIODS, 1910-1938*

Type of revenue	Total expenditures financed by various methods, percent		
	1910-1919	1920-1929	1930-1938
General revenues†	66.76	42.15	28.66
Vehicle-user taxes	4.73	22.01	35.07
Special assessments	26.43	19.84	5.34
Borrowing	1.50	13.14	17.53
Federal aid	0.0	0.77	12.67
Other revenues	0.58	2.09	0.73
Total amount	$2,024,960	$5,461,389	$5,428,698
Average per year	202,496	546,139	603,200
Deflated average‡	202,496	329,198	501,413

*Methods of original financing, including all proceeds from loans and excluding vehicle-user and general taxes used to retire debt.

†General revenues include both proceeds from general property taxes and expenditures from general city funds derived in part from other than property-tax sources, such as profits from operation of municipal utilities turned into the general fund. It was impossible to determine the exact sources of such general municipal funds, although they rested largely on property-tax revenues.

‡A highway construction cost index was used to deflate actual expenditures (Appendix B).

Expenditures by decades and methods of financing are shown in Table 6. Shifts in finance methods occurred which closely followed the state pattern pointed out in Appendix A. These are indicated and, in addition, complete data on special assessments for both urban streets and rural roads are shown.

Of the $12,915,000 spent on highways and streets during the period studied, $7,754,000 were spent for capital improvements. Because a major issue in the current highway-cost controversy concerns the fairness of charging full economic costs to vehicle users who already allegedly have contributed the major portion

TABLE 7. FINANCING OF CAPITAL IMPROVEMENTS ON STORY COUNTY HIGHWAYS AND STREETS, 1910-1938

Type of revenue	Capital improvements financed by various methods, percent		
	1910-1919	1920-1929	1930-1938
General revenues	45.67	25.26	8.98
Vehicle-user taxes	7.87	20.18	31.81
Special assessments	43.97	31.58	8.89
Federal aid	0.0	1.22	21.11
Borrowing	2.49	20.91	29.21
Other revenues	0.0	0.85	0.0
Total amount	$1,217,173	$3,433,107	$3,258,542

of the capital required for highway improvement, it is essential to note how these capital improvements have been financed. Story County highway data indicate that only 31.06 percent of capital improvements for 1910-1938 were financed by vehicle-user taxes, while 57.39 percent were financed by property imposts (general tax revenues and special assessments). However, Table 7 shows that the trend has been steadily in the direction of increased financing from vehicle-user taxes and federal aid.

Table 8 presents the methods used for financing the improvement in the various systems of Story County highways from 1913 to 1939. All data in the table relate to present mileages in the various systems and to the financing of these mileages. The investment in urban streets excludes that portion of plant improvement for which definite data could not be obtained, which is estimated at between $70,000 and $80,000. The relatively large amount of federal aid on primary urban extensions is the result of construction of a large, expensive underpass in 1938 to which federal contributions of $396,000 were made. Net borrowing is that portion of bond issues originally floated which

TABLE 8. METHODS OF FINANCING INVESTMENT IN ROAD AND STREET IMPROVEMENT IN STORY COUNTY, 1913-1938

Type of revenue	Capital improvements financed by various methods, percent				
	Primary rural roads	Primary urban streets	Other urban streets	Secondary roads	Total
General revenues	8.06	9.08	12.12	60.07	24.79
Vehicle-user taxes	41.93	19.89	0.0	27.19	26.31
Special assessments	0.59	29.23	87.68	8.05	23.83
Federal aid	10.30	40.30	0.0	1.60	9.41
Net borrowing	38.29	0.92	0.20	3.09	15.28
Other revenues	0.83	0.58	0.0	0.0	0.38
Total amount	$2,874,020	$982,660	$1,544,060	$2,353,548	$7,754,288
Average per mile	31,722	79,891	13,531	2,435	6,549

were still outstanding at the end of 1938. Retirement of these bonds probably will be accomplished either through vehicle-user taxes or general taxes, which thus ultimately bear the burden of the capital improvement.

In compiling Table 8 it was assumed that all user revenues received by the county were used for improvement of secondary roads. Special assessments for secondary roads for the period 1920-1930 were not separated from miscellaneous revenue sources in every year; they were estimated for years in which they were not separated by multiplying the costs of graveling in each year by 25 percent, which was the percentage of the cost of surfacing charged to property owners on all roads graveled by the county after 1919. For the period 1931-1938, recorded receipts from special assessments were used. Estimates were made of contributions by property owners for graveling on township roads during the years 1925-1929. For the years preceding 1930, when less than the full number of 16 townships reported, the totals were adjusted to a basis of 16 on the assumption that construction practices in the 2 to 4 not reporting were substantially the same as in those reporting.

User-tax support for secondary mileage recorded in Table 8 for the years 1920, 1921, and 1923 includes expenditures by the Iowa State Highway Commission on mileage subsequently returned to the county road system. Property taxes were assumed to be the source of any revenue not raised by indicated methods. These revenues were used principally to retire county road and bridge debt and to pay engineering costs prior to 1930. Proceeds of bond issues sold by the county in 1920 and 1921 were assigned to the present primary rural, primary urban, and secondary roads in the ratio of the relative expenditures by the county on these systems in these years. County expenditures for structures and right of way on the primary system for 1919-1923, for which the county was subsequently reimbursed from the primary road fund, were treated in Table 8 as having been made originally from primary road funds financed by user-tax revenues.

Construction of a highly improved physical plant and its financing by a variety of means have been accompanied by the development of complex use characteristics. These are pointed out for the state as a whole in Appendix A, and since they are applicable to Story County, will not be repeated. Certain relevant characteristics of the Story County plant do merit mention, however, and these are summarized, for the most part, in Table 9. This table shows that in 1936 and 1937 the roads and streets of the county carried a total annual traffic of about 82,381,000 vehicles of all classes. Traffic was concentrated on the primary

TABLE 9. ESTIMATED VEHICLE-MILES AND TON-MILES TRAVELED ON STORY COUNTY ROADS AND STREETS, 1936-1937

Road system	Vehicle-miles traveled		Ton-miles traveled		Average vehicles per mile per day
	Total	Percent	Total	Percent	
Primary rural	43,627,000	52.96	103,896,000	56.48	1,331
Primary urban	11,014,000	13.37	24,518,000	13.32	2,455
Other urban	11,099,000	13.47	21,502,000	11.70	266
County trunk	7,260,000	8.81	14,945,000	8.12	145
County local	9,381,000	11.39	19,076,000	10.38	30
Total	82,381,000	100.00	183,937,000	100.00	4,227

rural and urban roads, with a greater concentration on primary roads than was true for the state as a whole. This may be attributed to the character of the main highways in Story County.

While the data of Table 9 clearly show the differences in average intensity of use per mile of the various systems, they do not indicate the marked variations in the traffic flow over roads within each system. These differences were noted for every mile of rural road in the county in the Highway Planning Survey and are summarized in Table 10. This table shows that for the the primary system, traffic clusters about two concentration points, one of 350 vehicles a day, the other of about 2,000 to 2,500 vehicles a day, while ranging all the way from less than 100 to more than 3,000 vehicles a day. The spread for the county trunk system is from 50 to 500 vehicles per day, and for the county local system the range is from less than 10 to more than 100 vehicles daily.

TABLE 10. RURAL ROAD MILEAGE IN STORY COUNTY CLASSIFIED BY TRAFFIC CARRIED PER DAY DURING 1936 AND 1937

Average vehicles per day	Primary rural roads		County trunk roads		County local roads	
	Miles	Percent	Miles	Percent	Miles	Percent
0- 10	0.0	0.0	0.0	0.0	183.77	21.52
10- 25	0.0	0.0	0.0	0.0	287.37	33.65
25- 50	0.0	0.0	2.00	1.46	257.45	30.14
50- 100	0.28	0.31	43.20	31.47	102.11	11.95
100- 200	6.63	7.39	68.32	49.77	23.42	2.74
200- 300	3.77	4.20	14.17	10.32	0.0	0.0
300- 400	16.16	18.00	8.08	5.89	0.0	0.0
400- 500	2.82	3.14	1.50	1.09	0.0	0.0
500- 600	5.52	6.15	0.0	0.0	0.0	0.0
600- 700	0.30	0.32	0.0	0.0	0.0	0.0
				0.0	0.0	0.0
700- 800	0.0	0.0	0.0			
800- 900	3.65	4.07	0.0	0.0	0.0	0.0
900-1000	3.66	4.08	0.0	0.0	0.0	0.0
1000-1250	6.56	7.31	0.0	0.0	0.0	0.0
1250-1500	5.28	5.88	0.0	0.0	0.0	0.0
1500-2000	12.05	13.42	0.0	0.0	0.0	0.0
2000-3000	11.90	13.26	0.0	0.0	0.0	0.0
Above 3000	11.19	12.47	0.0	0.0	0.0	0.0

TABLE 11. EXPENDITURES FOR ALL HIGHWAYS AND STREETS IN STORY COUNTY DURING 1938

Road system	Type of expenditure				Total expenditure
	Construction	Operating costs*	Interest and finance	Debt retirement	
Primary rural	$218,112†	$53,533	$26,405	$42,000	$340,050
Primary urban	371,017†	4,562¶	0	0	375,579
County trunk	0	28,088‡	5,100	19,000	52,188
County local	91,886‡	90,685‡	0	0	182,571
Other urban	67,257	59,950	3,489	5,500	136,196
Total	748,272	236,818	34,994	66,500	1,086,584

*Operating costs include maintenance, administration, and municipal street lighting. They also include $17,571 for costs of administering motor-vehicle laws of the state, allocated to Story County and to systems within the county.

†Payments for work completed in 1938. A large expenditure on primary urban extensions was incurred by the construction of an expensive underpass. All engineering, inspection, and administration expenditures allocated to or expended in Story County have been allocated to construction and maintenance.

‡Includes expenditures of $37,404 by the W.P.A. in Story County, allocated as follows: County trunk maintenance, $2,762; county local construction, $18,702; and county local maintenance, $15,940.

¶Includes refunds to municipalities for maintenance, but does not include state work on urban extensions, which could not be separated from other maintenance expenditures on the primary system.

Highway Costs and Revenues for Story County During 1938

COSTS

Four definitions of highway costs were presented on page 21. While the first definition (that costs equal cash expenditures for all purposes) was rejected as erroneous, the total expenditures for 1938 (Table 11) have certain significance although construction expenditures on the primary rural and urban systems during 1938 were too large to be typical of the period studied. The total expenditures for 1938 were $1,087,000, which compare with an average of $646,000 for 1930-1938, $557,000 for 1920-1929, and $463,000 for 1910-1938.

Under the second definition, costs were substantially equal to the sum of operating costs and debt service, or $338,312 (Table 11), although the element of replacement cost entered into the 1938 construction outlays in the county to the extent of perhaps $10,000.

Under the cost definition of the Highway Research Board, which is believed the most satisfactory as an expression of the economic costs involved in the commitment of resources to highways, it was necessary to determine depreciation and interest costs. These are listed in Table 13. While the major techniques involved in constructing these costs already have been explained (page 40) and the details of the derivation of the valuations of each system shown in Table 12 are presented in Appendices C, D, E, F, and G, brief comment at this point on the data shown in Tables 12 and 13 seems desirable.

Interest costs are based both on depreciated replacement cost and on depreciated original cost wherever possible, but the complete cost figures are based on replacement-cost valuations. The valuation bases used for cost computations include only right of way which has been purchased during the period studied (which means, for all practical purposes, all right of way which has been purchased).

Maintenance costs are based on a 1935-1938 average to better reflect the typical annual outlays expected for this purpose. Costs associated with vehicle registration and the Iowa Highway Patrol (both costs of the Motor-Vehicle Department) were allocated to Story County on the basis of relative registration; costs of collection of the gasoline tax were allocated to Story County on the basis of relative ton-miles of travel; and costs of administering motor-carrier laws were allocated on the basis of relative truck registration. Amounts thus allocated to Story County were allocated to the various systems on the basis of relative travel.

Expenditures by the W.P.A., averaging $31,967 for 1935-1938, were assigned 50 percent to secondary road construction and 50 percent to secondary road maintenance, on advice of the county engineer. They were included in the economic costs at only 30

TABLE 12. VALUATION OF STORY COUNTY HIGHWAYS EXISTING IN 1938
(000 OMITTED)

Valuation base	Primary rural roads	Primary urban roads	County trunk roads	County local roads	Urban roads	All roads
Original cost of 1913-1938 capital investment	$2,874	$998*	$851	$1,504	$1,598*	$7,825
Original cost of present useful investment	2,577	961*	702	†	1,492*	†
Replacement cost of present useful investment, basis I‡	2,314	932¶	551	1,450	1,452ø	6,699§
Replacement cost of present useful investment, basis II**	2,372	996	640	1,962	2,486	8,456
Depreciated original cost of present investment	2,196	791	593	†	1,064	†
Depreciated replacement cost, basis I‡	1,960	759	456	1,201	1,031	5,407
Depreciated replacement cost, basis II**	2,018	823	540	1,713	2,065	7,159

*Excludes certain mileage whose valuation is included under replacement cost, but for which original cost is not available.

†Not available.

‡Includes only right of way actually purchased.

¶Includes $6,000 which is the estimated replacement cost of 3.78 miles of graveled primary urban extensions and should be excluded when replacement cost is compared with original cost.

øIncludes $86,000 which is the estimated replacement cost of 69.30 miles of graveled or cindered roads within urban localities and should be excluded when replacement cost is compared with original cost.

§Includes $92,000 which is the estimated replacement cost of graveled or cindered roads and should be excluded when replacement cost is compared with original cost.

**Includes all right of way, which is valued on the basis of estimated value of adjoining property.

percent of actual expenditures, however, which was the percentage of efficiency represented by such work in the opinion of the engineer.

Where engineering judgment dictated that part of the historical investment still physically present was no longer performing any useful service, such portion of the investment was not included in the valuation. The major investment element of this type was the large expenditure for tiling in 1919-1925; only 50 percent of the present depreciated value of this investment element was included.

By applying the methods outlined above and using the depreciated replacement cost ($5,407,000) of the present investment, including only right of way purchased, total annual costs of $458,098 (with interest rate of 2.25 percent) or $498,651 (with interest rate of 3 percent) were obtained (Table 13). While these figures are correct if the depreciation rates and interest rate used are accurate, substantially higher figures for annual costs would have resulted if techniques of previous highway-cost studies had been applied to the basic Story County data. The annual costs obtained in this study are lower because of several factors: (1) Valuation on the basis of replacement cost rather than historical cost, (2) use of depreciation rates based on generally longer service lives, (3) use of higher salvage values, and

TABLE 13. STORY COUNTY HIGHWAY AND STREET COSTS FOR 1938

Cost element	Costs of road or street system					Total costs
	Primary rural	Primary urban	County trunk	County local	Other urban	
Depreciation	$44,570	$16,723	$13,800	$14,857	$30,158	$120,108
Maintenance and administration	29,788	4,325	23,655	87,755	53,229*	198,752
Administration of motor-vehicle laws	9,924	2,340	1,427	1,824	2,056	17,571
Costs, basis I†	84,282	23,388	38,882	104,436	85,443	336,431
Interest at 2.25%	44,097	17,083	10,256	27,025	23,206	121,667
Interest at 3%	58,796	22,777	13,675	36,030	30,942	162,585
Costs, basis II-A‡ (2.25%)	128,379	40,471	49,138	131,461	108,649	458,098
Costs, basis II-B‡ (3%)	143,078	46,165	52,557	140,466	116,385	498,651
Tax equivalents	29,025	20,341	6,753	17,787	27,630	101,536
Costs, basis III-A¶ (2.25%)	157,404	60,812	55,891	149,248	136,279	559,634
Costs, basis III-B¶ (3%)	172,103	66,506	59,310	158,253	144,015	600,187
Costs, basis II-A on original cost	138,402	41,944	58,891	ø	112,389	ø

*Includes $1,980 for county expenditures on secondary road extensions within urban limits and $16,351 for street lighting. All data are based on a 1935-1938 fiscal-year average.

†Basis I includes only the economic costs necessary to insure that present users or beneficiaries pass on equally good facilities to future users.

‡Basis II includes full costs as previously defined in the text.

¶Basis III includes tax equivalents for taxes foregone because highway property is publicly owned. These sums are presented solely to indicate the relative importance of tax equivalents.

øNot available.

TABLE 14. SERVICE LIVES, SALVAGE VALUES, AND INTEREST RATES USED IN VARIOUS HIGHWAY COST STUDIES

Property element	Study*				
	Federal	Illinois	Missouri	Breed	This study
SERVICE LIVES FOR STATE HIGHWAYS, YEARS					
Concrete pavement	24 (1921-1932) 26 (1933-1937)	24	28	20	30 to 40
Bridges and culverts	50 (1921-1932) 55 (1933-1937)	24 to 40	45	30	60
Excavation	65 (1921-1932) 75 (1933-1937)	24 to 48	45	50	100
SALVAGE VALUES FOR STATE HIGHWAYS, PERCENT OF ORIGINAL VALUE					
Concrete pavement	20				20 to 25
Bridges and culverts					
Excavation		10			50
INTEREST RATE, PERCENT					
All	4.25 or 4.50	4.00	4.00	4.25	2.25 or 3.00

*The complete citations for the studies compared in this table are listed in footnote 1, page 8.

(4) use of a lower interest rate. Replacement-cost valuation, of course, was used largely because historical data on financing certain portions of the highway plant were not available. For the four road systems for which both historical and replacement costs were available (all except the county local system and unimportant segments of the urban street system), annual costs were 7.6 percent lower when based on replacement costs rather than on historical costs. This was caused by falling unit costs resulting from technical improvements and a decline in the general price level between 1920 and 1938. The use of replacement costs results in current depreciation charges which more accurately reflect the annual charges necessary to transfer equally good facilities to future generations than do charges based on historical costs. The use of historical costs does have practical advantages, however, where complete data are available.

Contrasts between depreciation rates, salvage values, and interest rates in some of the more important previous studies and in this study are shown in Table 14. Table 15 indicates the contrasting treatments of right-of-way values and tax charges. While sharp contrasts do exist, the choices for the current study can be defended. The service lives and salvage estimates used are presumed to be applicable to a local situation and need not agree with other studies conducted for other states or for the

nation. These estimates are based on the judgment of an engineer, Robley Winfrey, research associate professor of the Station staff, who has specialized in this particular problem in studies conducted for the Public Roads Administration and for the Station. Explanation of the interest rate, right-of-way treatment, and tax-charge method used in this study has been made earlier in this discussion.

TABLE 15. TREATMENT OF COSTS OF RIGHT OF WAY AND TAXES IN VARIOUS HIGHWAY COST STUDIES

Procedure	Study*				
	Federal	Illinois	Missouri	Breed	This study
All right of way included	No	No	Yes	No	No
Only right of way purchased included	Yes	Alternate	No	Yes	Yes
Tax charge included	No	Yes	Yes	Yes	No

*The complete citations for the studies compared in this table are listed in footnote 1, page 8.

The sharp contrasts presented in Tables 14 and 15 reflect a fundamental weakness of any highway cost analysis, namely, that important decisions which affect the results obtained must be made on the basis of judgment rather than on the basis of either empirical investigation or a set of deductive premises which cannot be questioned. Road-life studies, for example, are as yet so meager that depreciation rates used must be largely based on estimates. So long as this is true it cannot be contended seriously that any study will give the only correct answer. It can only be asserted that the answer obtained will be closer to accuracy than if depreciation as a cost were completely ignored.

Although each highway system presents its own special problems, the primary rural road system may be used to illustrate the techniques of determining annual costs.[31] First, an investigation of the original investment cost on present mileage for 1913-1938 was made. A study of county records was made to separate county investment in present primary rural roads from investment in other roads. County investment in present primary mileage was found to arise in three ways: (1) Investment during 1913-1919 in those county roads subsequently absorbed into the primary system, (2) investment during 1919-1929 in county mileage added to the primary system after it was established, and (3) investment during 1919-1923 in the construction of certain bridges and culverts and in the acquisition of right of way on primary mileage for which the county was subsequently

[31] Some explanation of the problems associated with the determination of annual costs for each system is given in Appendices C, D, E, F, and G.

refunded. The county investment for 1913-1938 in present primary mileage was $347,000 of the $2,874,000 gross investment. Thus, the bulk of the investment has been made by the state. Complete information on the state investment was obtained from the studies of the Road Life Survey of the Statewide Highway Planning Survey, where data on primary road investment for the entire state were assembled. Gross investment in the primary system by year, by type of investment, and by stretch of road thus was obtained. The summary data on investment by construction elements are as follows: Concrete surfacing, $1,365,000; excavation, $376,000; bridges and culverts, $365,000; gravel surfacing, $242,000; engineering, $183,000; tiling and drainage, $162,000; right of way, $125,000; betterments under maintenance, $15,000; miscellaneous construction, $15,000; roadside improvement, $14,000; and signs and appurtenances, $12,000.

It was necessary to make certain adjustments in the original investment cost to obtain the original cost of the present used and useful investment in the system. Deductions were made for retirements arising primarily from the paving of mileage previously graveled and from the replacement of structures. Portions of the physical plant still in use but rendering no useful service also were deducted. The latter deduction was necessary primarily because the large investment in tiling in 1919-1925 is not considered necessary under present practices of road construction. These adjustments reduced the investment figure from $2,874,000 to $2,577,000.

To obtain replacement costs it was then necessary to bring the original cost of the present investment to 1938 with the aid of construction-cost indices (Appendix B). When this was done an undepreciated investment value of $2,314,394 was obtained. The service life and salvage estimates were then applied to each component of the highway investment and a depreciated value of $1,959,854 was obtained. Annual depreciation also was determined for each of the highway elements. The original cost of the present used and useful investment, replacement cost, depreciated replacement cost, and annual depreciation thus obtained for each of the investment components are given in Table 16.

In compiling the engineering costs listed in Table 16 it was necessary to determine how engineering costs chargeable to construction for the state should be charged to Story County. The state ratio of engineering costs to construction costs for each year was applied to Story County investment for that year. It also was necessary to determine what portion of the total investment, excluding engineering, was subject to depreciation. This was found to be 74.5 percent, and this percentage of engi-

TABLE 16. INVESTMENT AND DEPRECIATION DATA ON VARIOUS COMPONENTS OF THE STORY COUNTY PRIMARY RURAL ROAD SYSTEM

Investment element	Original cost of present investment	Replacement cost	Depreciated replacement cost	Annual depreciation
Concrete surfacing	$1,365,000	$1,211,000	$997,242	$29,396
Excavation	390,000*	320,000	305,463	1,600
Bridges and culverts	349,000	385,000	304,822	6,428
Gravel surfacing	41,000	26,000	26,322	1,756
Engineering	170,000	158,000	138,499	3,046
Tiling and drainage	101,000†	84,000	73,025	838
Right of way	125,000	87,000	87,225	0
Miscellaneous	36,000‡	43,000	27,256	1,506
Total	2,577,000	2,314,000	1,959,854	44,570

*Includes clearing, grubbing, and roadside development.

†Excludes one half of the tiling and drainage investment for 1919-1925, or $61,300.

‡Includes betterments under maintenance, signs and appurtenances, and other miscellaneous costs.

neering costs was depreciated at 2.585 percent annually, which was the average rate.

The depreciated replacement cost was multiplied by 2.25 percent to obtain an annual interest cost of $44,097.

The average millage property tax rate for rural areas in Story County in 1938 was 22.81. Recent research indicates that the ratio of assessed to true value in rural areas in Iowa is about 65 percent,[32] so for each dollar of assessed value, there is about $1.54 of market value. Thus, there was a tax rate of about 14.81 mills per dollar of market value. On this basis, the tax equivalent for the primary rural system was 1.481 percent of $1,959,-854 (the depreciated replacement cost), or $29,025.

It was a relatively simple matter to obtain cash outlays for the existing plant. Maintenance and administration costs for Story County mileage were determined for the period 1933-1937 from published reports of the Iowa State Highway Commission, and an average was taken to eliminate wide variations. The overhead administration costs of the commission chargeable to Story County maintenance and administration were obtained by (1) summing the costs of the various divisions of the commission which were charged to maintenance by the commission itself, and (2) allocating Story County its share on the basis of its primary road maintenance costs relative to those for the state as a whole. The 1935-1938 average maintenance and administration cost was $29,788. In addition, the Story County primary rural system was charged with $9,924, its share of the annual costs of administering state motor-vehicle laws. It was in such a manner that annual costs for depreciation, interest, maintenance, administration of construction, and administration

[32]Murray, William G. Corporate Land, Foreclosures, Mortgage Debt, and Land Values in Iowa, 1939. p. 328. Research Bulletin 266, Iowa Agricultural Experiment Station, Ames, Iowa. 1939.

of motor-vehicle and carrier laws were determined for the primary rural road system of Story County. The costs are assembled and totaled in Table 13.

REVENUES

A second step in the fundamental comparison of highway costs and revenues is the determination of the annual revenues available to meet annual costs. For this purpose it is necessary to divide highway receipts into two categories—those available only for capital improvements which are not currently chargeable as costs of the existing plant and those currently available to cover costs of the existing plant. In the first category are federal aid,[33] special assessments, and bond issues. In the second category are highway-user taxes, which are earned through vehicle use of the existing plant; general taxes from current levies, such as the property millage levies for highways; and funds currently accruing for highway purposes because of net transfers of funds, utilization of balances, and miscellaneous imposts. *In a cost-revenue comparison, only the second category of*

[33]During recent years a rising percentage of federal aid has been expended for stage construction, where improvement of a road, previously improved to some degree, to a higher stage necessarily involves replacement as well as additional capital investment. A good illustration is the replacement of a gravel surface with a concrete surface.

TABLE 17. FINANCING OF HIGHWAY AND STREET EXPENDITURES IN STORY COUNTY DURING 1938

Revenue	Highway or street system				All roads
	Primary rural	Primary urban	Other urban	Secondary rural	
Vehicle-user taxes	$237,850	$54,487	$2,056*	$73,666	$368,059
Property taxes	0	0	9,152†	118,830‡	127,982
Other general revenues	0	25,000¶	60,769	0	85,769
Federal funds:					
Federal aid	102,200	296,092	0	0	398,292
W.P.A.	0	0	0	37,404	37,404
Total	102,200	296,092	0	37,404	435,696
Special assessments	0	0	7,219ø	6,732	13,951
Special-assessment bonds	0	0	57,000	0	57,000
Miscellaneous	0	0	0	1,250	1,250
Total	340,050	375,579	136,196	237,882§	1,089,707

*Prorata share of user revenues used to enforce laws relating to motor vehicles and motor carriers which was assigned to Story County and in turn to urban streets, as well as to other systems within the county.

†This figure is incomplete since it was not possible to determine accurately how large a portion of urban expenditures was financed by property-tax revenues, and how large a portion by general revenues from other sources.

‡Includes $24,100 levied by the county for debt service on county road and bridge bonds.

¶Contributed by the City of Ames from general funds toward meeting the cost of the underpass on Highway 69.

øRepresents amounts currently paid by property owners for debt service on special-assessment bonds previously issued.

§The total for secondary roads is $3,123 in excess of the expenditures indicated in Table 11 because revenues and expenditures in the financial statement of Story County do not exactly coincide in time with the county engineer's records of construction and maintenance work completed and paid for.

highway receipts is included, since receipts from the first category obviously have nothing to do with the adequacy of current tax structures to cover highway costs.

Table 17 shows how total expenditures of $1,087,000 in Story County in 1938 were financed.[34] Vehicle-user taxes in that year provided 63.3 percent of the $581,810 raised from current taxes or general revenues.

In the basic revenue-cost comparison it was necessary to determine the amount of vehicle-user taxes collected by the state which could logically be assigned to Story County and to systems within the county. For the most part, user-tax revenues were assigned in the ratio of the volume of traffic, in vehicle-miles or ton-miles, carried by the roads and streets of Story County relative to that of the state as a whole, rather than through legal allocations of user-tax revenues. Because the primary rural roads, and to some extent the county trunk roads, in Story County carry more traffic per mile than the average for the state, revenues were allocated to the county, not only on the basis of actual traffic, but also on the basis of the traffic which each system would have carried if its traffic had been equal to that of the state average on roads of similar surface types. This was done to permit revenue-cost comparisons which would be more representative of state conditions than otherwise would have been possible. Iowa vehicle-user revenues collected in 1938 and assigned to Story County are given in Table 18.

To obtain a complete revenue picture by systems for the

[34]Table 11 shows an allocation of this total expenditure by purpose and system.

TABLE 18. ALLOCATION OF THE VEHICLE-USER REVENUES DISTRIBUTED IN IOWA IN 1938 TO STORY COUNTY HIGHWAYS

Revenue	Net funds distributed in Iowa*	Funds allocated to Story County	
		Based on actual traffic	Based on average traffic
Motor-vehicle fees	$11,805,000	$193,130†	$139,417
Motor-fuel taxes	13,209,000	219,005‡	152,206
Motor-carrier taxes	473,000	14,351¶	5,298
Truck permit fees	64,000	844ø	844
Total	25,551,000	427,330	297,765

*From data issued by the Public Roads Administration. The net funds distributed differed from the net total receipts only when there were adjustments necessitated by previously undistributed funds.

†Based on the ratio of vehicle-miles traveled in Stofy County to the total vehicle-miles traveled in Iowa (1.636 percent).

‡Based on the ratio of ton-miles traveled in Story County to the total ton-miles traveled in Iowa (1.658 percent).

¶Based on the ratio of ton-miles traveled in Story County by common carriers subject to the tax to the total ton-miles traveled by them in Iowa.

øBased on the relative truck registration of Story County in comparison with that of Iowa.

TABLE 19. TOTAL REVENUES AVAILABLE TO MEET ANNUAL COSTS OF STORY COUNTY HIGHWAYS AND STREETS DURING 1938

Road system	User revenues		General revenues		Total revenues		Annual costs
	Basis I*	Basis II†	Property imposts‡	Other revenues	Basis I*	Basis II†	
Primary rural	$238,423	$130,173	0	0	$238,423	$130,173	$128,379
Primary urban	57,308	25,984	0	0	57,308	25,984	40,471
Other urban	51,752	65,999	$16,371	$52,568	120,691	134,938	108,649
County trunk	35,020	29,556	47,003¶	299	82,322	76,858	49,138
County local	44,827	46,053	71,827	1,809	118,463	119,689	131,461
Total	427,330	297,765	135,201	54,676	617,207	487,642	458,098

*User revenues allocated to Story County on the basis of actual traffic.

†User revenues allocated to Story County on the basis of average traffic.

‡Special assessments and general revenues devoted specifically to capital improvements are excluded.

¶County levies of $24,100 for debt service are included.

county it was necessary to distribute the vehicle-user revenues to the systems and to add the general revenues available for each system. This is presented in Table 19. If revenue estimates are based on actual traffic, vehicle users contributed 69.2 percent of the current revenues available to cover current costs, and if revenue estimates are based on average traffic, vehicle users contributed 61.1 percent.

COMPARISON OF COSTS AND REVENUES

With the estimates of annual costs and revenues it was possible to determine whether current revenues are sufficient to cover current costs, without regard to the relative share of the total costs which should be borne by various groups in the community. The data of Table 19 indicate that user revenues from vehicles using Story County roads and streets, allotted on the basis of actual traffic, plus revenues derived from current imposts on property owners and others within the county were more than sufficient to meet current annual costs. Thus, current beneficiaries of roads and streets within Story County were not only paying sums sufficient to continue facilities equal to those which they had received, but were providing additional sums which make possible net capital additions to the physical plant. This was true, moreover, for every system comprising the highway plant. For county local roads, where economic costs somewhat exceeded allocated revenues, the cost figure included an interest charge of $27,025; since no debt was outstanding on the system, current revenues were sufficient to make additions possible.

This conclusion, of course, is not based on existing legal allocations of vehicle-user taxes. Under existing laws, the secondary roads of the county received $73,666 in 1938; on the basis of actual traffic, the revenue allocation was $79,847. Urban

streets, exclusive of primary extensions, received nothing. All vehicle-user revenues not allocated to secondary roads in Iowa go to primary roads and urban extensions of primary roads.

When user revenues were allotted on the basis of average traffic figures, total revenues were still in excess of annual costs for the entire plant, although not for every system within the plant. Even for the various systems, however, revenues were more than sufficient to cover the costs necessary to maintain the capital investment and to pass on facilities which are equal to those existing at present. This is shown by a comparison of the costs on basis I presented in Table 13 for each system with the revenues for the system shown in Table 19.

This revenue-cost relationship, of course, is for the one year studied (1938). The relationship which will exist in the future cannot be predicted, although it is reasonable to suppose that both revenues and costs will increase. Costs will increase because a considerable portion of the primary and county trunk roads and the more important portion of the city streets probably will require replacement by a construction more costly than that now used. Increased traffic and construction to higher standards in width of roadway, sight distance, and roadside service will result in much greater expenditures than were made for the original facilities. Some completely new roads and streets may be built, although cost increases from this source are likely to be unimportant in Story County. Revenues have continued to increase with an expansion in truck ownership and in average travel by all vehicle classes. Income from Iowa motor-vehicle imposts in 1939, for example, totaled $27,245,000 as compared with $25,567,000 in 1938 and $23,477,000 in 1936.

Allocation of Highway Costs Among Groups of Beneficiaries

Even if there is no inadequacy in existing highway-tax structures for the highway unit studied, the tax burden may be inequitably distributed among groups of beneficiaries. Whether vehicle users and vehicle-user classes are paying their fair share of highway costs for any given political unit is highly controversial. The current alternative theories of highway finance previously discussed are essential to an understanding of this controversy.

Despite analytical difficulties, the possibility of actually arriving at some quantitative, scientific apportionment of highway costs among various groups of beneficiaries has greatly intrigued public and private groups interested in highway taxation problems. At least eight studies have been made since 1935, chiefly in an endeavor to determine whether vehicle users are meeting their share of annual highway costs. Each study has been con-

ducted by or for (1) the Federal Coordinator of Transportation, (2) the Association of American Railroads, (3) the National Highway Users Conference and its state affiliates, or (4) one of the state highway departments. These studies have been referred to on pages 8, 55, and 56.

Since there have been many charges that special-interest motives and lack of highway training and experience have affected the conclusions reached by those who made the studies, a brief statement of the charges and some pertinent information about each group seem advisable. The sincerity of the experts employed by each group is not questioned here; neither is it guaranteed that the experts employed by some of the groups may not have been unconsciously influenced by what they knew their employers wanted.

The two groups most criticized as special-interest groups are the Association of American Railroads and the Highway Users Conference. (The latter is financed mainly by the large corporations manufacturing and selling motor vehicles, road equipment, and road materials.) The cost studies published by the railroads have uniformly indicated that present commercial-motor-vehicle highway-use charges are too low; the cost studies published by the highway-users group have uniformly indicated that present motor-vehicle highway-use charges are either adequate or excessive.

The Illinois and Missouri Highway Department studies were made by the respective highway commission staffs of the two states. Groups of commercial trucking corporations had sued in the federal courts for injunctions in each state against the collection of existing truck highway-use charges. The highway commission staffs therefore made the cost studies to determine the veracity of the truckers' allegations. In both states, the truckers were overruled after the cost studies had been examined by the courts.

The study by the Federal Coordinator of Transportation was made by staff experts whose sincerity is not questioned, but whose highway training and experience may not equal those of the engineers of the state highway commission staffs. Like all the other studies, that of the Federal Coordinator was not necessarily based on adequate and reliable data.

The solutions propounded by seven of these studies are given in Table 20. The main highway-user group cost study is not included in this table because it developed no independent cost allocations but simply applied formulas of previous studies to cost data developed in the study. An examination of the studies shows that while each discusses the different classes of benefits conferred by each highway or street system, the final solutions

TABLE 20. ANNUAL HIGHWAY COST TO BE CHARGED TO MOTOR VEHICLES IN VARIOUS STUDIES

Type of road	Annual cost charged to motor vehicles, percent						
	Federal*	Ennis†	Duncan‡	Breed¶	Missouriø	Illinois§	Oregon**
Main trunk road	83	85	82	90.4	90	90	85.6
Intermediate road	34	85	82	90.4	66	60	10.9
Land-service road	34	85	82	90.4	66	60	10.9
City street	30	51	25	47.3	50	50	18.5

*Federal Coordinator of Transportation. Public Aids to Motor-Vehicle Transportation. p. 159. U.S. Government Printing Office, Washington, D.C. 1940.

†Ennis, William D. Motor-Vehicle Taxation in New Jersey. p. 35. Associated Railroads of New Jersey, Hoboken, N.J. 1935.

‡Duncan, C. S. Highway Competition. p. 6. 1935. (Original not seen.) Reported in Dillman, G. C., John S. Worley, D. Philip Locklin, and G. Lloyd Wilson. Highway Costs and Motor-Vehicle Taxation. Illinois Highway Users Conference, Chicago, Ill. 1939.

¶Breed, C. B., Clifford Older, and W. S. Downs. Highway Costs. p. 9. Association of American Railroads, Washington, D.C. 1939.

øMissouri Highway Department. Study of Missouri Highway and Street Costs. p. 20-21. Missouri Highway Department, Columbia, Mo. 1937.

§Glover, V. L. A Study of Highway Costs and Motor-Vehicle Taxation in Illinois. p. 11-13. Illinois Division of Highways, Springfield, Ill. 1938.

**Oregon State Highway Department. An Analysis of the Highway Tax Structure in Oregon. p. 112-113. Technical Bulletin 10, Oregon State Highway Department, Portland, Ore. 1938.

were based on one or more of the following plans of cost allocation.

1. Differentiation between general-use and local-use road factors by either (1) charging the costs of general-use roads against vehicle users and the costs of local-use roads against general taxpayers, or (2) analyzing the extent to which each system is of general-use or local-use character and determining cost allocations in that ratio.

2. Estimation of what the annual road and street costs would have been if motor vehicles had not developed, charging such costs to general taxpayers and the remainder of present costs to vehicle users. Two general methods have been proposed to arrive at the desired estimate: (1) Computing the complete cost of constructing and of maintaining a system of highways and streets adequate to serve traffic of the premotor-vehicle type, and of a mileage substantially equal to that of the present highway system, or (2) determining the per-mile costs or the per-capita expenditures of the period 1905-1913, before the rising demands of vehicle users for highway improvements were recognized in highway programs, finding the ratio of these per-capita costs or expenditures to real per-capita costs or expenditures in recent years,[35] and applying the resulting percentage to present annual costs.

All these methods for computing cost allocations have weak-

[35]Real per-capita costs or expenditures are those which have been adjusted by a cost index for changes in costs of construction and maintenance over the period in order to determine costs that may be used for fair comparisons.

nesses. Differentiation between general-use and local-use roads necessitates defining general or local use. A strictly general-use road may be defined as either a road on which all traffic passing over a given mile originated outside the township or county in which the mile is located, or a road on which all traffic passing over a given mile originated on some other mile. Under either definition relatively few miles would qualify as either strictly general-use or strictly local-use roads. Origin and destination studies in Iowa (Appendix A) show that even on primary state highways, 24.59 percent of the trips were of an intracounty character, and that on the county local system, 23.24 percent of the trips were of an intercounty character. Road-use studies (Appendix A) also show that 44.76 percent of the travel on the county local roads originated with vehicle users living on other roads. Even on the primary system a small percentage (2.80 percent) of the travel originated on the system. Studies in many other states show comparable road-use characteristics. It appears, in fact, that only where land-access roads and streets serve practically no one but residents adjoining them does the distinction between strictly general-use and local-use roads have sound basis. (The basis of support of genuine local-use roads would logically be special-benefit levies supplemented by a measure of general taxation within the area concerned.)

It is alleged, however, that even if almost no mileage is of strictly general or local use, analysis of the extent to which each type of use predominates on a given mile or system may be helpful in solving cost-allocation problems. Thus, the fact that only 2.80 percent of the vehicle-miles traveled on Iowa primary rural roads originates on that system may be cited as evidence that vehicle users should support the primary system, and the fact that 74.01 percent of the traffic on county local roads originates within the county, and that 55.24 percent originates on the county local system itself may be cited as evidence that vehicle-user support for county local roads should be limited. However, even on local-use roads access under present conditions is through motor-vehicle use, and some portion of vehicle-user revenues earned must be regarded as arising from such mileage. Such evidence is indeed admissible in determining cost allocations, but it is not especially helpful in determining how the share of costs not charged to vehicle users is to be divided between specially benefited property owners and general taxpayers.

Allocation of costs on the basis of what costs would have been if the motor vehicle had not developed also has many weaknesses. It is impossible to determine what our highway and street plant would be like today if the motor-vehicle era had never developed. It is possible that, with rising standards of living proceeding from other sources than development of the automobile industry,

considerably more might have been spent for highways in the last 30 years than was spent in the period 1905-1915, but even if this would have been true, the amount cannot be ascertained. Even if real per-capita expenditures or per-mile costs had remained the same with the coming of the motor vehicle, it is fallacious to assume that none of the costs of unimproved roads might equitably be charged to motor traffic today. The benefits of basic roads obtained through horse-drawn traffic 40 years ago are now obtained through motor-vehicle use. Even if the quality of the roads had not changed, proponents of motor-vehicle taxation could still argue for a measure of such taxation.

The chief merit in this second major method of cost allocation is its suggestion of a possible cost-allocation method which proceeds by trying to define a degree of improvement in the roads and streets that may be regarded as sufficient to provide basic community and property-access benefits under present conditions of motor-vehicle transportation. This method of cost allocation will be examined later.

Aside from the detailed weaknesses in the methods just examined, the fundamental weakness in the cost ratios based upon them is in the assumption that there can be any scientific or absolute cost allocation among groups of beneficiaries. Such an allocation is impossible because highway benefits to traffic, property owners, and society are so intermingled that it is analytically impossible to indicate where one type of benefit stops and another begins. Furthermore, the actual allocation is constantly being revised in the political sphere as prevailing notions of tax justice change, or as a special-interest group succeeds in making an important impact on the thinking of legislators in the field of highway taxation.

It seems much more desirable to recognize at the outset that it is possible to analyze the problem of cost allocation from two angles. When it is assumed that continuing social benefits from highways are so great that these benefits should be emphasized and special benefits minimized, it appears that the major highway-tax load should be placed on the shoulders of general taxpayers. On the other hand, when it is assumed that the billions of dollars spent on improved roads and streets in the past two decades have been expended primarily for and at the insistence of specially benefited groups, the social benefits are minimized and the major highway-tax load falls on the shoulders of vehicle users. The latter point of view emphasizes tangible economic benefits to traffic wherever possible and thus provides rather definite tests for determining how much should be spent for highways and gives a measure of assurance that those immediately benefiting in an economic sense will pay for those benefits.

When the alternative point of view is adopted, there seems to be the possibility that the whole problem of a rational expenditure program and highway-tax program will be dismissed with the easy statement that highways justify taxation because they confer great, intangible social benefits. Yet the actual impact of social objectives in stimulating highway expenditures has been greater in recent years than prior to the motor-vehicle era and cannot be overlooked. This is evidenced by the increased federal spending for highways in recent years—both through increased grants to state highway departments as a method of stimulating industry and through work relief spending on highways.

ALLOCATION BY SPECIAL-BENEFIT ASSUMPTION

If it is assumed that whenever special benefits exist they should be made the basis of highway support, the highway revenue system obviously would rely heavily upon special-benefit levies of all types and especially on vehicle-user taxes. The extent to which such levies can be justified, however, can be determined only by intensive examination of the benefits conferred by rural roads and urban streets, both prior to the highway era and at present.

RURAL ROADS. Prior to the motor-vehicle age rural roads served to bring products of agriculture and the forest to nearby trading centers and to take back the finished goods required by the producers of these commodities. They served farmers and their families as a means of receiving the mail; of getting to and from schools, churches, and social gatherings; and of obtaining medical service. Persons living in urban localities used the roads for short trips into the country or occasionally for trips to summer resorts and parks. These uses were thus economic, social, and cultural. They were, for the most part, strictly local in character, although closely associated with long-distance rail or water transportation.

It thus appears that the main ends served by the unimproved rural road system were much the same as those now served by improved roads. Furthermore, most of the benefits were obtained in the immediate sense through road use just as they are today. There were even business uses of the roads. The use of unimproved roads then differed from that of our present improved roads in that (1) the range and speed of movement were much more restricted; (2) commercial uses were mainly complementary to, rather than competitive with, other forms of transportation and typically were not for hire; (3) the number of vehicles using the highways was much smaller; and (4) the unimproved roads could not provide constant, all-weather access to other sections of the community.

While the roads were supported by general property taxes on the theory that the provision of highways was a general func-

tion of government, they might logically have been supported largely by vehicle taxes, since most of the benefits were derived through road use. That they were not is attributable to traditional views of governmental functions, to the fact that horse-drawn vehicles did not lend themselves readily to forms of user taxation, and to the fact that continuous pressure for ever-increasing expenditures on highway improvements was not present.

Considerable unimproved rural mileage remains in Iowa and other states, although it is constantly being reduced. The benefits conferred by this mileage remain much the same as in the premotor-vehicle era, yet today these benefits are derived largely through use of motor vehicles whose owners pay user-taxes to the state for gasoline consumed in their passage over these roads. It seems reasonable, therefore, that some portion of such road costs should be met from vehicle-user revenues.

In some sections of states that are well advanced in their programs of primary and secondary road improvement, however, unimproved rural mileage carries almost no traffic except that serving the relatively few families who live along these roads. The amount of user revenues assignable to the support of such roads is necessarily insignificant under any kind of allocation plan, and the customary way of financing their annual maintenance costs is still through general taxation within the immediate political area involved, whether county or township. Such land-access roads, however, have approximately the status of private roads for the two or three families who may live along any particular mile of them. As special beneficiaries, it is these residents who logically should pay all the annual costs of maintaining them, although a part of their support may be derived from the small amounts of vehicle-user revenues which may be assigned to their support. If levies on the specially benefited residents are not legally or politically possible, then certainly such mileage should be allowed to return to the status of a private road and cease to be a burden on general taxpayers.

Improved rural roads, which are almost entirely a product of the motor-vehicle era, have conferred substantial benefits on vehicle users. These benefits include a reduction in vehicle operating costs, a reduction in accident costs because of safer highway construction, constant access to all portions of the community, saving in time, and increased range of movement. The saving to vehicle users resulting from improved roads either because of lower vehicle operating costs or fewer accidents, provides a basis for the direct taxation of traffic. In fact, if the total annual costs of improved roads are more than offset by savings to the traffic passing over them, there exists no need to consider types of levies other than user taxes. Thus a solid

economic basis exists for the tendency during the motor-vehicle era to place the support of state trunk highways and of the more important secondary roads on the shoulders of vehicle users. There is the possibility, of course, that a governmental local unit, such as a county, may wish to proceed with its improvement program faster than its share of user revenues from the state will permit. Where improvement of the more important and more heavily traveled secondary roads is involved in such a program, resort to general taxation within the political unit may prove to be the most expedient way to raise the needed revenue.

In many instances, the volume of traffic has been insufficient to warrant road improvement solely on the basis of savings to the vehicle user. Then, other types of benefits which improved roads confer must be considered when the relative merits of other types of public levies are being considered. Among the more important of such benefits is the constant access provided by an all-weather surface. Constant access itself has yielded benefits of several types, including those of a purely commercial nature. The farmer is able to market his commodities at what he considers the most opportune time and to obtain delivery of supplies exactly when they are required. The urban merchant serving rural trade has his volume of business more evenly distributed and probably suffers less risk of loss from spoilage of perishable foodstuffs imported from other regions.

There also are certain satisfactions reflected by road use which may be enhanced by constant access, such as social and religious intercourse with other portions of the community, or between town and county. These satisfactions are derived partially through the ability of the people to enjoy these benefits precisely at the *time* desired, partially through increased use of the improved roads. Further satisfactions derived from the assurance of constant access are not necessarily reflected in road use at all. Thus, from a farmer's standpoint, one of the most important benefits of living along an improved road is the fact that medical attention always is available. Certain common benefits not related to the use of the improved road by any one person also help justify the road cost from the standpoint of the community. An example of this is provision of constant access to consolidated schools.

Constant-access benefits are not always related to use by individual vehicle owners, but seem to represent community benefits in large part which are difficult to measure quantitatively. Where such benefits are used to justify the improvement of secondary roads, general taxation in the area chiefly benefited is a logical means of support. However, user taxation still should have a place in meeting improvement and maintenance costs of

this mileage, since many constant-access benefits are clearly related to vehicle use, and few are entirely separated from such use. Low-traffic, semiprivate roads should be improved only at the insistence of adjoining property owners and should be financed largely through special assessments on such owners.

Other benefits of improved roads also are related closely to road use and also are difficult to measure in a quantitative economic sense. They furnish additional justification for meeting a part of road-improvement costs through vehicle-user taxation where traffic warrants such improvements.

URBAN STREETS. The apportionment of the costs of financing urban streets presents a more complex problem. The use of urban streets is not unlike that of rural roads, and, to this extent, a similar system of finance would seem to be suggested. Thus, for purely intracity traffic, "there is an obvious range from the private street used only by the immediate residents and occasional taxicabs or delivery vehicles which serve them, through an ordinary residential street used to a limited extent and for short distances by others than the residents and those who serve them, and a secondary trunk street, up to the so-called arterial street. The movement is heavy on these arterial streets in the mornings and late afternoons, when people are seeking to reach or leave concentrated places of work. In some cities there is one well-defined business and industrial area, while in others there may be several."[36] In addition to intracity traffic, there is the traffic into, out of, and through the municipalities, carried by primary urban extensions which constitute so close a link with the primary rural roads that their costs in many states are met in the same way, that is, through vehicle-user taxation.

However, the proportion of revenues which can equitably be collected from private motor-vehicle users to meet urban street costs is much smaller than that of rural highways. Use of rural highways for purposes other than private motor transportation is now unimportant, while city streets still are used to a considerable extent by pedestrians and bicycle traffic, by street railways, and by publicly owned vehicles of various municipal service departments. In addition, although rural highways serve few purposes other than transportation, urban streets serve a variety of other purposes—they afford an avenue of access for light and air to buildings, serve as fire barriers between city blocks, provide surface and underground space for equipment of public utilities, and sometimes serve as recreational areas for city inhabitants. In addition, most of the services of the street department —street lighting, dust abatement, snow removal, and street cleaning—are not necessitated solely by the existence of vehicle traffic since they serve pedestrian traffic and occupants of ad-

[36] Federal Coordinator of Transportation, *op. cit.*

joining buildings as well. Complicating the situation still further are the patterns of street use and categories of street benefit which vary widely between cities of various populations. Also, many miles of improved streets now serving motor vehicles were improved before the motor-vehicle era began, especially in large cities, and the possibilities of estimating savings in vehicle operating costs as a measure of vehicle responsibility for street finance are therefore slight.

Although the problem of cost allocation is complex it is probable from the special-benefit viewpoint that (1) costs of primary urban extensions should be charged against vehicle users, (2) costs of improving and maintaining arterial, heavily traveled, intracity streets should be met predominantly from vehicle-user taxes, (3) costs of improving low-traffic, property-access residential streets should be charged against property owners through special assessments, and (4) costs of improving intermediate-traffic streets of an intracity character should be met by both vehicle users and adjoining property owners. The maintenance of improved streets in the third and fourth categories should probably be financed by general taxation or general municipal revenues.

The analysis of cost allocation from the special-benefit viewpoint seems to indicate the following general conclusions.

1. For rural roads an analytical basis can be found for meeting the entire costs of many improved roads and even part of the costs of unimproved roads through vehicle-user taxes. A basis also can be found for continuing general taxation for secondary roads, although such taxation might be still further reduced, in the case of high-traffic mileage by increased reliance on user taxation and in the case of low-traffic, semiprivate roads by placing the responsibility for continued maintenance on those who directly benefit from them.

2. Urban roads should be financed by similar means, except that the costs assigned to general taxpayers should comprise a larger proportion of the total than in rural areas.

3. In the improvement of property-access, low-traffic roads in both city and country, special assessments should continue to finance the improvement.

4. A precise, analytical determination of the relative responsibilities of each beneficiary class for the costs of each particular road and street is difficult, if not impossible.

Even when the problem of highway cost allocation is analyzed from the special-benefit viewpoint, the existence of general social benefits justifying the continued use of general taxation for highways cannot be disregarded. Extended analysis of benefits from the social viewpoint could easily expand the relative importance assigned to such benefits and result in conclusions

quite different from those reached in the discussion just completed. However, issues of public policy cannot be settled by qualitative analysis alone, for various cost allocations are being demanded and will be given as long as the cost responsibilities of various beneficiary groups are matters of public debate and of tax legislation.

To seek such a quantitative answer has been the purpose of various studies which too often have tried to demonstrate that a particular cost allocation was the correct one. It is better to recognize that any cost allocation must be judged on the basis of its reasonableness or justice in the light of prevailing taxation concepts.

Cost Allocation Based on Social-Benefit Assumption

A cost allocation can be obtained in two ways. Either costs chargeable to the community (general taxpayers and others) can be determined and the residual costs charged to vehicle users, or the reverse procedure can be followed. In most of the previous studies the share chargeable to vehicle users has been determined first. In the discussion which follows, both methods were employed, but the former method was used as a starting point.

From the social-benefit viewpoint it is assumed that there is some degree of improvement in roads and streets of Story County which may be regarded as sufficient to provide basic community and property-access benefits under present conditions of motor-vehicle transportation. While such improvement is necessarily greater than simply the maintenance of a system of dirt roads, it is less than the improvement represented by concrete highways. Constant access to and rapid communication between all parts of the community could be obtained, for example, even if no road or street had been improved beyond the gravel stage. Dust abatement, a type of benefit which is particularly important to urban residential areas, may be obtained by some type of construction between gravel and concrete. When annual costs of such a system can be determined, they may be termed costs of a basic system and charged to general taxpayers or specially benefited property owners. The difference between present costs and assumed basic-system costs may be charged to vehicle users.

It was therefore assumed that a system of rural roads sufficient to meet the above requirements would be made up of graveled roads covering the routes of the present surfaced mileage in the county. Such roads would be approximated by graded and surfaced county local roads having an average present construction cost of $2,346 per mile and annual costs of $192 (Appendix H). For urban streets improved beyond the gravel or cinder stage, it was assumed that the basic street could be represented

TABLE 21. ALLOCATION OF ANNUAL HIGHWAY COSTS IN STORY COUNTY AMONG MAJOR GROUPS OF BENEFICIARIES IF SOCIAL BENEFITS ARE CONSIDERED PARAMOUNT

Road system	Annual costs	Basic costs chargeable to general public		Residual costs chargeable to vehicle users	
		Amount	Percent	Amount	Percent
INTEREST AT 2.25 PERCENT					
Primary rural	$128,379	$16,381	12.8	$111,998	87.2
Primary urban	40,471	16,593	41.0	23,878	59.0
County trunk	49,138	25,119	51.1	24,019	48.9
County local	131,461	131,461	100.0	0	0.0
Other urban	108,649	86,093	79.2	22,556	20.8
Total	458,098	275,647	60.1	182,451	39.9
INTEREST AT 3 PERCENT					
Primary rural	143,078	17,684	3.5	125,394	25.2
Primary urban	46,165	18,009	3.6	28,156	5.6
County trunk	52,557	27,135	5.4	25,422	5.1
County local	140,466	140,466	28.2	0	0.0
Other urban	116,385	89,745	18.0	26,640	5.4
Total	498,651	293,039	58.7	205,612	41.3

by the new stabilized gravel (gravel-clay mixture) streets recently laid in Ames, the largest city in the county. These streets have been laid (1935-1938) at an average cost of $19,531 per mile, including costs of completed surface, grading, and curb and gutter for a street of 30-foot average width with 27 feet of stabilized gravel surface (Appendix I). This is considerably less than the replacement cost of the present streets surfaced with portland-cement concrete or asphaltic concrete. Other improved mileage of the gravel or cinder type was included in the basic system at the existing stage of its improvement. All existing structures in the rural road system were included in the basic investment, as were all urban structures except the recently constructed underpass in Ames.

The basic costs computed for the entire plant and their allocation are presented in Table 21; Appendix J shows the details of computation. A comparison of vehicle-user revenues ($297,765) with costs charged to vehicle users ($182,451) indicates that vehicle users were more than paying their way when a cost allocation giving primary emphasis to social and property benefits is used.

COST ALLOCATION BASED ON SPECIAL-BENEFIT ASSUMPTION

A higher charge to vehicle users may be expected if the special-benefit approach is adopted as a point of departure. In this case costs chargeable to vehicle users are first determined and the residual costs charged to the general public. This approach does not imply that vehicle users should be charged with an amount equal to the value of all the benefits they derive from road use. However, those roads which give the promise

of the greatest surplus of added benefits over added costs should be improved first, and improvement should not go beyond the point where added benefits equal added costs. Assuming that, for the most part, this policy has been followed in the past, total benefits should greatly exceed present total costs. Vehicle-user charges based on their share of the total economic benefits should still leave users a surplus of benefits for the improvement program. This is exemplified clearly by many trunk highways which were hard-surfaced a decade ago. Traffic on these highways has continued to increase, and with the increase the surplus of benefits over annual costs has mounted.

On the basis of these considerations an effort was made to obtain a fair basic rate which could be charged to vehicle users for the support of roads and streets in all parts of the Story County road system. The state trunk roads and their urban extensions were used to determine this basic rate on the assumption that they represented a system whose benefits to vehicle users exceeded annual costs, whose traffic volume was known, and whose entire costs could logically be assessed to vehicle users.

Annual costs of state roads and their extensions ($168,850) were therefore divided by the "average" (page 60) total ton-miles of traffic (69,812,000) which they carry to obtain the basic rate used ($0.00242 per ton-mile). A ton-mile rather than a vehicle-mile factor was used because ton-miles seem to reflect use benefits more fully. Traffic on each of the road and street systems was multiplied by the ton-mile rate thus obtained to determine the share of costs charged to vehicle users. Remaining costs were charged to general taxpayers. The resulting cost allocation is given in Table 22. Charges to vehicle users ($315,323) were slightly in excess of amounts contributed by vehicle users ($297,765).

In this analysis an equal ton-mile charge was used for travel on all roads. This might seem to imply that the benefits per ton-mile were assumed to be identical on all types of roads, but such

TABLE 22. ALLOCATION OF ANNUAL HIGHWAY COSTS IN STORY COUNTY AMONG MAJOR GROUPS OF BENEFICIARIES IF VEHICLE-USER BENEFITS ARE CONSIDERED PARAMOUNT

Road system	Annual costs	Costs chargeable to vehicle users		Residual costs chargeable to general public	
		Amount	Percent	Amount	Percent
Primary rural	$128,379	$128,379	100.0	0	0.0
Primary urban	40,471	40,471	100.0	0	0.0
County trunk	49,138	30,848	62.8	$18,290	37.2
County local	131,461	47,916	36.4	83,545	63.6
Other urban	108,649	67,709	72.3	40,940	37.7
Total	458,098	315.323	68.8	142,775	31.2

was not the case. Vehicle-user benefits per ton-mile of travel do vary with the degree of road improvement, and the surplus of user benefits above costs probably is greater on the primary (state trunk) system than elsewhere. It was only assumed that a ton-mile rate sufficient to cover all costs on the primary system and its extensions will not exhaust total vehicle-user benefits on other systems. This assumption is borne out by the fact that measurable savings in vehicle operating costs per ton-mile on roads improved only to the gravel stage are alone almost equal to the ton-mile rate used in the cost allocation in Table 22.

Recent studies at the Iowa Engineering Experiment Station indicate that such savings are about 2.35 mills per ton-mile for a passenger car. This compares with the ton-mile rate of 2.43 mills found in the cost allocation. Such measurable savings are only one of several types of vehicle-user benefits, and the consideration of other types unquestionably would raise total benefits above the ton-mile rate charged, even on county local graveled roads.

The strikingly different amounts charged to vehicle users under the two cost-allocation methods indicate that the cost allocation obtained depends on the assumption made. Even under the second method, however, the 1938 levies on vehicle users ($297,765) were almost sufficient to cover costs; on this basis they were more than adequate to cover depreciation, maintenance, administration, and contractual interest, so that vehicle-user taxes were sufficient to provide for some net capital outlays.

Payments by Vehicle Users and General Taxpayers

A final cost allocation giving equal weight to both methods of allocation which have been developed was used. On this basis, charges to vehicle users were $248,887 (54.3 percent) and charges to the general public, $209,211 (45.7 percent). Vehicle-user taxes yielded $297,765. *Therefore, vehicle users were not being subsidized in their use of Story County highways in 1938.* However, this conclusion does not prove that vehicle-user taxation was excessive. Such proof would require a demonstration (1) that further highway improvements in the interest of vehicle users are not worth the cost and (2) that general revenues are insufficient to cover the costs properly chargeable to the general public. Neither of these propositions can be demonstrated for Story County highways. Much of the present graveled mileage on the primary and county truck systems could be improved to an intermediate (bituminous or soil-cement surface) stage at an annual economic cost of less than the probable annual savings in vehicle operating costs alone. This is true for 16 of the 25 miles of graveled primary rural roads and for 20 of the 136.5 miles of county trunk roads. On another 60 miles of

county trunk roads, savings in vehicle operating costs which would accompany such further improvement were found to be from 50 to 98 percent of the increase in annual costs. When other types of benefits to vehicle users are considered, such as savings in time resulting from increased average speeds and increases in comfort resulting from elimination of dust, economic merit might also be found for the improvement of this larger mileage (Appendix G). Continued expenditures on capital improvements can therefore be rationalized solely on the basis of immediate benefits to vehicle users.

There is an *apparent* deficiency in general revenues. Analysis, however, reveals this deficiency to be unimportant. General revenues from all sources in 1938 equaled $189,677 (Table 19), while costs charged to general taxpayers in the allocation just developed were $209,211. This sum, however, included interest costs of $53,000, found by multiplying the interest charge (at 2.25 percent) on the investment in each system by the percentage of cost on that system chargeable to general taxpayers. There is no more reason why the public should collect interest from itself on that part of highway investment deemed to be the responsibility of general taxpayers than on public investment in durable goods for a wide range of other general public services. Of course, there may be general agreement that sufficient general revenues should be collected to finance continuing programs of highway improvement conferring general benefits, but the adequacy of such tax rates should not be tested in the light of a current interest rate.

If general revenues are sufficient to cover depreciation, main-

TABLE 23. COSTS OF STORY COUNTY HIGHWAYS CHARGEABLE TO VEHICLE USERS UNDER VARIOUS COST-ALLOCATION FORMULAS

Cost study*	Date of study	Costs charged to vehicle users†	
		Amount	Percent of total
RAILROAD STUDIES			
Breed	1938	$350,000	76.4
Ennis	1935	339,000	74.0
Duncan	1935	291,000	63.5
STATE STUDIES			
Missouri	1937	307,000	67.0
Illinois	1938	299,000	65.2
Oregon	1936	157,000	34.3
FEDERAL STUDY			
Federal	1940	209,000	45.5

*The complete citations for the studies compared in this table are listed in Table 20.
†Total costs were assumed to be $458,098 (Table 13).

tenance, administration, and contractual interest which is chargeable to general taxpayers in the entire political unit studied, there are no deficiencies in general revenues which compel expenditure of vehicle-user revenues for general community purposes. In Story County the above cost items totaled $162,338, while general revenues equaled $189,677. The excess payments of vehicle users previously noted therefore do not constitute any subsidy to general taxpayers.

To further analyze whether vehicle users were paying their fair share of annual costs for the highway unit studied, the various cost formulas developed in previous studies were applied to the cost data of this study. In presenting the results (Table 23), the studies were placed in three groups: (1) Studies made by or for the railroads, (2) studies made by or for state governments or highway commissions, and (3) studies made by the Federal Coordinator of Transportation.

Only two of the formulas indicate any marked subsidization of vehicle users in Story County; these were developed by railroad studies. Both studies have weaknesses in their basic assumptions. Breed, Older, and Downs[37] argue that since all highways are a part of one connected and interdependent system, the responsibility of vehicle users for road support should be just as great for county local roads as for primary trunk highways. In their study, the proportion so assigned is 90.4 percent. The general opinion outside the railroad field seems to be against such a conclusion. Most writers agree that highway use is highly interdependent today, but they do not conclude, therefore, that benefits other than motor-vehicle benefits can be disregarded in a discussion of equitable taxation for the support of low-traffic, secondary roads. Even the intensive analysis of rural-road benefits from the special-benefit viewpoint made earlier in this section did not eliminate important social benefits. Under even the special-benefit assumption it cannot be denied that there are times when road improvement must be paid for by adjoining property owners because the quantitative benefits to vehicle users of the road are insufficient to justify such improvement. To argue that a county local road must be almost entirely supported from vehicle-user revenues because it is primarily a feeder of traffic to a trunk highway, overlooks the fact that much of the traffic on county local roads never leaves the farm-to-farm system. In Iowa, for example, this is true of 55 percent of the traffic on the county local system. Thus, the analysis used by Breed, Older, and Downs does not vitiate the previous conclusion that there is no evidence of subsidy to Story County vehicle users, even on the assumption that its roads carried only an average amount of traffic.

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[37] Breed, C. B., Clifford Older, and W. S. Downs, *op. cit.*

Cost Allocation Among Classes of Vehicle Users

Basic Considerations

Coordinate in importance with cost allocation between vehicle users and other beneficiaries is the allocation among various vehicle classes. The theoretical background for this problem already has been traced in the third section of this bulletin, where the difficulty of showing that any highway cost is obviously and directly attributable to the provision of highway service for one particular vehicle was noted. The three major methods of cost allocation are (1) application of the cost-of-service taxation theory, (2) application of the benefit taxation theory by apportioning costs on the basis of a physical unit of service, such as the ton-mile, and (3) application of the benefit taxation theory by apportioning costs on the basis of the value of service. The remainder of this section discusses the classification of vehicles and the major cost-allocation methods, and applies one of the methods to an analysis of costs and payments for various vehicle classes registered in Iowa.

Several methods of vehicle classification have been made the basis of vehicle taxation and others have been suggested. The more important are listed below.

1. Separation of vehicles into publicly owned and privately owned classes.
2. Separation of vehicles into categories of passenger cars, trucks, and busses.
3. Separation of vehicles into operating classes, such as common carriers, anywhere-for-hire carriers, contract carriers, private business carriers, and private pleasure carriers.
4. Separation of trucks into classes according to the principal commodity hauled.
5. Separation of all vehicles into size and weight classes.
6. Separation of all vehicles into size and weight classes, with average mileage figures for each class.

Classification by public or private ownership requires little discussion. Regardless of what division of costs is made between general taxpayers and private vehicle users, *private* vehicle users should not be expected to pays costs which are incurred because of public vehicles unless such vehicles are operated primarily to serve vehicle users. General taxpayers have this irreducible minimum responsibility for highway costs. Whether such payments find their way to highways through general taxation or user taxation of public vehicles is immaterial, for such payments would fall on the general taxpayers anyway. For example, two 5-ton trucks of the same gross weight and traveling the same mileage, one publicly owned, the other privately owned, should pay the same total tax toward highway support.

One of the earliest license-fee classifications segregated passenger cars, trucks, and busses. This classification probably was based on an imperfect realization that trucks and busses caused increased highway costs and received a business service through highway use. Later refinements have developed from this fundamental classification.

Classification by operating classes also has been common in the more recent stages of the motor-vehicle era. In some states this type of classification has been the broad one of private and commercial carriers. In general, this broad differentiation for highway taxation is difficult to defend from the standpoint of equity. As the Washington Highway Cost Commission pointed out in 1935:

"Such differentiation ... tends to penalize the small business to the advantage of the large corporation. With such a system of taxation large businesses such as chain stores and gasoline companies are able to purchase their own equipment and thus become private operators subject to the lower tax rate. The small business with but a few items to ship must pool its shipments with other small businesses by hiring the services of the highway transportation company. If the highway transportation company is required to pay higher rates for the use of the highways than the private business transporting its own goods, this highway tax is passed on to the small shipper in the form of increased rates and to this extent it may be said that the small business is being penalized. The same applies in the field of passenger carriage on the highways. The more fortunate persons who are able to own private automobiles may ride over the highways in a more luxurious manner upon the payment of a very small tax. Less fortunate persons must rely upon common-carrier motor coaches. The higher tax paid by the motor coach is passed on in the form of fares to those persons who must rely upon them for transportation."[38]

This statement indicates that trucks of the same gross weight and annual mileage should not be charged different amounts for the use of highways simply because they are in different operating classes. The only valid exception to this statement appears to be the common carrier which holds an exclusive franchise for operations of specific type over a particular stretch of road. When such operations constitute a monopoly or yield an abnormally large profit, there exists a basis for higher taxation rates on such carriers for highway support. If monopoly profits exist and a flat tax is imposed on them, such a tax is not likely to be shifted and consequently is not subject to the criticism noted above.

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[38]Highway Cost Commission, State of Washington. Report, January, 1935. p. 66. Washington State Printing Plant, Olympia, Wash. 1935.

This bulletin has stated that highway costs may be allocated on the basis of (1) causal responsibility, that is, the extent to which various vehicle classes are responsible for highway costs; (2) highway use, measured by physical units of service such as vehicle-miles or ton-miles of travel; and (3) value of service rendered.[39] To apply any of these methods of cost allocation to a program of vehicle taxation requires the use of one of the last three vehicle classifications listed on page 78.

Costs may be allocated on the basis of the cost of service rendered by either the damage theory or the increment theory. During and immediately following World War I the development and use of heavy vehicles on road surfaces and bridges not designed to carry such loads unquestionably hastened deterioration and in some cases caused actual breakdown of such highway elements. Such deterioration has been emphasized in the assessment of higher license fees against heavier vehicles (the damage theory). Lack of means to measure such damage, however, makes its incorporation as a genuine cost-allocation theory impossible. Also, under pressure of traffic increases and improved engineering design, highways soon began to be designed to handle the heavy loads. Of course, it may be argued that heavier and wider vehicles have been considered in providing better highways, and that such vehicles have increased maintenance costs. This has tended to emphasize the increment theory, which assumes that vehicles requiring special investment should bear all the cost of the special investment, as well as their share of the normal investment.

An excellent statement of the increment theory appeared in the 1933 report of a joint committee of railroads and highway users. According to this statement, "The basic cost of constructing, improving, and maintaining a given highway should be determined from a highway designed for private passenger vehicles and other vehicles commensurate therewith. All vehicles using such highway should pay their proportionate share of that total as a base tax. The total additional cost of construction, improvements, and maintenance to make road suitable for a type of vehicle requiring such additional cost should be shared by each vehicle of that type and each vehicle of greater size. Thus each group should share in the base cost plus all increments of

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[39]The application of any of these methods to an analysis of cost allocation is made easier by the work which has been done by the Statewide Highway Planning Survey. When, for example, certain gross-weight classes have been set up, it is possible to find the average mileage traveled by a vehicle in each class, the number of vehicles registered in each class, the average gasoline consumption of a vehicle in each class, and other pertinent information. With this information, it is possible to compute the approximate contribution of each class to total user revenues, and to compare this with what is conceived to be the equitable contribution under either a cost-of-service theory or some use theory, such as the ton-mile theory. Precisely this sort of analysis was made in Iowa in 1939 with the aid of Planning Survey data and was made the basis of a proposal to the legislature for revision in the license-fee structure. The object was to allocate total user taxes more equitably between classes of trucks and combinations on the basis of the ton-mile theory.

TABLE 24. HYPOTHETICAL ILLUSTRATION OF THE INCREMENT METHOD OF APPORTIONING HIGHWAY COSTS

Vehicle class	Number of vehicles	Cost index*	Cost increments,* percent	Costs per vehicle	
				Increment	Cumulation
Basic vehicle	100,000	100	0	$16	$16
Class B truck	15,000	125	25	10	26
Class C truck	7,500	150	50	25	51
Class D truck	2,500	175	75	100	151

*For variable costs only.

cost up to and including the cost required by it."[40]

Two concepts are involved in the increment theory, a basic vehicle and a basic highway. A basic vehicle is a private passenger car or light motor truck having a wheel load not exceeding 2,000 pounds. It is generally asserted that trucks in this classification should not exceed passenger-car width and length. A basic highway would be the type of highway necessitated if only basic vehicles were used. Proponents of the increment theory point out that highways would have been constructed much differently and much more cheaply if heavier and wider vehicles had not been used. They further assert that maintenance costs, even on present construction, are increased by the use of heavy vehicles.

To illustrate the taxation system which would be necessitated by the increment theory, a hypothetical case was evolved on the assumption that the theory not only is sound but actually workable (Table 24). Capital and maintenance costs of the basic highway were assumed to be $2,000,000, and it was estimated that half this amount would not vary even when highways are built with stronger surfaces and structures, lower gradients, and better alignment to provide for the larger, heavier vehicles. It was assumed that the other $1,000,000 would be increased by the indicated cost increments for the successively heavier vehicle classes. Under the increment theory, if a highway is built to serve all vehicle classes, $2,000,000 of its annual cost represent an amount which is chargeable to all the vehicles using the highway, a charge of $16 per vehicle. In addition, all 25,000 vehicles in classes B, C, and D of Table 24 have a joint responsibility for a 25-percent increase in the costs which vary with vehicle size, that is, for $250,000. Thus each vehicle in classes B, C, and D must pay $10 in addition to its share in the basic costs of $16 per vehicle. The total amount chargeable to each vehicle in class B becomes $26. By continuing the same analysis, total fees are $51 for class C and $151 for class D.

[40] Joint Committee of Railroads and Highway Users. Regulation and Taxation of Highway Transportation. p. 16. Joint Committee of Railroads and Highway Users, New York, N.Y. 1933.

This is an illustration of the increment theory only, and gives no weight to factors of highway use. The variations in service rendered to different vehicle classes also may be considered. Such modification of the basic method is likely to increase the relative share of costs charged to the larger vehicles, since they characteristically travel more than the average mileage. For example, if the average annual mileages of the four groups of Table 24 were 8,000, 15,000, 25,000, and 35,000, respectively, average costs in each class would be $12.32, $30.60, $74.00, and $196.40. This compares with allocated costs of $16, $26, $51, and $151 by the increment method only.

If there were agreement on the extent to which heavier and wider vehicles increase costs, application of the increment method would do much to promote an economic allocation of resources between motor transportation and competing forms of transportation, since each vehicle would be forced to pay its full share of the cost of facilities necessary to accommodate it or to cease using the highways. Actually there is violent disagreement concerning the extent to which heavy vehicles are responsible for increasing highway costs. There does seem to be agreement, however, that the correct measure of the strain exerted upon a road by a vehicle is not the gross weight of the vehicle, nor even the static wheel load, but rather the impact of the moving wheel load, which varies with the static wheel load, the speed of the vehicle, the type of road, and the nature of the tire equipment. It is further agreed that heavy impacts either necessitate a high-type surface or increase the maintenance costs of a low-type surface. Apparently no agreement exists, however, concerning the *extent* to which gross weight, wheel load, or impact force of heavy vehicles have actually increased expenditures on roads.

Because of the disagreement in the application of the increment method of analysis, there seems to be little merit in trying to use it. From this and foregoing conclusions it appears there is slight possibility of constructing any kind of highway-user tax structure which will guarantee that each class of vehicle actually will pay its share of highway costs. If highway costs were exactly the same for every vehicle, and if the public were willing to accept the idea that every vehicle should pay its proportionate share of the joint cost through a flat fee, every vehicle could equitably be charged the same amount for meeting highway costs. It should not be overlooked, however, that costs do bear some relation to the weight and width of vehicles which pass over the highways, even if this relationship is not measurable, and the general public unquestionably feels that it is fair to charge for highway use in relation to the amount of service enjoyed. This induces consideration of possible indices of serv-

ice which the public will consider fair, even though not exact. The possibility of using either physical units of service or the value-of-service method for determining such service indices was mentioned previously.

The ton-mile has been widely advocated as a physical unit of service for analyzing the fairness of user-tax structures. An analysis based on the ton-mile assumes that, within the kind and type of highway use which the law permits, a highway system is provided which is adequate. It further assumes that the costs of this system allocated to vehicle users as a group should be distributed among classes of vehicle users according to the benefits received, that use is a satisfactory measure of benefits, and that the ton-mile is a satisfactory measure of use. It gives consideration to the factors of both weight and distance in determining the benefits derived by a particular vehicle from highway use.

If the simple gross-ton-mile method is utilized, every ton of gross weight which moves one mile over the highways will pay a fee which, when multiplied by the number of tons moving over the highways in a year, will equal the total amount to be levied against motor-vehicle users in that year. This means that, if a vehicle with a gross weight of 40,000 pounds travels 1 mile, the charge for the privilege will be 10 times as much as the charge against a 4,000-pound vehicle. The charge is on the basis of use, although some consideration is given to the possibility that heavier vehicles involve greater highway costs than basic vehicles since the heavier vehicles pay a much greater fee.

In the application of the ton-mile method to determine whether a given vehicle class is meeting its fair share of highway costs, various vehicles are separated into classes according to empty weight and average loaded weight. The average annual miles traveled by vehicles in each class are determined and the ton-miles traveled are computed. The annual costs to be borne by all vehicles are then apportioned among the various classes on a ton-mile basis. The sum assigned to each class is divided by the number of vehicles in that class to give the annual cost per vehicle. These annual costs are then compared with the amount now being paid by the average vehicle in each class through registration fees, gasoline taxes, and other user taxes to determine whether existing fees are reasonable.

The ton-mile allocation has several imperfections. First, it does not necessarily charge each class of vehicle with the costs incurred by it, since it cannot be demonstrated that such costs are proportional to ton-miles of travel. Second, although the ton-mile method premises cost allocation on the basis of benefits received, there can be no proof that economic benefits derived from road use are proportional to ton-miles of travel. Third, the sim-

ple ton-mile method is an imperfect measure even of highway use; it does not consider the relatively greater occupancy of the highways by large trucks and busses. Both trucks and busses are generally of greater width than passenger cars, and the former often slow other traffic. This suggests that the ton-mile tax rate should be graduated if the ton-mile method is to be used. Such graduation, however, is not a strict application of the ton-mile method since occupancy does not vary with the ton-miles traveled. Moreover, the ton-mile method cannot establish an equal ton-mile rate for every vehicle of a given class so long as there are marked deviations from the average within each class, both in weight of vehicle and in annual mileage traveled. This particular defect might be overcome by adopting a ton-mile tax as the sole form of user tax for all vehicles, but the administrative problems involved make such a tax impractical.

For widely different reasons, therefore, neither the increment nor the ton-mile method is satisfactory for determining whether certain vehicle classes are subsidizing other classes, or for calculating exactly what contributions each vehicle owner should make if he is to pay his share of highway costs. Since the increment method is difficult to use and allocation on the benefit basis is an alternative which seems fair to the general public, the use of the ton-mile method of analysis probably is as good a practical solution as can be found.

There is also the possible use of a value-of-service method in allocating highway costs. The value-of-service method derives its logic from the fact that once highways are built, their costs are essentially joint in nature. As such they may be apportioned on the basis of some unit of service. This method offers the possibility of varying transportation charges for various commodities sufficiently to encourage maximum highway utilization, an important social consideration.

Railroad rates have long been charged on the basis of what the traffic will bear. The application of this technique to highway taxation would require an enormous amount of study of the relative value of commodities hauled over the highways, of the profitability of various industries served by such transportation, and of other factors, before any kind of rate structure could be set up for maximum utilization of present highways. Any comprehensive attempt to apply the method would evolve a commodity classification approaching the complexity of a railroad classification. The Supplemental Report of the Highway Cost Commission of the State of Washington, issued in 1937, came to the following reasonable conclusion concerning the application of the value-of-service method to highway taxation.

"The administrative cost and other practical difficulties involved in issuing licenses and otherwise ensuring that each truck

is properly classified and paying its proper tax precludes the possibility of attempting to introduce such additional refinements into the rate schedule. But, in the event the rapid increase in the volume of trucking continues, it may be found advisable, after a thorough study of commodity values and other elements, to reconsider the expediency of introducing further refinements by further classification."[41]

Ton-Mile Analysis of Motor-Vehicle Taxation in Iowa

An application of the ton-mile method of allocating highway costs among vehicle classes was made for Iowa as a whole because registration and ton-mile data were available only on a statewide basis through the Highway Planning Survey. Ton-mile analysis, moreover, was applied to total user revenues collected from vehicles registered in Iowa in 1937,[42] rather than to annual costs, since complete annual cost data for the state were not available. On the basis of the ton-mile allocation it was possible to show whether certain classes of vehicle users were subsidizing other classes, and to indicate what changes in vehicle-user-tax schedules would be necessary to eliminate such subsidy. It already has been shown that vehicle users as a group are paying sums in excess of their share of annual costs in Story County. If, therefore, vehicles using Story County highways represent a cross section of state registration, the changes required to equate the tax contributions of each vehicle type on a ton-mile basis for the state as a whole also would insure that each vehicle class would pay its fair share of annual costs for the use of Story County highways, in addition to contributing further capital for improvement of the plant.

Several technical problems were encountered in making the ton-mile study. Until 1939, for instance, trucks, tractor-trucks, semitrailers, and trailers were registered in Iowa on a licensed-capacity basis, and it was necessary to use load determinations of the Highway Planning Survey to convert each licensed capacity to the gross weight necessary for the ton-mile analysis. Mileages and gasoline consumption data also were gathered by the Road-Use Section of the Survey on a rated-capacity basis for trucks, and it was necessary to use Survey estimates to translate these data into the gross-weight classification desired. The specific ton-mile tax on certified common-carrier trucks and busses which was in effect in 1937 could not be allocated between vehicles registered in Iowa and those registered elsewhere, and

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[41] Highway Cost Commission, State of Washington. Supplemental Report, January, 1937. p. 94. Washington State Printing Plant, Olympia, Wash. 1937.

[42] The year 1937 was used because the large amount of work necessary to make a ton-mile analysis for the state had been done in a preliminary form by the Highway Planning Survey. Recent ton-mile analysis of 1940 vehicle-user taxes in Iowa by the Safety and Traffic Division of the Iowa State Highway Commission yields results very similar to those found with 1937 data.

it was necessary to assume that it all was paid by vehicles registered in Iowa.[43] In comparing equitable and actual contributions on the ton-mile basis, it was necessary to estimate and deduct motor-fuel tax paid by foreign-owned vehicles on the basis of the Survey data. Since gross-weight classifications could not be obtained for certified common-carrier trucks, these trucks were left in the general truck classification and were dealt with only in the aggregate.

The first operation in the analysis was the summarizing of receipts from all types of motor-vehicle imposts in Iowa during 1937 (Table 25). The following revenues were deducted from total revenues to obtain the revenues used in the ton-mile analysis: (1) Revenues not applicable to a comparison of taxes paid by various classes of automotive vehicles, including payments for dealers' licenses and motorcycle fees; (2) revenues contributed by out-of-state vehicles traveling in Iowa; and (3) revenues, consisting of motor-fuel tax only, contributed by publicly owned vehicles (since such payments depend upon general taxation, they were eliminated from the analysis). These deductions, from the total of $25,598,773 (Table 25), were (1) $59,826, (2) $1,172,599 (8.75 percent of the motor-fuel tax), and (3) $134,919,[44] which left a remainder of $24,231,430 to be allocated among major vehicle classes. The sources of this remainder were classified by the use of 1937 tax revenues compiled by the Highway Planning Survey (Table 26).

After revenues were allocated to the various vehicle classes, comparisons of total ton-miles of travel and of user revenues contributed by each class were possible (Table 27). The data in

[43]Since all nonresident common carriers doing business into Iowa, although not through Iowa, are required to obtain Iowa licenses, the error introduced was not great. Less than 4 percent of the common-carrier busses weighed during the traffic counts did not carry Iowa licenses. However, more than 50 percent of the common-carrier trucks and combinations did not have Iowa licenses. In view of the recognized evasion of the ton-mile tax by out-of-state trucks, it is doubtful if such trucks paid anything like 50 percent of the ton-mile tax paid by all common-carrier trucks.

[44]These figures were based on a 1935 study by the Highway Planning Survey. Data were available for no other year.

TABLE 25. RECEIPTS FROM ALL TYPES OF MOTOR-VEHICLE IMPOSTS IN IOWA, 1937

Type of impost	Receipts	Type of impost	Receipts
Registration fees:		Motor fuel tax:	
Passenger cars	$8,213,168	Gross receipts	$14,979,890
Trucks	2,674,605	Less refunds and sales tax	-1,830,890
Trailers	85,968	Net receipts	13,149,000
Motorcycles	8,101	Special motor-carrier taxes:	
Nonresident fees	78,776	Ton-mile taxes	467,779
Transfers and miscellaneous	213,599	Truck permit fees	64,280
Dealers' licenses	51,725	Total	532,059
Duplicate plates	25,058	Drivers' and chauffeurs' licenses	565,064
Fines and penalties	1,650		
Total	11,352,650	Grand total	25,598,773

TABLE 26. PAYMENTS OF VARIOUS MOTOR-VEHICLE IMPOSTS BY MAJOR VEHICLE CLASSES IN IOWA, 1937

Type of impost	Vehicle class			Total
	Passenger car	Truck and combination	Bus	
Registration fees	$8,487,091	$2,780,585	$25,149*	$11,292,825
Motor-fuel taxes	8,941,838	2,803,644	96,000*	11,841,482
Motor-carrier taxes	0	347,458	184,601	532,059
Drivers' and chauffeurs' licenses	460,862	104,202	0	565,064
Total	17,889,791	6,035,889	305,750	24,231,430

*Gasoline taxes and license fees for busses are for 1935, the only year for which such data are available.

Table 27 indicates that trucks and combinations were being subsidized, *on the basis of a ton-mile analysis,* by passenger cars.

Separation of trucks and combinations into various weight classes was made in Table 28. This table shows that, on the basis of average gross weights, the two lightest classes of single-unit trucks were—like passenger cars—more than paying their way. Trucks in these two classes comprised 46.9 percent of the total truck and combination registration in 1937. For single-unit trucks in heavier gross-weight classes, however, and for combinations, the ratio of actual to equitable contributions on a ton-mile basis dropped; it was only 42.69 percent for tractor-truck semitrailer combinations. When common-carrier trucks as a group were separated from the general truck classification, their contributions were found to be 58.24 percent of their equitable contributions on a ton-mile basis.[45]

Prior to the 1939 meeting of the General Assembly, the general problem of truck legislation was studied intensively by a subcommittee on truck legislation of the State Planning Board.[46] One of the major problems which this committee considered was truck taxation. To provide the committee with basic data on current payments by various vehicle classes in relation to highway use, the Highway Planning Survey made an analysis which made possible comparisons of contributions and highway use similar to those in Tables 27 and 28. These comparisons made

[45]To determine this ratio the average gross weight of Iowa-registered, common-carrier trucks was determined from load tables of the Highway Planning Survey to be 9.95 tons (combined average weight of empty and loaded trucks and combinations). The average mileage of these trucks and combinations was 36,775, which gave an average of 365,911 ton-miles per truck per year. The 1936 registration was 1,299, which gave 475,318,710 ton-miles traveled in Iowa by common-carrier trucks annually (4.77 percent of the ton-miles traveled by all Iowa-registered vehicles in Iowa during 1936-1937). Since total user revenues for 1937 were $23,688,079, this figure was multiplied by 4.77 percent to give $1,126,506 as the equitable share of common-carrier trucks on a ton-mile basis. From 1936 data of the Survey, the sum of license fees and gasoline taxes for the 1,299 trucks was $386,141. The ton-mile tax paid by all common-carrier trucks in 1937 was $282,615. Total contributions thus equaled $658,756, or 58.24 percent of the equitable share of common-carrier trucks.

[46]Iowa State Planning Board, Transportation Committee. Report and Recommendations on truck legislation. Iowa State Planning Board, Des Moines, Iowa. 1939.

TABLE 27. PERCENTAGE OF TON-MILES TRAVELED AND VEHICLE-USER REVENUES CONTRIBUTED BY VARIOUS CLASSES OF VEHICLES REGISTERED IN IOWA, 1937

Type of vehicle	Registration in 1937	Ton-miles traveled, percent of total*	User revenues contributed		Ratio of travel to revenue percentages
			Dollars	Percent of total	
Passenger car	657,381	68.84	$17,890,000	73.83	107.24
Truck and combination	87,868	29.64	6,035,000	24.90	83.95
Bus	353†	1.52	306,000	1.27	‡
Total private vehicles	745,602	100.00	24,231,000	100.00	100.00
Public vehicles	5,393	——	125,000¶	——	——
Grand total	750,995	——	24,356,000	——	——

*Iowa Statewide Highway Planning Survey. Report of the Traffic Survey. Table T-104b. Iowa State Highway Commission, Ames, Iowa. 1938.

†Common-carrier and city busses registered in 1936, as determined by the Highway Planning Survey. Such registration was not available for other years.

‡The travel-revenue ratio is not computed for busses because the lack of sufficient information concerning the ton-miles traveled makes the ton-mile percentages in the table unreliable in the smaller numbers.

¶Gasoline tax.

it evident that, *on a ton-mile basis,* users of private passenger cars were subsidizing users of trucks and combinations, and that sharp variation existed in the ratios of actual to equitable contributions between various trucks and combinations. Nevertheless, the committee recommended only that (1) the basis of truck registration be changed from a licensed-capacity to a licensed-gross-weight basis, (2) existing truck fees be changed to establish a closer relationship between payments by trucks and combinations on a gross-weight basis and their ton-mile use of the highways without increasing revenues, and (3) the existing ton-mile tax on common-carrier trucks and busses not be repealed without substituting some other type of third-structure tax designed to raise an equal amount of revenue. The committee also proposed a sample schedule of adjusted fees designed to carry the second recommendation into effect.

On the basis of this report, a license-fee schedule was submitted to the legislature[47] which proposed (1) a shift to a gross-weight registration basis for trucks, combinations, and busses; (2) an increase in registration fees for trucks and combinations in the higher gross-weight brackets; and (3) repeal of the ton-mile tax and substitution for it of a series of annual compensation taxes assessed on a licensed-gross-weight basis to all for-hire carriers, with a differentiation between classes of for-hire carriers.

[47]The schedule was submitted by Peter S. Peterson of the Central Trucking Association, but was based on factual information supplied by the Highway Planning Survey.

TABLE 28. VEHICLE-USER TAXES FOR VARIOUS CLASSES OF VEHICLES REGISTERED IN IOWA AND EQUITABLE TAXES ON A TON-MILE BASIS, 1937

Gross-weight class*	Number in class	Average gross weight, pounds	Average annual mileage†	Ton-miles, percent of total‡	Equitable contributions per vehicle	Actual contributions¶			Ratio of actual to equitable contributions, percent
						Registration fees	Gasoline taxes	Total	
SINGLE-UNIT TRUCKS									
0- 6	35,203	3,422	6,000	3.52	$23.05	$14.32	$16.47	$30.79	133.58
6- 8	6,034	3,826	6,000	0.67	25.60	16.26	16.73	32.99	128.87
8-10	27,009	6,402	9,050	7.62	65.05	24.24	28.50	52.74	81.07
10-12	9,507ø	7,968	13,550	5.00	121.25	46.55	46.44	92.99	76.69ø
12-14	3,919	9,420	16,000	2.87	168.84	67.13	60.59	127.72	75.64
14-16	2,262	10,054	19,000	2.10	214.04	94.84	76.60	171.44	80.01
16-18	1,950	11,342	19,000	2.05	242.36	116.79	83.25	200.04	82.52
18-20	263	12,861	30,000	0.49	429.54	130.88	138.58	269.46	62.73
20-24	265	15,607	30,000	0.61	530.71	142.30	150.23	292.53	55.12
24-28	37	18,406	30,000	0.10	623.11	183.05	159.13	342.18	54.91
Above 28	65	24,259	30,000	0.23	815.80	277.81	189.78	467.59	57.32
Total	86,515			25.26	67.31	28.96	29.59	58.55	86.98
TRACTOR-TRUCK SEMITRAILER COMBINATIONS									
16-20	152	18,075	30,000	0.44	667.39	86.66	160.47	247.13	37.03
20-24	364	21,070	30,000	1.23	779.07	128.49	173.30	301.79	38.74
24-28	209	20,678	30,000	0.69	761.14	204.17	171.71	375.88	49.38
28-32	257	23,154	30,000	0.95	852.25	264.18	183.27	447.45	52.50
32-36	211	25,565	30,000	0.86	939.70	317.03	197.98	515.01	54.80
Above 36	55	28,498	30,000	0.25	1,047.98	336.69	219.20	555.89	53.04
Total	1,248			4.42	816.50	205.16	179.72	384.88	47.14
TRUCK AND FULL-TRAILER COMBINATIONS									
All	105	13,287	30,000	0.27	592.87	67.24	186.91	254.15	42.86
PASSENGER CARS									
All	657,381			70.05	24.57	12.91	13.64	26.55	108.06

*Gross-weight classes in thousands of pounds, set up as the empty weight determined by the Traffic Survey Division of Statewide Highway Planning Survey plus the licensed maximum load of the vehicles weighed.

†Estimated by the Highway Planning Survey on the basis of a study of data gathered by the Road-Use Division and by the Traffic Survey. While the sudden breaking points make the changes of the ratios of actual to equitable contributions equally sudden, those in charge of the Highway Planning Survey state that these sharp breaks in mileage apparently occur when the heavier truck classes are reached.

‡Ton-miles for each class were determined by using the average gross weights of vehicles in each gross-weight class as determined by the Highway Planning Survey.

¶Ton-mile taxes and permit fees paid by special classes of trucks were omitted.

øA total of 105 trucks of 1½-ton rated capacity were taken out of this gross-weight class and classified with full trailers. Such an assumption was deemed reasonable by the Survey, but it obviously renders conclusions on the ratio of actual to equitable contributions for this subclass subject to an unknown amount of error.

Some of these proposals met strenuous opposition from trucking interests, so that the final law adopted the gross-weight registration basis and repealed the ton-mile tax, but did not increase the registration fees for heavy vehicles sufficiently to equalize their payments on a ton-mile basis with those of light trucks and passenger cars (Table 29).[48] A compensation tax was adopted as a substitute for the ton-mile tax, but was applied only to common carriers.

Even under present Iowa vehicle-user-tax schedules, heavy vehicles continue to be subsidized by light vehicles on a ton-mile basis, and the common-carrier truck as a special class of heavy truck still is subject to the payment of a third-structure tax. Whether the apparent subsidy of heavy trucks and combinations should lead to further increases in their tax load is a problem of public policy and not one to be decided here. However, if alterations need to be made in the vehicle-user-tax structure to obtain equality of payments on a ton-mile basis, this may be accomplished in several ways: (1) Registration fees may be increased in the heavier weight brackets and decreased in the lighter brackets, leaving total revenues the same; (2) registration fees may be increased in the heavier weight brackets but left unaltered in the lighter brackets, thus increasing total revenues; or (3) special third-structure taxes may be levied against all vehicles in the heavier weight brackets, either in the form of a specific ton-mile tax or in the form of an annual, fixed compensation tax. Such special taxes might or might not be accompanied by a reduction in license fees on lighter vehicles, depending on whether it is desired to increase total vehicle-user revenues more than might occur simply through continued increase in registrations and annual travel.[49]

A specific ton-mile tax would have the greatest equity of any of these devices, since its payment would be based on the actual amount of road use by a given vehicle. Increases in license fees or the use of a fixed compensation tax necessarily ignore variations in amount of travel by various vehicles within a given class. However, experience with the ton-mile tax in Iowa and other states indicates that it is difficult to administer because it involves self-declaration by each vehicle user of the ton-miles traveled. Payment of the full tax is therefore open to evasion.

The apparent discrimination against the common-carrier truck under existing tax structures may be defended on the ground

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[48]Because of an error in interpreting the data supplied by the Highway Planning Survey, the schedule of license fees adopted actually increased the fees imposed on one class of light trucks already overtaxed on a ton-mile basis.

[49]Changes in gasoline taxes are not considered because the efficiency of transportation with the heavy trucks is so much greater than with the light trucks that gasoline consumption per ton-mile falls sharply as the size of the vehicle and load increases. No increase in gasoline taxes could therefore bring about a more equitable distribution of user taxation on a ton-mile basis.

TABLE 29. VEHICLE-USER TAXES FOR VARIOUS VEHICLE CLASSES, BASED ON THE 1937 REGISTRATION

Gross-weight class, 1,000 pounds	Actual contributions		Equitable contributions per vehicle†
	Under 1937 law	Under 1939 law*	
SINGLE-UNIT TRUCKS			
0- 6	$30.79	$31.47	$23.05
6- 8	32.99	41.73	25.60
8-10	52.74	53.50	65.05
10-12	92.99	106.44	121.25
12-14	127.72	140.59	168.84
14-16	171.44	176.60	214.04
16-18	200.04	213.25	242.36
18-20	269.46	298.58	429.54
20-24	292.53	341.23	530.71
24-28	342.18	409.13	623.11
Above 28	467.59	496.78	815.80
TRACTOR-TRUCK SEMITRAILER COMBINATIONS			
All	384.88	458.47	816.50

*This column shows what the various classes of trucks would have paid in 1937 if the schedule of registration fees as revised by the 1939 legislature had been in effect.

†On a ton-mile basis.

that, because he has a monopoly in common-carrier motor transport between specified points, the common carrier may be deemed to have a special privilege for which some extra payment is warranted. From this viewpoint no inequity exists in compelling a common-carrier truck operator to pay a higher ton-mile rate than other carriers operating trucks of the same gross weight. Even when equality in the ton-mile rate for all trucks is accepted as desirable, the strongest case that can be made for the common-carrier truck is that its degree of underpayment was simply less in 1937 than that of heavy trucks not in the common-carrier class.[50] There is evidence that the new compensation tax which went into effect on January 1, 1940, will not result in payments per vehicle equal to those under the old ton-mile tax. Consequently, relative payments by common-carrier trucks in relation to trucks used for other purposes remain about the same.[51]

In summary, if it is desired to utilize ton-mile analysis as a basis for obtaining equity in vehicle-user taxation, there is basis for further increases in vehicle-user tax schedules in Iowa for all except passenger cars and light trucks. The fact that such increases in rates might force certain heavy vehicles from the high-

[50]For heavy trucks and combinations having an average gross weight of 9 tons or more, the ratio of actual to equitable payments in 1937 was 43.50 percent. For common-carrier trucks of all weights, the ratio was 58.24 percent.

[51]The Safety and Traffic Division of the Iowa Highway Commission is of the opinion that about 1,500 vehicles operated in certificated common-carrier service in Iowa during 1937. These vehicles paid $468,000 in ton-mile tax, or $312 per vehicle. In contrast, it seems probable that the average compensation tax paid by a certificated common-carrier truck registered in Iowa under the 1940 tax will be about $150.

ways should not be considered if it is not desired to subsidize commercial highway transport. Although higher vehicle-user-tax rates may be maintained for certificated common-carrier trucks than for trucks having other uses, this is not inequitable if the special privileges represented by common-carrier franchises are recognized. Finally, the ton-mile method of analysis itself must be justified on the basis of its fairness and reasonableness, rather than as the application of an exact, scientific allocation of highway costs.

APPENDICES

A. Highway Finance and Administration in Iowa, 1904-1939

Governmental units throughout the United States have embarked on a program of rapid expansion in highway expenditures during the past 30 years. Revolutionary changes in highway transportation have accompanied this program of increased expenditures. They have been evidenced by the improvement in roads and vehicles and by the changes in amount and types of road use, in methods of public administration, and in methods of financing construction and maintenance. While these changes form the main picture of Iowa highway transportation during this period, a survey of such changes should be accompanied by a study of the period, as well as a cross section of the present characteristics of highway transportation.

Expenditures

From 1904 (which represents the approximate beginning of the motor-vehicle era in the state[52]) to 1938 more than a billion dollars were spent on Iowa highways and streets (Table 30). Of this amount, 55.1% was spent for capital outlay, and the remainder for maintenance, administration, and interest on debt. The state trunk (primary) system created in 1919, absorbed 37.2% of the expenditures, although it constituted only about 6.6% of the total Iowa road and street mileage during the period. The secondary road system (now embracing the county trunk and county local systems) absorbed 49% of the expenditures, although it was 86.1% of the mileage. The remainder was expended on urban streets.

Of even more interest in the historical picture of the government's high-

[52]In 1904, the first motor-vehicle law was passed and the Iowa State Highway Commission was created. Fewer than 1,000 vehicles were in use in Iowa at that time.

Table 30. Expenditures for Roads and Streets in Iowa, 1904-1937
(000 Omitted)

Type of expenditure	Road or street system			Total
	Primary (1919-1937)	Secondary (1904-1937)	Urban (1910-1937)	
Capital outlay	$293,237	$229,500	$55,574	$578,311
Maintenance and administration	59,496	267,617	89,534	416,647
Interest and finance	37,355	16,955	*	54,310
Total	390,088	514,072	145,108	1,049,268
	(37.2%)	(49.0%)	(13.8%)	(100.0%)

*The interest and finance expenditures for urban streets are not available. They are not included in the totals.

TABLE 31. SHIFTS IN AVERAGE ANNUAL EXPENDITURES FOR ROADS AND STREETS IN IOWA, 1910-1937 (000 OMITTED)

Period	Highway or street system				Bond retirement*	Grand total	Highway cost index	Adjusted sub-total†	Real increase over 1910-1914, percent	Real change over previous period, percent
	Primary	Second-ary	Urban	Sub-total						
1910		$5,377	$3,471	$8,848		$8,848		$8,848		
1910-14		7,308	3,689	10,997		10,997	100.0	10,997		
1915-19	$199‡	15,591	4,994	20,784	$334	21,118	168.9	12,306	11.9	11.9
1920-24	14,585	19,582	7,824	41,991	1,079	43,070	237.3	17,695	60.9	43.8
1925-29	23,168	22,256	5,776	51,200	2,557	53,757	208.8	24,521	123.0	38.6
1930-34	28,216	19,236	4,108	51,560	3,398	54,958	159.2	32,387	194.6	32.1
1935-37	19,450	19,937	4,384	43,771	6,182	49,953	169.1	25,885	135.4	—20.1
1930-37	24,929	19,449	4,212	48,590	4,442	53,032	163.0	29,810	171.1	21.6

*Primary and secondary road debt.
†Adjusted to the base period 1910-1914.
‡Based on 1919 only.

way functions in the state are the data on shifts in public expenditure during the period 1910-1937. These data, presented in Table 31 in averages for periods of 5 years, show an increase in expenditures, exclusive of debt retirement, from less than $9,000,000 in 1910 to an average of more than $48,500,000 during the period 1930-1937. They further indicate that, even when deflated by a cost index, the real resources used for highway purposes were more than 170% greater during the Thirties than they had been three decades before. The adjusted data also show that the percentage increase in real highway expenditures by 5-year periods continued until about 1935 and that expenditures have now stabilized at between 40 and 50 million dollars.

Data for both Table 30 and 31 were calculated from the annual reports of the Iowa Highway Commission, the annual reports on municipal finance, and biennial reports of the state auditor. Expenditures for the primary system include expenditures made by the Iowa Highway Commission on urban extensions of primary rural roads. Expenditures for engineering, inspection, and administration have been allocated between capital outlay and maintenance.

Between 1913 and 1930 all townships did not consistently report their expenditures, and estimates of Iowa Highway Commission reports were used. Expenditures on urban streets were not available before 1910, and it is certain that the published figures considerably understate actual expenditures. It was discovered in the Story County study that many of the large capital outlays financed by special assessments were never included in reports submitted to the state.

Moreover, since 1922 municipalities of less than 2,000 population have made no separation in published reports between capital outlay and maintenance. The division for the group from 1922 to 1938 is therefore somewhat arbitrary (Tables 30 and 31). Since debt incurred for street purposes and interest on that debt could not be separated from the total urban debt, the interest on urban street debt was not available.

A description of highway expenditures in the state should show where highway funds are now being spent. The only complete information available for this purpose was compiled by the Statewide Highway Planning Survey [53] for the fiscal year ending in 1935 and the data presented in Table

[53]The Survey, a joint project of the Iowa Highway Commission and the Public Roads Administration, was carried on intensively during 1936-1939. Comprehensive data were gathered on a wide variety of subjects, including finance, road use, traffic, and road inventory. Much of the data are used in this bulletin, especially in the empirical study of Story County.

32 are largely based on its figures. Engineering, inspection, and administration costs related to construction or maintenance have been allocated to the items in Table 32. The item administrative and collection costs includes all costs associated with collection of motor-vehicle revenues and enforcement of motor-vehicle laws which could be ascertained. Expenditures for subsequent years somewhat exceed those for 1935, but differ little as to purpose or place of expenditure. In 1935, 44.8% of expenditures were for construction, 38.7% for maintenance, 13.8% for interest, and 2.7% for miscellaneous expenses.

Exclusive of debt retirement and miscellaneous administrative items not readily assignable to systems, 38.4% of expenditures were for primary rural roads, 48.0% for secondary rural roads, 7.2% for urban extensions of primary roads, and 6.4% for other urban streets.

Physical Plant

It has been pointed out that expenditures for improvement of Iowa roads and streets exceeded $575,000,000 during 1904-1937. These expenditures have been accompanied by a tremendous physical development. No data are available for urban streets, although it is known that most of the present surfaced mileage in cities and towns has been built during this period. For rural roads, however, on which more than $520,000,000 were invested during the period, fairly complete data are available for the period from 1920 to the present.

Table 33 shows that virtually all the improvements on Iowa rural roads have been accomplished in less than two decades, although basic land-access roads of approximately the same total mileage existed prior to the period of highway improvement. It also shows that a comparatively small mileage has been made the object of the bulk of construction activities in the state[54] and that a large mileage, mostly low-traffic local roads representing more than 40% of the total rural mileage, remained completely unimproved at the end of 1938.

The table does not indicate the wide variation in secondary road improvement existing between counties within the state. Thus, 57 counties had their entire county trunk systems graded and surfaced at the end of

[54]About $136,000,000 have been spent for concrete surfacing alone on slightly more than 5,000 miles.

TABLE 32. EXPENDITURES FOR ALL PURPOSES RELATED TO HIGHWAYS AND STREETS FOR FISCAL YEARS ENDING IN 1935
(000 OMITTED)

Purpose	Total	System			
		Primary rural	Secondary rural	Primary urban	Urban streets
Construction	$17,030	$6,673	$7,294	$2,263	$800
Maintenance	14,677	3,227	9,778	397	1,275
Interest	5,371	4,348	757	0	266
Administrative and collection costs	861*				
Miscellaneous	74*				
Subtotal	38,013	14,248	17,829	2,660	2,341
Debt retirement	8,581	4,059	1,370	0	3,152
Total	46,594	18,307	19,199	2,660	5,493

*Represents an item which could not be allocated to road systems but is included in the subtotal and total.

TABLE 33. EXTENT OF IMPROVEMENT IN THE IOWA RURAL ROAD SYSTEM, 1920-1938*

Year	Total mileage at end of year	Miles unimproved	Miles graded but not surfaced	Miles paved with concrete or brick	Miles of bituminous surface	Miles graveled or improved with other surfacing
PRIMARY RURAL ROADS						
1920	6,619	4,739	1,021	67	0	792
1930	6,813	375	485	3,260	0	2,693
1938	8,498	78	52	5,090	587	2,691
COUNTY TRUNK ROADS						
1920	10,552	8,681	1,023	2	0	846
1930	12,816	5,621	982	7	0	6,206
1938	13,710	1,202	1,150	27	28	11,303
COUNTY LOCAL ROADS						
1920	84,963	83,224	†	0	0	1,739
1930	81,744	72,191	2,214	0	0	7,339
1938	80,199	42,054	13,684	13	180	24,268

*Reports of the Iowa Highway Commission for 1920, 1930, and 1938 were used as the source of data.

†Not available.

1938, while 12 had their systems less than half complete. Variation was even more pronounced in the improvement of the county local system where 26 counties had surfaced more than 50% of their mileage, while 28 had carried through similar improvement on less than 5%, and 13 on less than 1%. In 1933 the Brookings Institution found similar conditions which it attributed to three factors: (1) Variations in topographic conditions which cause highway construction and maintenance costs to vary widely, (2) variations in funds available for secondary road work, and (3) variations in administrative efficiency owing to lack of a line of demarcation in some counties between the functions of the county engineer and board of supervisors.[55] According to state highway authorities, some improvement has been made in the third factor since 1933, but the other two still constitute serious drawbacks to secondary road improvement, particularly in southern Iowa where per-capita wealth and income are below the state average and highway construction costs are above it. Increased revenues were made available for secondary roads under the 1939 Farm-to-Market Road Act, but this act, designed to bring only about 10% of the most heavily traveled secondary mileage up to modern standards, leaves the local road situation untouched. Nor does distribution of four ninths of the net proceeds of the motor-fuel tax and of farm-to-market road funds on an area basis among the counties solve a problem based fundamentally on an unequal distribution of wealth and income. It is obvious that the problem is part of the broad problem of the distribution of user-tax revenues among governmental units and road systems which was mentioned in the first section of this bulletin.

[55]The Brookings Institution, Institute of Government Research. Report on a Survey of Administration in Iowa. p. 304-311. The Brookings Institution, Washington, D.C. 1933.

TABLE 34. CHANGES IN EXTENSIVE AND INTENSIVE USE OF IOWA HIGHWAYS, 1915-1939

Year	Registrations			Gasoline consumption per vehicle, gallons
	Total	Passenger cars	Trucks and busses	
1915	145,100			
1920	437,378			
1923	571,061	534,796	36,265	
1927	704,207	649,309	54,898	
1929	784,450	714,919	69,531	385
1931	748,438	670,024	78,414	487
1933	632,292	562,802	69,490	494
1936	728,414	644,565	83,849	565
1939	766,412	671,858	94,554	602

ROAD USE

An increase in the extensive and intensive use of highways has accompanied the increase in highway expenditures and the improvement of physical plant which have taken place during the past 30 years. The former is evidenced by the number of vehicles registered and the latter by the increased mileage traveled. Total vehicle registration in Iowa reached a peak in 1929, although truck registration increased sharply in the following decade. Gasoline consumption per vehicle, however, rose steadily between 1929 and 1939. While an interdependent relationship has undoubtedly existed between the increasing use of highways and their physical development through the entire motor-vehicle era, it is evident that in Iowa (particularly since 1929) extensive demand has shown itself primarily in a demand for better roads, and intensive demand has been reflected by the increasing use per vehicle of those better roads. The relevant data on registration and gasoline consumption are reproduced in Table 34.

Registration figures used in Table 34 were taken from data gathered annually by the Public Roads Administration and published in its magazine, *Public Roads*. Gasoline consumption per vehicle was computed from the same source and would be absolutely accurate only if travel by Iowa-owned vehicles outside the state exactly equaled travel by foreign-owned vehicles in the state; during 1936 and 1937 foreign travel in Iowa somewhat exceeded travel by Iowa-owned vehicles in other states. However, the trend in intensive use shown in Table 34 is fairly accurate.

Increased vehicle ownership and use, and improvement of various portions of the highway plant have resulted in varied and complex characteristics of road use. A detailed account of these characteristics is given in the road-use and traffic-survey tables of the Statewide Highway Planning Survey. However, only the most important are summarized in the following paragraphs.

1. Use of the present Iowa highway and street plant is highly interdependent; (a) vehicle owners living on any one system contribute to traffic on all the systems, (b) travel on all rural systems—even on the county local system—derives in considerable part from urban-owned vehicles and vice versa, (c) vehicles owned in other states are an important part of the traffic on the primary system (Table 35).

2. Travel is concentrated on the primary system, although less than 3% originates or ends on this system. To a large extent, therefore, the other systems act as feeders for the primary system. Average daily traffic per mile on the primary system during 1936-1937 was 719 vehicles, compared with 111 on the county trunk system and 25 on the county local system.

3. Much of the traffic on urban streets both originates and ends there.

TABLE 35. ESTIMATED VEHICLE-MILES TRAVELED IN IOWA BY ALL VEHICLES REGISTERED IN IOWA AND BY FOREIGN VEHICLES TRAVELING IN IOWA, 1936*

Place of vehicle ownership	Percentage of travel on					Grand total, percent
	Primary rural roads	County trunk roads	County local roads	All rural roads	Urban streets	
Primary	2.80	1.30	1.85	2.49	1.19	2.09
County trunk	2.42	15.87	2.91	3.97	1.36	3.16
County local	15.83	31.52	55.24	23.27	7.83	18.50
Total rural	21.05	48.69	60.00	29.73	10.38	23.75
Total urban	63.01	48.83	38.56	57.21	85.09	66.31
Nonresident registered	1.07	†	†	0.80	0.33	0.65
Foreign vehicles	14.87	2.48	1.44	11.56	4.20	9.29
All vehicles	44.11	10.99	14.12	69.22	30.78	100.00

*Iowa State Highway Commission. Road-Use Series of the Statewide Highway Planning Survey. Table 27S-AA. Iowa State Highway Commission, Ames, Iowa. 1938. Mimeographed.

Iowa State Highway Commission. Traffic Survey Series of the Statewide Highway Planning Survey. Table 103. Iowa State Highway Commission, Ames, Iowa. 1938. Mimeographed.

†Negligible.

Even for the smallest cities (1 to 1,000 population), 33% of the travel was of this type. The intraurban traffic was about 80% for cities of 25,000 or more residents.

4. Iowa-registered vehicles traveled an average of about 6,250 vehicle-miles in Iowa during 1936-1937. This is an average made up of average mileage for different classes of vehicles, which varied widely. Passenger cars averaged 5,856 miles; trucks, 8,854; common-carrier trucks, 36,775; common-carrier busses, 31,648; and city busses, 37,607.

5. There is considerable variation in motor-vehicle use between urban and rural population. Not only did urban owners travel relatively more than rural owners (6,662 miles compared with 5,777), but registration was more concentrated in urban areas (fewer persons per vehicle). Hence, travel by urban owners dominated the total traffic, representing 73.7% as against 26.3% for rural-owned vehicles. Even on the county local system it contributed nearly 40% of the total traffic.

6. The average trip on rural highways is of short distance, even on primary roads. Thus, none of our rural highway systems can be strictly classified as either general-use or local-use systems. Even on the primary system, only 34.1% of the trips were for distances more than one county beyond the point of origin, and 24 6% of the trips did not cross a county line (Table 36).

TABLE 36. LENGTH OF TRIPS ON IOWA ROADS, 1936-1937*

Road system	Intracounty trips, percent	Trips between two adjoining counties, percent	Trips through more than two counties, percent
Primary rural	24.59	41.30	34.11
County trunk	64.16	30.09	5.75
County local	74.01	23.24	2.75

*Iowa State Highway Commission. Origin and Destination Series of the Highway Planning Survey. Table 2. Iowa State Highway Commission, Ames, Iowa. 1938. Mimeographed.

Financing Highway Expenditures

As previously pointed out, more than a billion dollars were spent on public highways in Iowa during 1904-1937. More than $575,000,000 went into the improvement of some 44,000 miles of rural roads and several thousand miles of urban streets. Not only have such expenditures conferred benefits, both to vehicle users and to the community in general, but they have required the raising of commensurate sums from various groups in the community and have involved far-reaching changes in the methods of raising these sums as compared with the years preceding the motor-vehicle era.

While data on the financing of urban street improvements are not available in published reports, an analysis of the revenues which became available for rural road purposes is given in Table 37. The figure given in this table for special assessment receipts for primary roads, represents net receipts. Gross receipts from 1921 to 1930 were $6,108,000, but the legislature authorized refund of all special assessments. Why the $173,000 listed as net receipts were not refunded is not known.

Miscellaneous current revenues for primary roads in Table 37 include receipts from cities in payment for their share of primary urban extensions constructed by the Iowa Highway Commission and bond premium receipts. The sum of $50,526,000 spent on secondary roads and received from general taxes committed to highway purposes during 1913-1937 is composed of the following: County engineering costs charged to the county general fund, $11,486,000; interest costs charged to general funds, $16,356,000; and debt retirement charged to general funds, $22,684,000.

Vehicle-user tax receipts of $72,398,000 for secondary roads were obtained

Table 37. Revenues Collected to Finance Expenditures for Primary and Secondary Road Systems of Iowa, 1904-1937
(000 Omitted)

Source of funds	Primary roads	Secondary roads	All roads	Percentage of total funds
Imposts on property:				
Taxes levied specifically for highways	0	$341,811	$341,811	
General taxes committed to highway purposes	$5,946*	50,526	56,472	
Special assessments	173	3,288	3,461	
Total	6,119	395,625	401,744	44.5
Vehicle-user taxes	230,484	72,398	302,882	33.5
Federal aid	65,076	18,693†	83,769	9.3
Poll taxes‡	0	7,248	7,248	0.8
Miscellaneous current revenues	4,960	12,661	17,621	1.9
Total receipts from non-borrowed sources	306,639	506,625	813,264	90.0
Borrowing through bonds:				
Bonds issued	114,294	31,249		
Bonds retired	30,845	23,802		
Net borrowing	83,449	7,447	90,896	10.0
Total	390,088	514,072	904,160	100.0

*County tax levies for primary road bond debt service for 1920-1930, as ascertained by W. G. White of the Public Roads Administration in a special study in 1939.

†This includes $12,297,000 of W.P.A. funds spent on secondary roads during 1935-1937 and the first 3 months of 1938.

‡Poll taxes levied from 1909 to 1930, and poll tax receipts from 1930 to 1938.

TABLE 38. SOURCES OF CURRENT REVENUES IN IOWA FOR SUPPORT OF PRIMARY AND SECONDARY HIGHWAYS, 1904-1938*
(000 OMITTED)

Year	General tax revenues			Vehicle-user revenues				Highway specials	Poll taxesø	Federal aid	Total non-borrowed revenues	Long-term borrowing			Total revenues¶	Percent nonborrowed revenues		
	Highway property	Other†	Total	License fees	Net fuel tax	Other‡	Total					Receipts	Retired	Net		Property imposts§	User taxes	Federal aid
1904	$4,459**	0	$4,459	$1	0	0	$1	0	$235	0	$4,695				$4,695	95.0	0	0
1910	5,105**	0	5,105	66	0	0	66	0	230	0	5,401			$125øø	5,526	94.5	1.2	0
1915	8,794**	$480	9,274	1,533	0	0	1,533	0	268	0	11,075			1,154øø	12,229	84.8	13.8	0
1920	14,850	1,803	16,653	7,507	0	0	7,507	0	261	$315‡‡	24,736	$5,638	$487	5,151	29,887	67.3	30.3	1.3
1925	14,510	4,514	19,024	9,741	$3,129	0	12,870	$895	295	1,262	34,346	2,581	2,424	157	34,503	58.0	37.5	3.7
1930	16,014	2,261††	18,275	12,658	10,493	$344	23,495	159	430	3,876	46,235	26,925	2,364	24,561	70,796	39.9	50.8	8.4
1935	7,732	1,694	9,426	9,870	11,549	483	21,902	100	96	6,090	37,614	0	5,298	–5,298	32,316	25.3	58.2	16.2
1938	11,331	1,512	12,843	11,635	13,234	699	25,568	93	36	6,109	44,649	2,403	7,318	–4,915	39,734	29.0	57.3	13.7

*Collection costs and costs of administering the laws relating to motor vehicles are included.

†This represents debt service and engineering costs met with county taxes levied on general funds, including small county levies for debt service of primary road bonds in 1920, 1925, and 1930.

‡Ton-mile tax receipts on common carriers, truck operator permit fees, and chauffeur and driver license fees.

øPoll tax levies indicated by reports of the Iowa Highway Commission, except for 1930, 1935, and 1938, for which actual collections are listed.

¶Premiums and accrued interest on primary road bonds sold are included.

§These imposts include special property assessments.

**Taxes levied.

††Approximate.

‡‡Federal aid received from 1919 to 1921.

øøOnly the net increase in county bridge bonds outstanding is included; other data were not available.

from gasoline tax receipts (1925-1937) of $54,120,000, license fees (1912-1920) of $11,161,000, ton-mile tax receipts (1925-1937) of $3,378,000, and Iowa Highway Commission funds spent for secondary roads (1931-1937) of $4,739,000.

Receipts totaling $12,661,000 received from miscellaneous current revenues for secondary roads comprise a balancing figure and represent expenditures by townships (1913-1930) in excess of the various types of property tax imposts and user tax revenues which were reported to the counties. These represent, therefore, net transfers of funds which were obtained mainly from property taxes.

During the period 1904-1937, property imposts, vehicle-user taxes, net borrowing, and federal aid were the chief sources of revenue in the order named. Vehicle-user taxes and net borrowing provided almost the exclusive support for the primary road system, property imposts were the predominant source of financing secondary roads, and 39% of the capital expenditures for primary roads were financed through bonds.

In the field of finance, however, the changes which took place during 1904-1937 in methods of raising funds stand out most clearly. These changes, for the most part summarized in Table 38, include (1) the relative decline in reliance on property tax revenues for rural roads throughout the entire period and apparent stabilization of this source at between 25 and 30% of nonborrowed revenues in recent years; (2) conversely, the increase throughout the period in the relative importance of vehicle-user taxes, which have stabilized at between 55 and 60% of nonborrowed revenues during recent years; (3) the rapid improvement of primary roads through bond issues voted by the counties, particularly during 1927-1931 when more than $85,000,000 were received from this source; (4) the growing importance of grants from the federal government as a method of financing primary rural, primary urban, and secondary rural road construction; and (5) the direct spending of millions of dollars by the federal government in recent years for road and street purposes as a means of providing unemployment relief. The relief expenditures were supplemented by a considerable contribution from local governmental units.[56]

These changes may be viewed as the development of new and varied revenue sources for rural roads during the period, made in response to an increased demand from motor-vehicle users within the community for improved transportation. Thus, in 1904, support for rural roads rested on only two sources, general property taxation and poll taxes. In 1930 three major sources of vehicle-user taxation (license fees, motor-fuel tax, and ton-mile tax on common carriers), federal aid, and, to a minor extent, special assessments had been adopted and accepted as a permanent part of the public revenue system, while long-term borrowing had been developed as a method of accelerating road improvement, particularly for primary roads. To all these must be added other types of license fees developed and applied by the state. These include dealer licenses, truck-operator permit fees, and chauffeur and driver license fees, as well as special property assessments within urban localities. The latter, which was an established method of finance prior to the motor-vehicle era, was applied extensively to finance street improvement between 1910 and 1930.

While the relative importance of imposts on property for the financing of rural highways has been steadily declining, secondary roads still are financed largely by property tax levies, which provided more than 60% of the current nonborrowed revenues for these roads in 1938. In relation to the value of land, the property tax burden for highways probably is greater than 20 years ago, though less than a decade ago. Urban street improvements still are financed largely by property imposts, except for federal re-

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[56] Between October, 1935, and January, 1939, the Works Progress Administration spent $19,164,000 and local sponsors, $10,035,000 on Iowa secondary roads. The local sponsors apparently were the counties, and such contributions presumably appear in recorded expenditures of the counties for these years.

lief expenditures for work on streets, and for federal and state expenditures for construction work on primary urban extensions. For urban and rural highways in Iowa, property imposts still contributed 31.0% of current revenues from all sources in 1935. Revenue sources for all rural highway and urban street purposes in Iowa for the fiscal year ending in 1935 were as follows:

I. Highway-user revenues:			
A. Motor-vehicle fees:			
1. Passenger cars and busses	$7,105,000		
2. Trucks and tractors	2,393,000		
3. Trailers	64,000		
4. Motorcycles	7,000		
5. Dealer licenses	48,000		
6. Miscellaneous	253,000		
	$9,870,000		
7. Less refunds	40,000		
8. Total	$9,830,000		
B. Motor-fuel tax:			
1. Gross tax assessed	$12,607,000		
2. Less refunds	1,058,000		
3. Net proceeds	$11,549,000		
C. Other user revenues:			
1. Motor-carrier tax	$370,000		
2. Truck-operator fees	61,000		
3. Driver fees	52,000		
	$483,000		
Total		$21,862,000	47.2%
II. Property levies:			
A. County levies:			
1. Highway property tax	$7,898,000		
2. Highway debt service and engineering paid with general funds	1,545,000		
3. Special assessments	100,000		
	$9,543,000		
B. Urban levies:			
1. Property and general fund taxes	$2,676,000		
2. Special assessments	2,152,000		
	$4,828,000		
Total		14,371,000	31.2%
III. Federal aid:			
A. Received and administered by the Iowa Highway Commission	$6,090,000		
B. Received directly by cities	38,000		
Total		6,128,000	13.2%
IV. Current borrowing:			
A. Municipal	$202,000		
B. County	197,000		
Total		399,000	0.9%
V. Poll taxes:			
A. Municipal	$136,000		
B. County	96,000		
Total		232,000	0.5%
VI. Miscellaneous revenues:			
A. Iowa Highway Commission:			
1. Decrease in balances	$297,000		
2. Premium on refunding bonds	287,000		
3. Other	4,000		
	$588,000		

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B. County:			
1. Net transfers of funds	$581,000		
2. Decrease in balances	1,294,000		
3. Miscellaneous	588,000		
	$2,463,000		
C. Municipal:			
1. Decrease in balances	$125,000		
2. Net transfers of funds	159,000		
3. Miscellaneous	6,000		
	$290,000		
Total		3,341,000	7.2%
Total revenues		$46,333,000	100 0%

Data on the highway-user revenues listed above were taken from financial tables published by the Public Roads Administration in its magazine, *Public Roads*. County data were taken from the county section of the 1935 Iowa Highway Commission report. Municipal revenues were based on research conducted by the Highway Planning Survey and published in its financial survey series. The total receipts do not agree exactly with the total expenditures in Table 32 chiefly because the fiscal years used for receipts and expenditures did not agree in every instance.

The role played by the federal government in financing road improvements in the state has greatly expanded during recent years and appears to be undergoing fundamental changes. Contrary to the rule in force from 1916 to 1933, Iowa was required to match federal grants for highways only for certain classes of federal appropriations from 1934 to 1938. Federal grants now are being made for expenditures on urban extensions of primary roads and on secondary roads as well as on the regular rural federal-aid system. Federal aid is becoming more and more a means of financing stage construction as contrasted with original improvement. Stage construction is the modernization, additional improvement, or reconstruction of a highway system. Direct federal spending for relief purposes on roads and streets is becoming accepted as a permanent fact.

Prior to 1933, federal aid was granted to the states only on the matching principle and the funds were expended solely for improvement of a designated mileage of the primary system after plans had been approved by the U.S. Bureau of Public Roads. Since the coming of expanded federal public works spending in 1933, however, more than $28,500,000 have been allotted to Iowa under acts requiring no matching by state funds. This compares with allotments of about $14,250,000 under acts requiring use of the matching principle. Under the first of the emergency grants, which amounted to more than $15,000,000, it was stipulated that 25% of the funds be spent on secondary roads and not less than 25% on extensions of federal-aid roads through municipalities. Subsequent emergency grants, as well as the allotments for 1938-1941 under federal secondary-road aid, either have required or permitted expenditure of funds on other than the rural federal-aid system exclusively.[57] On the regular federal-aid rural system, the purpose of expenditure has been gradually shifting from one of initial improvement to one of stage improvement. For the country as a whole, stage construction rose to 56% of the current construction program in 1937.

The importance of the flow of federal funds to the continuance of a highway construction program in Iowa, now that the full impact of the county borrowing program for primary roads has been felt and annual debt service requirements of about $8,000,000 must be met, is evidenced by examining Iowa Highway Commission reports for the years 1934-1938.

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[57] In 1933-1938 more than $6,400,000 of federal-aid funds were expended on secondary roads in this state by the Iowa Highway Commission. Total federal authorizations for secondary-road aid in addition to the above amounts for the fiscal years 1938-1941 were $2,060,000.

For this 5-year period, 65.1% of expenditures for construction or nearly $37,000,000 out of $56,500,000, were financed by federal funds. To what extent these grants to Iowa have been offset by tax contributions by Iowans to the federal government is not clear, both because so large a portion of federal expenditures have been financed by borrowing in recent years and because it is impossible to ascertain quantitatively the incidence of the large number of manufacturers' excise taxes which are levied by the federal government. That some part of the federal grants represent a distribution of federal taxes is evident from estimates of federal excise taxes on automobiles, tires, accessories, gasoline, and oil paid by Iowans during recent years. These estimates show that from 1932 to 1937 Iowa received $37,398,000 in federal aid for highways, while such excise taxes borne by Iowans amounted to about $33,200,000.

Iowa vehicle-user taxation began in 1904, when vehicle registration and a filing fee of $1 were first required. This fee was increased to $5 in 1907, and in 1911 recognition was given in principle to the varying responsibilities of passenger cars and trucks for highway costs by the establishment of a fee of $8 for vehicles of 20 horsepower or less, with a 40-cent additional fee for each additional horsepower. It also was in 1911 that recognition was first given to the principle that vehicle-user taxes should be dedicated to road purposes; 85% of the fees were distributed to the counties for construction of county roads. Since 1915, all vehicle-user taxes collected in the state have been allotted for highways (either for actual construction, maintenance, or debt service, or for enforcement of motor-vehicle laws). In Iowa, vehicle-user taxes have been recognized as fees paid for the special benefit of improved roads for motor-vehicle use rather than as taxes for the general functions of government.

Registration fees on new passenger cars and busses since 1919 have remained at 1% of value plus 40 cents for each 100 pounds of weight, but fees on trucks were increased in 1919, 1925, and 1939. Under the 1940 law, trucks, semitrailers, trailers, and busses are licensed on a gross-weight basis. Fees range from $15 for a gross weight of 3 tons or less to $375 for a tractor-truck and semitrailer combination representing a gross weight of 18 tons, which probably would approximate the maximum legal wheel load of 4 tons.

The Iowa motor-fuel tax, now the most productive state vehicle-user revenue, was introduced in 1925 at 2 cents a gallon, was raised to 3 cents in 1927, and has remained there since. A ton-mile tax on common-carrier trucks and busses was levied in 1927, but was succeeded in 1939 by a special annual fee on common carriers "as compensation for use of the highways to carry on business and for repair and maintenance of the highways." The rate varied from $75 for a vehicle or combination having a gross weight of 8 tons or less to $250 for each vehicle or combination having a gross weight in excess of 16 tons. While registration fees in Iowa are above the national average and the average of surrounding states in all categories of vehicles, the Iowa motor-fuel tax is considerably below the national average of 3.96 cents. The combined motor-fuel tax and license fee for the average Iowa vehicle is below the national average ($33.48 in Iowa as compared with $37.56 for the United States in 1939). Net receipts from registration fees, after certain deductions for costs of collection and administration, go to the primary-road fund, along with five ninths of the net motor-fuel tax receipts and one half of the compensation tax on common carriers. All such receipts in the primary-road fund above $17,000,000, however, are now placed in a farm-to-market road fund to improve secondary roads. At 1940 receipt rates from user taxes this will provide more than $3,000,000 annually for secondary roads. In addition secondary roads receive four ninths of the motor-fuel tax proceeds and one half of the proceeds of the compensation tax on common carriers. Under present laws, secondary roads are receiving a higher percentage of vehicle-user revenues than the percentage of total traffic which they carry. Had the provisions of the 1939 law been applied to the disposition of 1938 user tax revenues, for example,

secondary roads would have received 32.9% of the revenues, whereas they carried only 25.1% of the total traffic.

Two other sources of revenue have been developed and applied to road improvement in the state during the motor-vehicle era. One of these is long-term borrowing and the other the special assessment. Borrowing for secondary-road and bridge construction has a history extending back to the early years of the century. It reached the modest peak of $23,099,000 outstanding at the end of 1923 and was reduced steadily to $6,545,000 outstanding by the close of 1938. Long-term borrowing for primary roads was authorized in 1919, and from then until the end of 1938, 97 of the 99 counties in the state had sold $116,643,000 par value of bonds. This indebtedness reached a peak of about $97,000,000 outstanding at the end of 1931, and by 1939, $79,790,000 remained outstanding. Debt retirement is proceeding under a program designed to leave the primary system free of debt by 1950, well within the life of the concrete roads which the bonds were issued to finance. While they are legal obligations of the counties these bonds have been serviced almost entirely from the primary road fund, in recognition of the benefits to vehicle users which improvement of our main highways confers. Meantime, a comprehensive refunding program during 1934-1938 reduced annual interest charges on these bonds by $1,650,000 and established a combined debt service requirement of about $8,000,000 annually.

When the primary system was established in 1919 the program for financing it also included special assessments on adjoining lands which were not to exceed 25% of the cost of hard-surfacing, and in no instance were they to exceed 4% of the value of the property. More than $4,650,000 were collected under this law in 1921-1924. By 1923, however, it was recognized that the existing law placed a severe financial burden on landowners adjoining roads which were being hard-surfaced at a cost of more than $25,000 a mile, and it was recognized that benefits to urban as well as rural traffic were sufficient that vehicle users should meet the entire costs of such roads, either directly through user taxes or indirectly through bonds serviced by user-tax receipts. Consequently, between 1923 and 1928 the special assessment as a means of financing primary road improvement was eliminated, and refunds were authorized for all assessments previously collected. But the provisions of the 1919 law authorizing special assessments for the surfacing of secondary roads up to 25% of the surfacing cost have remained on the statute books. This recognizes that a greater proportion of the benefits of secondary roads accrue to adjoining property than do the benefits of primary roads, and that surfacing costs are much smaller. Several counties in the state, including Story County, have made considerable use of this law.

Administration

The expansion in highway expenditures, improvement of physical plant, increase in vehicle ownership and road use, and changes in methods of revenue raising which have characterized the motor-vehicle era in Iowa have required and been accompanied by equally far-reaching changes in highway administration. An increasing amount of control has been vested in the Iowa Highway Commission, established in 1904, including complete control over the primary road system set up in 1919, supervision over secondary roads, and more recently over the farm-to-market road system. Immediate control over all secondary roads has been transferred from the townships to the county boards of supervisors. Thus the general tendency since 1900 has been away from the decentralized type of road administration, which then operated through the township and subtownship systems, toward the centralization demanded for efficient expenditure of funds for present public highways.

This tendency toward centralization was not accomplished without a tremendous struggle in the Iowa legislature from 1900 through 1919. Certain businessmen and many believers in local self-government fought adminis-

trative centralization bitterly. This struggle is summarized and the principles of administration over which a fight was staged are indicated by the following quotation:

> It is apparent that the last eight years (1904-1911) of the history of road legislation in Iowa have been characterized by two distinct forces. First, there has existed a reactionary tendency directed against the . . . law of 1902 which provided for the consolidation of road districts on the basis of the civil township, the appointment of one township road superintendent, and the payment of road taxes in money. This reactionary tendency resulted in the . . . law of 1909, authorizing the division of a township into road districts, election of road district supervisors and payment of one half the road tax in labor. The other force has been the progressive good roads movement which has had for its purpose the payment of all property road taxes in money, the enlargement of the county road fund together with the appointment of a trained county engineer, a state aid policy, and, finally, the strengthening of the powers of the State Highway Commission.[58]

The objectives of the good-roads movement were attained through legislative acts from 1911 to 1916. In the field of administration, these acts established a county road system apart from the township road system and gave the boards of supervisors authority over it, including the power to levy taxes on a county basis for its support. They likewise strengthened the powers of the Iowa Highway Commission by giving the commission power to adopt plans of highway construction and maintenance suited to the needs of the different counties, furnish standard plans to the counties, and approve all proposed contracts in excess of $2,000 for any bridge or culvert on all roads. In addition, these acts provided for the permanent support of the commission from proceeds of motor-vehicle license fees.

The next definite step toward centralization was given by the Federal Aid Road Act of 1916. This act, which brought the national government back into the field of highway improvement after an absence of three quarters of a century, required the designation of a system of highways controlled by a single state agency as a prerequisite for participation in federal grants.

In Iowa, after some temporary legislation, there followed in 1919 a law creating a primary and secondary system, and through successive acts, powers of the boards of supervisors over primary roads were completely transferred to the Iowa Highway Commission by 1927.

In 1929, secondary road administration was changed drastically when the township was virtually eliminated as an administrative area, although formulation of plans for development of local county roads still is divided between township trustees and the county supervisors.

Meantime, the powers of the Iowa Highway Commission over secondary road activities have been retained and extended. The commission now gives final approval or disapproval to county proposals for improvement of secondary roads, and contracts for secondary road work on which the cost per mile exceeds $2,000 must be approved by the commission. Furthermore, under the 1939 Farm-to-Market Road Law, the commission must approve all projects submitted by the counties and award all contracts for road construction.

By another series of acts extending from 1919 to 1938, the commission was given authority to construct and was required to maintain or provide for the maintenance of urban extensions of the primary system. County boards of supervisors were given substantially the same powers over urban extensions of county trunk and local county roads.[59] Finally, the federal

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[58]Brindley, John E. Road Legislation and Administration in Iowa. Bulletin 28, Iowa Engineering Experiment Station, Ames, Iowa. p. 42. 1912.

[59]Except that the provisions of the law do not compel such maintenance by the county, and except that cities of more than 2,500 are excluded from the provisions of the law unless houses average 200 or more feet apart.

TABLE 39. UNIT-COST INDICES USED IN ESTIMATING REPLACEMENT COSTS OF VARIOUS COMPONENTS OF STORY COUNTY HIGHWAYS AND STREETS (1936-1938=100)

Year	General	Excavation	Graveling	Paving	Tiling	Equipment	Structures	Right of way
1910	62.5							
1911	61.1							
1912	59.1							130.9
1913	65.2						51.1	135.0
1914	57.7	201.3			71.7		50.8	141.8
1915	60.4	116.6			71.8		50.4	152.7
1916	84.5	177.5	85.3		72.7	73.4	57.8	174.6
1917	118.3	169.5	102.9		85.9	82.5	66.9	182.7
1918	123.4	176.8	138.2		97.0	94.8	81.9	197.7
1919	129.4	185.4	180.8		110.1	102.6	90.7	218.2
1920	164.0	200.5	300.0		174.7	110.4	148.2	290.5
1921	131.7	161.0	248.5		140.4	105.2	104.6	268.6
1922	134.9	164.9	227.9	130.8	106.0	96.8	79.9	220.9
1923	150.4	170.2	208.8	126.0	87.9	98.1	100.4	212.7
1924	144.2	153.6	205.8	131.9	115.2	98.1	104.2	195.0
1925	136.9	145.0	205.8	127.9	125.2	98.1	97.7	185.5
1926	131.9	153.6	211.8	116.2	108.1	98.1	91.1	177.3
1927	130.0	174.2	222.1	123.0	114.1	98.1	105.3	165.0
1928	121.6	139.7	213.2	114.5	113.1	96.8	99.2	159.6
1929	117.5	129.8	216.2	112.1	110.1	96.1	93.1	158.2
1930	109.3	117.9	163.2	117.2	109.1	95.5	90.1	154.1
1931	97.9	102.6	108.8	109.9	90.9	93.5	82.9	133.6
1932	77.8	77.5	98.5	85.3	76.8	89.6	72.3	109.1
1933	94.6	89.4	119.1	100.5	72.7	89.6	82.1	79.1
1934	107.1	90.7	102.9	107.9	85.9	95.5	93.5	85.9
1935	102.8	108.6	113.2	106.2	86.9	95.5	98.5	91.4
1936	105.7	121.9	107.4	99.7	97.0	95.5	101.3	100.0
1937	101.3	96.6	97.1	102.0	101.0	104.5	97.9	100.0
1938	92.9	79.5	95.6	98.1	102.0		100.8	100.0

government has itself continually exercised control over the spending of federal grants by the states, since the grant of federal funds always has been conditioned on approval by the U.S. Public Roads Administration (called the U.S. Bureau of Public Roads until 1939) of plans for proposed improvements on federal-aid mileage. Since 1900, control over our highway system has been highly centralized as compared with the premotor-vehicle era. Along with this centralization has gone the maintenance of continuous contacts between federal, state, and local administrative agencies. In some states, in fact, centralization has now reached the point where the county unit has been entirely abolished for purposes of road administration, but there is no indication of such a movement in Iowa at present.

B. Derivation of Index Numbers

All index numbers have been placed on a basis of 1936-1938 as 100 (Table 39). Wherever possible, actual Story County cost data were used. In the absence of such data, unit costs for work in the state as a whole as gathered by the Iowa Highway Commission were substituted when possible. In some instances it was necessary to draw on standard indices computed by agencies outside the highway field. Where index numbers for specific components of highway construction were not available in the earlier years, it was necessary to use the general index.

GENERAL

For the period 1922-1938, the general index was derived from the Public Roads Administration index for the cost of a composite mile (concrete surfacing, structures, and excavation). For the period 1910-1921, the index was

derived from the *Engineering News-Record* construction-cost index. These two series were integrated by taking a 6-year average (1922-1927) of the ratio of the Public Roads Administration index to the *Engineering News-Record* index and multiplying the original index for the period 1910-1921 by this ratio.

Excavation

The excavation index is an index of the cost of moving a cubic yard of dirt. For the period 1914-1917, it is based on actual grading contracts on county roads in Story County. For the years 1922-1938, it is based on unit costs of excavation for Iowa as gathered by the Iowa Highway Commission. From 1918 to 1922, no unit cost data were available. Estimates for these years are based on relative changes in the general index for the same period.

Graveling

The graveling index is an index of the cost of a cubic yard of gravel on the road. It is based on actual gravel contracts for work done by Story County, except for the years 1922, 1924, and 1930, for which the index numbers are averages of the previous and following years. There were no county gravel contracts in these years.

Paving

The paving index is an index of the cost of a cubic yard of portland-cement concrete. It is based on costs per square yard gathered by the Iowa Highway Commission since 1922 and changed to a cubic-yard basis to allow for changes in average thickness over the years covered by the index.

Tiling, Equipment, and Structures

The tiling index is based on county records for the cost of tile and tiling per foot of 6-inch tile. The equipment index is based on the costs of roadway machinery as reported to the Interstate Commerce Commission by the railroads.

The structures index is based on the price movements in the cost of a cubic yard of concrete with reinforcing steel as embodied in the construction of box culverts. The cost data are for Story County for the years 1913-1928; for Story and surrounding counties, 1929-1933; and for Iowa, 1934-1938. Specifications for box culverts have changed sharply; a cubic yard of concrete with reinforcing steel today involves not only more steel per yard of concrete, but a much higher quality of concrete as well. The extent of change resulting from differences in reinforcing steel was compensated for in the index by finding, for each year, the cost of replacing steel and concrete in the proportions used during the period 1936-1938. However, the index does not allow for changes in the quality of the concrete.

Right of Way

The right-of-way index is based on the index of land values per acre in Iowa as gathered by the U.S. Department of Agriculture.

C. Determination of Various Cost Elements for the Primary Rural Road System of Story County, 1938

Depreciation

The investment in the primary rural roads of Story County at the end of 1938 is shown in Table 40; a detailed explanation of the way in which the data for this table were gathered is found on page 41 of the text. The replacement costs shown on the table were determined by means of the index numbers given in Appendix B.

Table 41 shows the depreciation charges for the primary rural road system of Story County in 1938. The replacement costs for this table were taken from Table 40.

TABLE 40. INVESTMENT IN THE PRIMARY RURAL ROAD SYSTEM IN STORY COUNTY, 1913-1938*

Year	Excavation	Cleaning and grubbing	Roadside improvement	Gravel surfacing				Concrete surfacing	Bridges, culverts, and crossings			Right of way
				Gross recorded investment	Retirements by paving	Reduction in value from other factors†	Original cost of 1938 graveling‡		Gross	Retirements	Net	
1913	$1,232	0	0	0	0	0	0	0	$7,017	$3,049	$3,968	0
1914	13,422	0	0	0	0	0	0	0	10,893	588	10,305	0
1915	7,744	0	0	$129	$129	0	0	0	7,779	2,322	5,457	0
1916	17,101	0	0	2,740	582	$982	$1,176	0	4,207	1,162	3,045	0
1917	7,391	0	0	1,014	411	603	0	0	113	0	113	0
1918	920	0	0	15,858	14,769	1,089	0	0	8,680	4,524	4,156	0
1919	0	0	0	28,019	25,250	2,769	0	0	8,650	3,635	5,015	0
1920	0	0	0	*36,244*	11,219	16,465	8,560	0	0	0	0	0
1921	3,160	$327	0	*10,281* 20,132 30,413	20,132	3,501	6,780	0	*26,036* 16,576 42,612	0	42,612	*$1,350*
1922	36,737	1,080	0	63,202	63,202	0	0	0	*954* 29,652 30,606	0	30,606	*6,606*
1923	15,274	46	0	30,956	30,956	0	0	0	*1,259* 26,598 27,857	0	27,857	*4,884*
1924	0	0	0	*15,196* 199 15,395	199	6,833	8,363	0	*316* 2,176 2,492	0	2,492	0
1925	0	0	0	0	0	0	0	0	32,103	0	32,103	4,438
1926	0	0	0	*6,413* 56 6,469	56	1,076	5,337	0	8,652	0	8,652	0
1927	2,318	87	0	*1,277* 1,141 2,418	1,141	1,277	0	0	*5,512* 14,953 20,465	0	20,465	1,088
1928	0	0	0	0	0	0	0	0	*29,171*	0	29,171	0
1929	35,880	1,705	0	0	0	0	0	$245,221	*497* 27,578 28,075	0	28,075	45,802
1930	136,706	13,867	0	0	0	0	0	697,320	22,628	0	22,628	23,217
1931	46,164	94	0	0	0	0	0	283,573	13,068	0	13,068	17,705
1932	0	0	0	0	0	0	0	0	0	0	0	1,714
1933	0	0	0	0	0	0	0	0	0	0	0	0
1934	547	0	$11,795	8,438	0	3,374	5,064	0	36,024	0	36,024	1,131
1935	0	0	1,970	0	0	0	0	0	343	0	343	427
1936	85	0	0	0	0	0	0	1,661	60	0	60	164
1937	0	0	0	0	0	0	0	0	0	0	0	0
1938	32,710	1,576	400	ø5,504	0	0	ø5,504	137,259	23,261	0	23,261	16,618
TOTAL ORIGINAL COST												
——	357,391	18,782	14,165	242,241	168,046	37,969	40,784	1,365,034	364,756	15,280	349,476	125,144
DEPRECIATED NET ORIGINAL COST												
——	339,377	18,026	13,900	——	——	——	40,784	1,120,698	——	——	281,152	125,144
NET REPLACEMENT COST												
——	289,403	17,267	13,329	——	——	——	26,322	1,210,682	——	——	384,896	87,225
DEPRECIATED NET REPLACEMENT COST												
——	275,812	16,571	13,080	——	——	——	26,322	997,242	——	——	304,822	87,225

*All expenditures prior to 1920 were made by the county, all after 1929 by the Iowa Highway Commission. County expenditures for 1920-1929 are in italics.

†Such as double entries for gravel investment in years widely separated and depletion made good by maintenance in recent years at lower unit costs.

TABLE 40. INVESTMENT IN THE PRIMARY RURAL ROAD SYSTEM IN STORY COUNTY, 1913-1938—Continued

Tiling and drainage			Engineering			Guard rail and markers	Betterments under maintenance	Miscellaneous	Total gross investment	Retirements and write-downs	Original cost of 1938 used and useful investment
Gross	Write-downs¶	Net	Gross	Retirements	Net						
0	0	0	$522	$87	$435	0	0	$10,000	$18,771	$3,136	$15,635
$222	0	$222	1,765	42	1,723	0	0	0	26,302	630	25,672
185	0	185	1,202	186	1,016	0	0	0	17,039	2,637	14,402
1,136	0	1,136	1,831	198	1,633	0	0	0	27,015	2,924	24,091
1,182	0	1,182	652	68	584	0	0	0	10,352	1,082	9270
538	0	538	1,193	935	258	0	0	0	27,189	21,317	5,872
7,177	$3,589	3,588	1,516	1,095	421	0	0	0	45,362	36,338	9,024
14,077	16,660	16,659	*2,168*	1,762	2,814	0	0	0	74,139	46,106	28,033
19,242			2,408								
33,319			4,576								
6,952	29,811	29,811	*739*	1,183	6,032	0	0	0	144,699	54,627	90,072
52,670			6,476								
59,622			7,215								
2,037	10,035	10,036	*152*	4,519	7,662	0	0	0	170,483	77,756	92,727
18,034			12,029								
20,071			12,181								
2,394	1,197	1,197	*17*	2,279	4,668	$6,300	0	0	94,658	40,732	53,926
			6,930			—6,300					
			6,947			0					
13	6	7	*896*	352	544	0	0	0	18,796	7,390	11,406
0	0	0	4,237	0	4,237	0	0	0	40,778	0	40,778
475	0	783	*244*	140	2,161	0	$515	0	18,720	1,272	17,448
308			2,057								
783			2,301								
1,815	0	1,815	*132*	122	1,365	0	47	0	29,725	2,540	27,185
			1,355								
			1,487								
129	0	129	*698*	16	682	0	36	0	30,034	16	30,018
62	0	6,125	*16*	0	23,379	43	0	0	386,230	0	386,230
6,063			23,363								
6,125			23,379								
17,687	0	17,687	52,720	0	52,720	2,009	0	0	966,154	0	966,154
4,142	0	4,142	27,930	0	27,930	2,791	3,933	0	399,400	0	399,400
150	0	150	0	0	0	0	10,122	0	11,986	0	11,986
0	0	0	0	0	0	0	0	0	0	0	0
10	0	10	5,856	0	5,856	0	30	0	63,831	3,374	60,457
1,237	0	1,237	0	0	0	0	75	0	4,052	0	4,052
0	0	0	0	0	0	0	202	4,079	6,251	0	6,251
0	0	0	0	0	0	0	338	0	338	0	338
4,352	0	4,352	23,604	0	23,604	506	0	484	241,716	0	246,274
TOTAL ORIGINAL COST											
162,284	61,298	100,991	182,708	12,984	169,724	5,349	15,298	14,563	2,874,020	301,877	2,576,701
DEPRECIATED NET ORIGINAL COST											
——	——	85,863	——	——	148,263	1,745	12,849	8,006	——	——	2.195,807
NET REPLACEMENT COST											
——	——	83,840	——	——	158,178	5,230	18,122	19,900	——	——	2,314,394
DEPRECIATED NET REPLACEMENT COST											
——	——	73,025	——	——	138,499	1,706	15,221	10,329	——	——	1.959,854

‡The original cost of the 1938 gravel investment has been determined by methods explained in Appendix E, which deals with the same problem for secondary roads.

o$4,558 of this amount is gravel investment made through maintenance during 1934-1938.

¶Tiling no longer considered useful or necessary in the opinion of the county engineer.

TABLE 41. DEPRECIATION CHARGES FOR THE PRIMARY RURAL ROAD SYSTEM OF STORY COUNTY, 1938

Investment component	Replacement cost	Estimated salvage	Depreciable value	Service life, years	Annual depreciation
Excavation	$289,403	$144,702	$144,701	100	$1,447
Clearing and grubbing	17,267	8,634	8,633	100	86
Roadside improvement	13,329	6,664	6,665	100	67
Gravel surfacing	26,322	0	26,322	15	1,756
Concrete surfacing	1,210,682	302,671	908,011	32.4	29,396
Bridges and culverts	384,896	0	384,896	60	6,428
Tiling and drainage	83,840	0	83,840	100	838
Guard rail and markers	5,230	0	5,230	10	523
Subtotal	2,030,969	462,671	1,568,298		40,541
Engineering	158,178	40,335	117,843	38.7	3,046
Betterments under maintenance	18,122	0	18,122	38.7	468
Miscellaneous	19,900	0	19,900	38.7	515
Subtotal	2,227,169	503,006	1,724,163		44,570
Right of way	87,225				
Total	2,314,394				

Service lives and salvage estimates for the investment components in the first subgroup of Table 41 were taken from Table 2 (page 43), except for gravel surfacing, which was given a service life of 15 years based on the assumption that at the end of 15 years existing gravel roads on the primary system will have been replaced with a higher type of surface. The service life of 32.4 years for concrete surfacing is a weighted average of pavement constructed in 1929, 1930, and 1931, having an estimated service life of 30 years, and of pavement built in 1938, having an estimated life of 40 years.

No exact service lives or salvage estimates were possible for investment components in the second subgroup. For engineering costs involved in construction work, it was assumed that the same percentage would be subject to depreciation as the percentage of total investment excluding engineering. This percentage was found to be 74.5 percent, which was then applied to $158,178 to give $117,843 subject to depreciation. All items in the second group were depreciated on the basis of the average life of the items in the first subgroup (38.7 years).

MAINTENANCE

Since maintenance figures based on one year are likely to be distorted because particular maintenance items fluctuate from year to year, a 5-year average based on annual reports of the Iowa Highway Commission, was used (Table 42). While the object was to get a maintenance figure that would fairly represent costs for 1938, it was necessary to exclude 1938 from Table 42, since in that year a considerable mileage of graveled road was being paved, and it was not clear whether some of the 1938 maintenance costs had been incurred for paved or graveled mileage.

The overhead or administrative costs assignable to Story County maintenance were computed as the portion of total state engineering, inspection, and administration costs assignable to maintenance, determined from allocation schedules of these costs between construction and maintenance provided by the Iowa Highway Commission. Story County was assigned its share on the basis of the ratio of maintenance costs in Story County to maintenance costs for the state as a whole.

Published reports of the Iowa Highway Commission show betterments (small capital improvements) under maintenance costs. For purposes of this study, betterments were deducted from maintenance and put into capital investment.

The average maintenance cost per mile for both paved and graveled roads as obtained in Table 42 was applied to the 1938 rural mileage to get an estimated maintenance cost.

On this basis the total maintenance cost for the 61.3 miles of primary concrete road in Story County (1938) was $18,301, or $298.55 per mile. Maintenance on the 29.3 miles of graveled road was $11,487, or $392.06 per mile. Total maintenance cost of the combined 90.6 miles was $29,788.

Part of the maintenance costs incurred by the Iowa Highway Commission in Story County were for urban extensions of primary rural roads. Costs for such mileage are summarized in the discussion of primary urban extensions in Appendix D.

Interest

Depreciated replacement cost was $1,959,854. This was multiplied by 2.25%, the interest rate used, to obtain $44,097, the annual interest charge.

Administration of Motor-Vehicle Laws

It was necessary to determine the costs of administering the motor-vehicle laws for the entire state, to allocate a portion of such costs to Story County, and to allocate costs for Story County to the various road systems within the county. The procedure, which follows, is not repeated in explaining costs for the other road systems.

1. Costs of the Iowa Motor-Vehicle Department for 1938 were $1,000,000. This included expenditures for the highway patrol and for issuing license plates, and refunds and fees retained by county treasurers from proceeds of the sale of license plates. The allocation to Story County on the basis of relative registration was 1.408%, or $14,080.

2. The cost of administering the motor-fuel law for the state was $85,000. The allocation to Story County on the basis of relative ton-miles of travel was 1.658%, or $1,409.

Table 42. Annual Maintenance Costs of Primary Rural Roads of Story County, 1933-1937

Year	Miles	Surface	Roadbed	Structures	Snow removal	Subtotal	Superintendence	Overhead administrative costs	Total
Pavement									
1933	56.8	$10,692	$2,937	$1,478	$1,470	$16,577	$841	$855	$18,273
1934	56.8	1,737	4,532	1,383	2,571	10,223	699	544	11,466
1935	56.7	1,145	5,575	2,421	5,302	14,443	874	736	16,053
1936	57.0	2,288	6,329	1,622	7,063	17,302	422	712	18,436
1937	57.0	2,315	7,464	1,466	7,908	19,153	725	775	20,653
Total	284.3	18,177	26,837	8,370	24,314	77,698	3,561	3,622	84,881
Annual average	56.86	3,635	5,367	1,674	4,863	15,540	712	724	16,976
Cost per mile		63.93	94.40	29.44	85.53	273.30	12.51	12.74	298.55
Gravel									
1933	33.5	6,112	835	463	610	8,020	405	412	8,837
1934	33.6	4,162	1,924	874	1,033	7,993	434	338	8,765
1935	39.0	7,104	989	807	1,281	10,181	617	519	11,317
1936	38.6	13,337	2,323	536	2,420	18,616	454	766	19,836
1937	38.6	15,476	2,210	688	3,079	21,453	812	864	23,129
Total	183.3	46,191	8,281	3,368	8,423	66,263	2,722	2,899	71,884
Annual average	36.67	9,238	1,656	674	1,685	13,253	544	578	14,377
Cost per mile		251.92	45.16	18.38	45.95	361.41	14.83	15.82	392.06

TABLE 43. INVESTMENT IN PRIMARY URBAN EXTENSIONS OF STORY COUNTY, 1911-1938*

Year	Excavation			Curb and gutter	Surfacing					Drainage	Structures	Right of way	Engineering	Other	Gross total	Net total
	Contracts	Other	Total		Brick	Concrete	Gravel	Other	Total							
1911	$982	0	$982	0	0	0	0	$14,802	$14,802	0	0	0	0	0	$15,784	$982
								—14,802	—14,802							
								0	0							
1914	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1915	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1916	2,230	0	2,230	$19,519	0	$84,827	0	0	84,827	0	0	0	$1,387	$315	108,278	103,830
	—108		—108	—546		—3,794			—3,794							
	2,122		2,122	18,973		81,033			81,033							
1917	0	0	0	0	$34,263	0	0	0	34,263	0	$1,176	0	0	0	35,439	35,439
1918	1,055	0	1,055	0	0	0	0	9,161	9,161	0	3,293	0	0	0	13,509	1,230
								—9,161	—9,161		—3,118					
								0	0		175					
1919	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1920	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1921	799	0	799	0	0	82,409	0	0	82,409	$1,889	49,422	0	4,136	0	138,655	138,655
1922	0	0	0	0	0	0	0	0	0	0	198	0	0	0	198	198
1923	500	0	500	0	0	55,143	0	0	55,143	564	0	$50	2,190	200	58,647	58,647
1924	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1925	0	0	0	0	0	0	$853	0	853	385	0	1,010	253	0	2,501	1,648
							—853		—853							
							0		0							
1926	0	$2,732	2,732	0	0	9,205	1,979	0	11,184	67	0	0	755	190	15,091	9,848
						—3,101	—1,979		—5,080				—163			
						6,104	0		6,104				592			
1927	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1928	0	0	0	748	0	9,747	0	0	9,747	300	0	0	482	1,047	12,324	12,324
1929	0	3,389	3,389	0	0	23,010	0	0	23,010	474	14,524	1,536	2,770	161	45,864	45,864
1930	237	0	237	0	0	17,704	0	0	17,704	0	0	0	439	0	18,380	18,380
1931	0	0	0	0	0	10,855	0	0	10,855	0	0	0	0	0	10,855	10,855
1932	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 43. INVESTMENT IN PRIMARY URBAN EXTENSIONS OF STORY COUNTY, 1911-1938*—Continued

Year	Excavation			Curb and gutter	Surfacing					Drainage	Structures	Right of way	Engineering	Other	Gross total	Net total
	Contracts	Other	Total		Brick	Concrete	Gravel	Other	Total							
1933	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1934	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1935	0	0	0	0	0	0	0	0	0	0	34,509	0	0	0	34,509	34,509
1936	0	0	0	0	0	0	0	0	0	0	0	0	0	60	60	60
1937	0	0	0	0	0	0	0	0	0	0	26,280	81,826	9,200	27	117,333	117,333
1938	0	0	0	0	0	0	0	0	0	0	329,961	1,967	36,249	2,840	371,017	371,017
TOTAL GROSS ORIGINAL COST																
—	——	——	11,924	20,267	34,263	292,900	2,832	23,963	353,958	3,679	459,363	86,389	58,024	4,840	998,444	960,819
DEPRECIATED NET ORIGINAL COST																
—	——	——	11,816	9,125	16,275	167,742	0	0	184,017	3,433	436,899	86,389	55,130	4,340	——	790,835
NET REPLACEMENT COST																
—	——	——	7,249	23,104	28,962	261,512	5,859	0	296,333	3,053	456,443	85,332	55,598	4,575	——	931,687
DEPRECIATED NET REPLACEMENT COST																
—	——	——	7,249	10,617	13,757	150,357	5,462	0	169,576	2,616	426,434	85,332	53,294	4,126	——	759,244

*Deductions represent retirements through replacement by another facility of the same or an improved type.

3. The cost of administering the motor-carrier law for the state was $158,000. The allocation to Story County on the basis of relative truck registration was 1.318%, or $2,082.

Thus the total administration costs allocated to Story County were $17,571. Allocation of this total to the primary rural roads of Story County on the basis of relative ton-miles of travel was 56.48%, or $9,924.

Total Annual Costs (Compare with Table 12)

1.	Depreciation	$44,570
2.	Interest	44,097
3.	Maintenance	29,788
4.	Administration of motor-vehicle laws	9,924
	Total	$128,379

D. Determination of the Various Cost Elements for the Primary Urban Extensions of Story County, 1938

Original Investment

Most of the data on original investment in primary urban extensions (Table 43) were obtained from council proceedings of the municipalities, which reported approval of completed contracts. County or state records were used in a few instances where either the county or state had built and paid for improvements within city limits. Scattering data also were obtained from a study of published reports of the municipalities.

For a considerable urban mileage (mostly urban streets other than primary extensions), which represented a small part of the total investment, accurate historical data were not available. This mileage represented most of the present graveled or cindered mileage. Such mileage was included in the cost base at a replacement cost. Estimates were made of replacement costs, both new and depreciated, from field examination of this mileage by engineers.

Depreciation

The procedure used for the primary rural system (Appendix C) was employed in determining the annual depreciation on the primary urban extensions. Annual depreciation was found to be $16,723, which may be verified by applying the service lives and salvage values given in Table 2 to the replacement-cost figures given in Table 43. The total depreciation charge of $16,723 was made up of the following specific depreciation charges: Surfacing, $7,865; structures, $7,623; drainage, $31; and engineering and other, $1,104.

Interest

The depreciated replacement cost of $759,233 was multiplied by 2.25% to give $17,083 as the interest cost.

Maintenance

The annual cost of maintenance for the mileage maintained directly by the Iowa Highway Commission (1935-1938 average) was $2,140. The average refunds to municipalities for maintenance of the remaining primary urban mileage (1935-1938 average) was $2,185, making a total maintenance cost of $4,325.

Administration of Motor-Vehicle Laws

The total cost of $17,571 for administering the motor-vehicle laws in the county was multiplied by 13.32%, the relative share of total county traffic carried by primary urban extensions, to give $2,340.

Total Annual Costs

Total annual costs of $40,471 were segregated as follows: Depreciation, $16,723; interest, $17,083; maintenance, $4,325; and administration of motor-vehicle laws, $2,340.

E. Determination of the Various Cost Elements for the County Trunk System of Story County, 1938

Original Investment

All historical cost data in Table 44 were taken from county and state records. Most of the investment was made by the county and only items in italics represent investment by the Iowa State Highway Commission.

The equipment item was classified as an excavation cost on recommendation of the county engineer. In Story County practically all bridge construction and road surfacing on the county trunk system have been done by contract, and equipment purchases in the earlier years represent purchases for grading.

Estimating the original cost of the present investment in graveled roads constituted a major problem in valuing the county trunk system. This was because some of the mileage had several duplicating entries in the investment account over the period studied, and even when no duplication was involved there still remained the question of how much of the original investment still existed in the road and how much of the present investment was made through maintenance. The county engineer stated that it has been the uniform policy to spread 1,500 cubic yards of gravel per mile initially, and subsequently to keep the roads in an average 90-percent condition (1,350 yards per mile) through maintenance. It was assumed that a road graveled with 1,500 cubic yards per mile eventually will lose about 500 cubic yards of original gravel, and that the remaining 1,000 cubic yards will stabilize as permanent investment. Therefore, 1,000 cubic yards were entered at original cost; the most recently recorded investment (as opposed to maintenance) was used where there were duplicating entries. It was assumed that the remaining 350 cubic yards represented top gravel which must be continually replaced through maintenance. These 350 cubic yards were therefore valued on the basis of average unit costs for the period 1934-1938. The final cost fell below the gross original cost because duplicating investment entries had been eliminated, unit costs of the 350 cubic yards representing investment through maintenance were much below unit costs of the original investment, and the present investment was assumed to be 1,350 cubic yards per mile instead of 1,500 cubic yards.

In 1928 the total recorded investment in equipment was $12,730. On the advice of the county engineer, $10,184 of this was transferred to the county local system, since the equipment was purchased for grading and most of the grading on the county trunk system was completed by 1929 whereas that on the county local system was just getting under way.

Depreciation

Annual depreciation was determined by the same procedure as for the primary rural system (Appendix C). The annual depreciation was found to be $13,800, by an application of the data on service lives and salvage values given in Table 2 to the replacement-cost figures given in Table 44. The present investment in the county trunk gravel surfacing was depreciated over a 15-year period, on the recommendation of the county engineer, who believes the gravel will be replaced by some higher type of surface after an average of 15 years additional service life.

The annual depreciation charge of $13,800 comprises the following specific depreciation charges: Excavation, $500; tiling and drainage, $679; structures, $3,505; surfacing, $8,358; and engineering, $758.

Maintenance

Maintenance costs (Table 45) were taken from the annual reports of the county engineer of Story County, except for the figures on expenditures through the W.P.A. For the period represented, all county trunk mileage was graveled; this eliminated the necessity of separate estimates of maintenance costs for dirt and for graveled roads. The maintenance mileage given includes mileage within urban localities maintained by the county.

TABLE 44. INVESTMENT IN THE COUNTY TRUNK SYSTEM OF STORY COUNTY, 1913-1938*

Year	Excavation			Gravel surfacing	Structures			Tiling and drainage			Right of way	Engineering	Total gross investment
	Grading	Equipment	Total		Gross	Retirements	Net	Gross	Write-downs†	Net			
1913	$1,582		$1,582	0	$5,942	0	$5,942	0	0	0	0	$501	$8,025
1914	13,082	$1,248	14,330	0	7,249	$78	7,216	$717	0	$717	0	1,614	23,955
1915	15,113	455	15,568	$2,048	9,122	1,052	8,070	157	0	157	$270	2,198	29,093
1916	3,975	184	4,159	2,059	4,908	0	4,908	480	0	480	362	712	12,680
1917	13,079	480	13,559	10,723	3,882	0	3,882	1,281	0	1,281	1,331	1,821	32,597
1918	0	275	275	2,383	4,825	0	4,825	516	0	516	75	330	8,404
1919	0	976	976	17,726	4,950	125	4,825	3,416	$1,708	1,708	0	965	28,033
1920	2,424	10,330	12,754	62,511	2,953	0	2,953	30,656	15,828	15,828	1,800	4,126	116,430
								1,000					
								31,656					
1921	3,694	790	4,484	44,008	5,250	0	5,250	67,195	34,511	34,511	0	4,933	127,698
								1,828					
								69,023					
1922	1,204	127	1,331	3,589	3,688	0	3,688	11,676	5,838	5,838	0	1,263	21,547
1923	*2,340*	145	2,485	887	7,532	0	7,532	9,383	5,092	5,092	430	904	22,421
								800					
								10,183					
1924	14,729	325	15,054	7,112	24,610	0	24,610	5,536	2,768	2,768	1,532	2,323	56,167
1925	8,952	0	8,952	30,253	38,984	0	38,984	4,560	2,280	2,280	1,065	2,562	86,376
1926	100	0	100	26,212	4,404	0	4,404	1,377	0	1,377	1,047	1,056	34,196
1927	12,448	2,583	15,031	46,046	6,788	0	6,788	2,600	0	2,600	330	2,129	72,924
1928	9,417	2,546	11,963	28,393	0	0	0	1,946	0	1,946	160	1,933	44,395
1929	9,978	1,966	11,944	26,887	11,850	0	11,850	3,820	0	3,820	50	2,904	57,455
1930	4,433	0	4,433	15,678	355	0	355	4,379	0	4,379	650	1,083	26,578
1931	173	0	173	2,535	21	0	21	246	0	246	0	125	3,100
1932	0	0	0	642	0	0	0	0	0	0	0	0	642
1933	0	0	0	0	0	0	0	0	0	0	0	0	0
1934	0	0	0	275	0	0	0	0	0	0	0	0	275
1935	0	0	0	0	0	0	0	0	0	0	0	0	0
1936	0	0	0	0	*37,785*	0	*37,785*	0	0	0	0	0	37,785
1937	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 44. INVESTMENT IN THE COUNTY TRUNK SYSTEM OF STORY COUNTY, 1933-1938—Continued

Year	Excavation			Gravel surfacing	Structures			Tiling and drainage			Right of way	Engineering	Total gross investment
	Grading	Equipment	Total		Gross	Retirements	Net	Gross	Write-downs†	Net			
1938	0	0	0	0	0	0	0	0	0	0	0	0	**0**
TOTAL ORIGINAL COST													
—	—	—	139,153	329,967	—	—	183,888	—	—	85,544	9,102	33,842	**850,776**
ORIGINAL COST OF PRESENT USED AND USEFUL INVESTMENT													
—	—	—	139,153	250,310	—	—	183,888	—	—	85,544	9,102	33,842	**701,833**
DEPRECIATED NET ORIGINAL COST													
—	—	—	127,840	221,979	—	—	144,542	—	—	72,083	9,102	17,371	592,917
NET REPLACEMENT COST													
—	—	—	99,920	139,230	—	—	209,903	—	—	67,881	4,672	29,499	551,105
DEPRECIATED NET REPLACEMENT COST													
—	—	—	91,905	125,307	—	—	159,964	—	—	57,322	4,672	16,655	455,825

*State expenditures are in italics. All other expenditures were made by Story County.
†Tiling no longer considered useful or necessary in the opinion of the county engineer.

TABLE 45. MAINTENANCE COSTS OF COUNTY TRUNK ROADS OF STORY COUNTY, 1935-1938

Year	Miles maintained	Road maintenance	Gravel maintenance	Snow removal	Structure maintenance	Equipment and tools	Tiling and drainage	W.P.A. funds	Engineering	Total
1935	140	$6,234	$8,981	$440	0	$6,034	$41	0	$412	$22,142
1936	144	7,535	6,293	1,129	$1,372	8,385	115	$632	464	25,925
1937	144	8,439	7,689	384	563	7,971	53	664	582	26,345
1938	144	6,774	7,123	475	362	8,494	24	829	635	24,716
Total	572	28,982	30,086	2,428	2,297	30,884	233	2,125	2,093	99,128
Yearly average	143	7,246	7,522	607	574	7,721	58	531	523	24,782
Average per mile	143	50.67	52.60	4.24	4.02	53.99	0.40	3.72	3.66	173.30

According to the state W.P.A. office, expenditures on secondary roads in Story County during 1936, 1937, and 1938 were $28,540, $29,995, and $37,404. The county engineer estimated that work done by the W.P.A. could have been done at about 30% of the cost if carried on under efficient operating conditions. The W.P.A. expenditures were therefore multiplied by 0.30 to give the amounts used in this study. About half the W.P.A. work represented construction, and half constituted maintenance work. A division was made between county trunk and county local maintenance on the basis of the relative mileage in these two systems. The expenditures entered in the maintenance tables for county trunk and county local systems were thus obtained.

The allocation of engineering costs charged to maintenance on both county trunk and local roads was made on the basis of relative maintenance costs on each system, exclusive of engineering.

The final maintenance cost of $173.30 per mile was multiplied by 136.5 miles, the rural county trunk mileage in 1938, to obtain $23,655, the annual maintenance cost.

INTEREST

The depreciated replacement cost of $455,825 was multiplied by an interest rate of 2.25% to give an interest charge of $10,256.

ADMINISTRATION OF MOTOR-VEHICLE LAWS

The total cost of $17,571 for administering the motor-vehicle laws in the county was multiplied by 8.12%, relative share of total county traffic carried by county trunk roads, to give $1,427.

TOTAL ANNUAL COSTS

The total annual costs of $49,138 for the county trunk system were divided as follows: Depreciation, $13,800; maintenance, $23,655; interest, $10,256; and administration of motor-vehicle laws, $1,427.

F. Determination of Various Cost Elements for the County Local Road System of Story County, 1938

ORIGINAL INVESTMENT

Prior to 1930 the township trustees had charge of road improvements and the construction of small structures on the township (now the county local) road system. The county, however, has had charge of construction of all major structures since 1913 and of all construction on the county local system since 1930. All data in Table 46 were taken from county records.

For work done by the townships, no information is available prior to 1916, and only gross totals for those townships reporting are available for the period 1916-1929. Reported road investment for this period was adjusted upward to allow for estimated spending by nonreporting townships. In general, no valuation based on historical costs was possible for work done by

TABLE 46. INVESTMENT IN THE COUNTY LOCAL SYSTEM OF STORY COUNTY, 1913-1938

Year	Road Improvement								Total road investment	Bridges and culverts							Engineering	Total gross investment
	Excavation				Surfacing	Tiling and drainage	Right of way	Miscellaneous		Concrete and steel			Other			Total		
	Grading proper	Equipment	W.P.A. funds	Total						Gross	Retirements	Net	Culvert materials	Filling bridges and culverts	Timber and steel structures			
1913										$9,045	$110	$8,935	0	0	0	0	$498	$9,543
1914										24,922	472	24,450	0	0	0	0	1,149	26,071
1915										27,369	278	27,091	0	$1,949	0	$1,949	1,466	30,784
1916										41,304	374	40,930	0	838	0	838	1,682	43,824
1917									$19,011	15,848	0	15,848	$924	407	0	1,331	547	36,737
1918									12,032	21,773	789	20,984	3,153	858	0	4,011	618	38,434
1919									15,090	26,434	2,288	24,146	3,296	1,364	0	4,660	535	46,719
1920									29,268	38,515	0	38,515	5,136	1,623	0	6,759	867	75,409
1921									25,557	7,695	0	7,695	2,294	362	0	2,656	172	36,080
1922									29,670	10,944	0	10,944	0	36	0	36	394	41,044
1923									21,682	34,540	0	34,540	3,226	1,455	0	4,681	1,183	62,086
1924									23,813	10,091	0	10,091	3,338	1,491	0	4,829	349	39,082
1925									33,838	2,245	0	2,245	2,817	1,168	0	3,985	71	40,139
1926									51,673	18,260	0	18,260	3,566	362	0	3,928	332	74,193
1927									52,267	29,537	0	29,537	4,092	1,789	0	5,881	519	88,204
1928									58,706	0	0	0	1,824	2,345	$8,813	12,982	267	71,955
1929									41,858	16,270	0	16,270	3,015	0	9,384	12,399	802	71,329
1930	$15,731	$11,033	0	$26,764	$169	$1,599	0	$117	28,649	3,424	0	3,424	0	0	8,477	8,477	1,752	42,302
1931	29,903	7,907	0	37,810	36,714	2,628	$845	343	78,340	2,994	0	2,994	0	0	3,684	3,684	3,554	88,572
1932	40,299	4,117	0	44,416	43,259	2,289	294	0	90,258	1,773	0	1,773	0	0	6,933	6,933	3,019	101,983
1933	12,324	2,911	0	15,235	37,296	1,133	40	0	53,704	1,264	0	1,264	0	0	5,304	5,304	1,621	61,893
1934	10,850	1,490	0	12,340	25,779	978	45	0	39,142	1,696	0	1,696	0	0	6,264	6,264	1,609	48,711
1935	31,489	4,906	0	36,395	35,038	2,152	0	0	73,585	2,224	0	2,224	0	0	10,285	10,285	3,088	89,182
1936	25,569	7,371	$4,281	37,221	42,833	2,534	250	0	82,838	3,430	0	3,430	0	0	3,208	3,208	2,855	92,331
1937	19,820	2,170	4,494	26,484	32,025	2,545	65	0	61,119	730	0	730	0	0	2,517	2,517	2,084	66,450
1938	30,839	3,081	5,610	39,530	26,005	1,953	453	0	67,941	7,266	0	7,266	0	0	3,414	3,414	2,784	81,405
Total original cost				276,195	279,118	17,811	1,992	460	990,041	359,593	4,311	355,282	36,681	16,047	68,283	121,011	33,817	1,504,462
Replacement cost:																		
Work from 1930 to 1938				287,016	273,036	19,543	1,773	457	581,825	—	—	—	—	—	—	—	—	—
Work prior to 1930				91,350	159,644	*	*	*	250,994	—	—	—	—	—	—	—	—	—
Total				378,366	432,680	19,543	1,773	457	832,819	—	—	451,398	—	—	—	130,343	35,189	1,449,749
Depreciated replacement cost				344,003	392,172	18,771	1,773	457	757,176	—	—	314,976	—	—	—	97,865	31,091	1,201,108

*Records of expenditures for these items were not available for work done prior to 1930. This introduces a small indeterminable error in the replacement cost total.

TABLE 47. MAINTENANCE COSTS OF COUNTY LOCAL ROADS IN STORY COUNTY, 1935-1938

Year	Miles maintained	Road maintenance	Gravel maintenance	Snow removal	Structure maintenance	Equipment and tools	Tiling and drainage	Special	W.P.A. funds	Engineering	Total
1935	831	$25,651	$20,797	$1,596	$7,470	$12,827	$1,050	0	0	$1,317	$70,708
1936	831	30,227	16,634	7,622	13,434	12,379	980	$125	$3,649	1,538	86,588
1937	831	33,725	20,151	2,106	15,229	13,623	1,642	0	3,830	2,006	92,312
1938	830	23,457	20,320	1,604	8,098	16,240	1,256	10	4,781	1,935	77,701
Total	3,323	113,060	77,902	12,928	44,231	55,069	4,928	135	12,260	6,796	327,309
Yearly average	830.75	28,265	19,476	3,232	11,058	13,767	1,232	34	3,065	1,699	81,827
Average per mile	——	34.02	23.44	3.89	13.31	16.57	1.48	0.04	3.69	2.05	98.49

townships prior to 1930, since there was no information as to exactly what amounts were spent for the various types of improvement. It was known that practically all the investment in road improvement went into grading and graveling, but a replacement-cost method of valuation is the only method by which an over-all figure for this system could be obtained.

To get replacement-cost estimates for work done by the county on the township system since 1913, the same technique was used as for the other road systems. Historical costs were brought to 1938 with the cost indices, and service lives and salvage values from Table 2 were applied to the undepreciated replacement costs thus obtained. These techniques were used for all investment since 1930, except for gravel surfacing, and for all investment in structures and engineering from 1913 to 1938.

To obtain replacement-cost estimates for work done by the townships from 1913 through 1929, the following methods were used:

GRADING. Practically all the grading prior to 1930 was of a temporary type estimated at 3,000 yards per mile, compared with 10,000 yards at present standards. The investment in each of the miles graded prior to 1930 was therefore entered at 3,000/10,000 times $767 (average cost of grading a mile during 1935-1938), which gave a total of $87,323. The county engineer estimated that these miles will be brought to permanent grade in an average period of 20 years from their construction, at which time he expected a salvage value of 50 percent. This investment was therefore depreciated on assumption of a 20-year life and a 50-percent salvage.

Five and one fourth miles had been brought to permanent grade prior to 1930. These were entered in the investment at $767 a mile with the assumed average construction date of 1925.

SURFACING. It is known that 220 of the 586 miles of county local road surfaced by the end of 1938 had been surfaced prior to 1930. By 1938 these 220 miles reportedly had been brought, through maintenance, to a comparable standard with the 366 miles surfaced after 1930. These 220 miles were multiplied by $746, average cost of surfacing a mile of county local road during 1935-1938, to give $273,036. On the assumption that the roads are maintained in 90-percent condition, $273,036 was multiplied by 0.90 to give $245,732 as the present value. For purposes of continuity, the remaining 366 miles were given a replacement-cost valuation on the same basis

DEPRECIATION

The same procedure was used for determining depreciation of the county local roads as for the primary rural roads, except that present gravel investment was not made subject to an annual depreciation charge. It was assumed that the graveled roads would be maintained in 90-percent condition and would not be replaced by a higher-type surface because of low traffic carried. Annual depreciation, found to be $14,857, comprised the fol-

lowing specific depreciation charges: Excavation, $3,638; structures, $10,797; drainage, $188; and engineering, $234.

INTEREST

The depreciated replacement cost of $1,201,108 was multiplied by an interest rate of 2.25% to give an interest charge of $27,025.

MAINTENANCE

The maintenance costs for county local roads (Table 47) were taken from records of the county engineer of Story County, except for the allocation of W.P.A. spending and for allocation of engineering to county local maintenance. The basis for these allocations is explained in Appendix E.

Since only part of the county local system was graveled, it was necessary to find an average maintenance cost for both dirt and graveled roads. Average maintenance costs, exclusive of maintenance gravel, were computed as $75.05 per mile. It was assumed that, for the graveled mileage, maintenance gravel does not need to be laid until 2 years after graveling is completed. Thus costs of maintenance gravel in 1938 were for mileage that was graveled previous to the close of 1936. On this basis, total gravel maintenance for 1935-1938 was divided by total miles of graveled road for 1933-1936, giving $44.26 as the average cost per mile of maintenance gravel. The cost of maintenance gravel added to other maintenance costs gave $119.31, which represents the maintenance cost per mile of the 585.5 miles of graveled road on the county local system. The total maintenance cost for the graveled roads was $69,856. The 238.5 miles of dirt road in the county local system at $75.05 per mile had a total maintenance cost of $17,899. The combined 824.0 miles had a total maintenance cost of $87,755.

ADMINISTRATION OF MOTOR-VEHICLE LAWS

The total cost of $17,571 for administering the motor-vehicle laws in the county was multiplied by 10.38%, the relative share of total county traffic carried by county local roads, to give $1,824.

TOTAL ANNUAL COSTS

Total annual costs were $131,461, which included the following expenses: Depreciation, $14,857; maintenance, $87,755; interest, $27,025; and administration of motor-vehicle laws, $1,824.

G. Determination of the Various Cost Elements for the Urban Streets in Story County, 1938

DEPRECIATION

In determining annual depreciation, the same procedure was used as for the primary rural system (Appendix C). Annual depreciation was $30,158 by an application of service lives and salvage values given in Table 2 to the replacement costs given in Table 48. Table 48 was prepared in the same manner as Table 43 of Appendix D. The annual depreciation charge of $30,158 comprised the following specific depreciation charges: Surfacing, $28,255; drainage, $139; structures, $560; and engineering and other, $1,204.

INTEREST

The depreciated replacement cost of $1,031,390 was multiplied by an interest rate of 2.25% to obtain an interest charge of $23,206.

MAINTENANCE

The average recorded maintenance expenditures for the fiscal years 1935-193[illegible] for Story County municipalities, as reported in *Report of Municipal Accounts,* were $37,047. The average refunds to municipalities by the Iowa Highway Commission for maintenance work done on the primary urban extensions were $2,185; this amount was therefore not used on urban streets and should be deducted. Expenditures by the county on the maintenance of secondary roads within urban limits were $2,016. In addition, the average street lighting costs for Story County municipalities for the period 1935-1938, as reported in *Report of Municipal Accounts* or as estimated for

TABLE 48. INVESTMENT IN URBAN STREETS OF STORY COUNTY, 1910-1938*

Year	Excavation			Curb and gutter	Surfacing					Drainage	Bridges and culverts	Engineering	Miscellaneous	Gross total	Net total
	Contracts	Other	Total		Brick	Concrete	Stabilized gravel	Gravel	Other						
1910	0	0	0	0	0	0	0	0	$54,236 —54,236 0	0	0	0	0	$54,236	0
1911-13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1914	$1,714	0	$1,714	$964	0	$33,511	0	0	0	0	0	$1,268	$222	37,679	$37,679
1915	0	0	0	0	0	0	0	0	0	0	$1,747	0	0	1,747	1,747
1916	7,592	0	7,592	38,297	0	207,708	0	$1,850 —1,850 0	0	0	339	1,696	362	257,844	255,994
1917	0	0	0	4,156	$29,187	0	0	0	0	0	1,500	0	0	34,843	34,843
1918	948	0	948	0	0	0	0	0	12,651 —12,651 0	0	6,083	0	0	19,682	7,031
1919	0	0	0	0	0	0	0	7,674 —7,674 0	0	0	0	0	0	7,674	0
1920	2,435	0	2,435	0	0	0	0	12,735 —12,735 0	0	0	0	0	357	15,527	2,792
1921	3,473	0	3,473	0	0	75,182	0	0	0	$1,559	0	3,796	0	84,010	84,010
1922	1,265	0	1,265	0	0	54,346	0	0	0	537	0	2,810	0	58,958	58,958
1923	6,325	0	6,325	0	0	177,694	0	0	0	2,518	2,048	9,387	125	198,097	198,097
1924	16,902	0	16,902	0	0	204,182	0	0	0	5,215	0	6,947	13,001	246,247	246,247
1925	0	$4,045	4,045	0	0	0	0	0	0	0	846	0	900	5,791	5,791
1926	0	0	0	0	0	154,007	0	0	0	0	5,151	8,117	0	167,275	167,275
1927	0	2,760	2,760	0	0	0	0	0	0	0	0	0	0	2,760	2,760
1928	5,216	2,190	7,406	1,491	0	99,174	0	16,925 —16,925 0	0	3,482	0	4,180	399	133,057	116,132
1929	0	1,439	1,439	0	0	0	0	0	0	0	958	0	0	2,397	2,397
1930	0	2,340	2,340	0	0	0	0	0	0	0	0	0	0	2,340	2,340
1931	0	111	111	0	0	0	0	0	0	0	0	0	0	111	111

TABLE 48. INVESTMENT IN URBAN STREETS OF STORY COUNTY, 1910-1938—Continued

Year	Excavation			Curb and gutter	Surfacing					Drainage	Bridges and culverts	Engineering	Miscellaneous	Gross total	Net total
	Contracts	Other	Total		Brick	Concrete	Stabilized gravel	Gravel	Other						
1932	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1933	0	352	352	0	0	0	0	0	0	0	0	0	2,951	3,303	3,303
1934	1,711	4,255	5,966	31,787	0	56,163	0	0	0	628	480	2,222	0	97,246	97,246
1935	0	1,888	1,888	0	0	0	$32,675	0	0	0	0	0	0	34,563	34,563
1936	5,068	867	5,935	23,672	0	0	24,196	0	0	574	9,733	1,250	0	65,360	65,360
1937	0	2,730	2,730	0	0	0	0	0	0	0	0	0	0	2,730	2,730
1938	446	2,466	2,912	14,978	0	23,342	20,784	0	0	480	0	2,259	64	64,819	64,819
TOTAL GROSS ORIGINAL COST															
——	——	——	78,538	115,345	29,187	1,085,309	77,655	39,184	66,887	14,993	28,885	43,932	18,381	1,598,296	1,492,225
DEPRECIATED NET ORIGINAL COST															
——	——	——	78,538	90,308	13,863	730,846	70,335	0	0	13,283	20,739	35,161	11,289	——	1,064,362
NET REPLACEMENT COST															
——	——	——	57,658	119,857	24,670	991,282	75,747	85,785	0	13,873	33,557	35,405	14,298	——	1,452,132
DEPRECIATED NET REPLACEMENT COST															
——	——	——	57,658	91,548	11,719	651,996	68,711	73,955	0	12,191	25,849	28,540	9,223	——	1,031,390

*Deductions represent retirements through replacement by another facility of the same or an improved type.

TABLE 49. AVERAGE CONSTRUCTION COSTS (OTHER THAN STRUCTURES) ON COUNTY LOCAL ROADS OF STORY COUNTY, 1935-1938*

Year	Clearing and grading		Surfacing		Tiling	Equipment	Right of way	Engineering†	Total
	Miles	Cost	Miles	Cost					
1935	62	$31,489	42	$35,038	$2,152	$4,906	——	$3,088	$76,673
1936	34	29,850‡	62	42,833	2,534	7,371	$250	2,855	85,693
1937	37	24,314‡	38	32,025	2,545	2,170	65	2,084	63,203
1938	48	36,449‡	40	26,005	1,953	3,081	453	2,784	70,725
Total	182	122,102	182	135,901	9,184	17,528	768	10,811	296,294
Average per mile	——	670.89	——	746.20	50.46	96.31	4.00	59.40	1,627.26

*Source: Records of the county engineer of Story County, Iowa.

†Engineering costs allocated to construction are based on 1932-1936 ratios of engineering costs to construction and maintenance as determined by the county engineer.

‡W.P.A. work estimated at efficiency value (30%) is included. This amounted to $4,281 for 1936, $4,494 for 1937, and $5,610 for 1938.

localities with municipal light plants, were $16,351. The total of these elements of maintenance costs for urban streets was $53,229.

ADMINISTRATION OF MOTOR-VEHICLE LAWS

The total cost of $17,571 for administering the motor-vehicle laws in the county was multiplied by 11.7%, relative share of total county traffic carried by urban streets, to give $2,056.

TOTAL ANNUAL COSTS

Total annual costs were $108,649 and included the following expenses: Depreciation, $30,158; maintenance, $53,229; interest, $23,206; and administration of motor-vehicle laws, $2,056.

H. Derivation of Replacement Cost and Annual Cost per Mile of Surfaced County Local Road in Story County, 1938

REPLACEMENT COST

The present investment in excavation (clearing and grading), surfacing, tiling, equipment, and right of way was determined on the basis of 1935-1938 average construction costs (Table 49). The present investment per mile in bridges and culverts completed since 1913 was determined as explained in Appendix F.

For engineering investment, a separate computation was made for investment per mile in the engineering of road improvement and the engineering of structures. This was necessary because the county engineer has had charge of bridge and culvert construction on the county local system since 1913, while he assumed charge of complete road improvement in 1930.

The engineering costs between 1913 and 1929 were $12,135 (Appendix F). For the period 1930-1938, the investment in county local road improvement was $575,574 and in structures, $72,277, while the engineering expenditures for the same period have a present cost of $23,054 (Appendix F). The engineering costs for a given investment in grading and surfacing are believed about twice as great as for the same investment in structures. On this basis, 5.91% of the $23,054, or $1,362, should be charged to structural work on the county local system for 1930-1938. Thus total engineering costs in structures on the county local system since 1913 have been $12,135 plus $1,362, or $13,497, and the engineering costs per mile were $13,497 divided by 830 miles, or $16.26.

The remaining engineering investment for 1935-1938 was $10,263 ($10,811 minus $548); this was assigned to road improvement. Since 182 miles of county local road were constructed during this period the average engineer-

ing investment per mile was $56.39. Thus, the total engineering investment per mile for both structures and road improvement was $72.65.

The total replacement cost per mile, $2,346.51, was composed of the following cost elements: Clearing and grading, $670.89; surfacing, $746.20; tiling, $50.46; equipment, $96.31; right of way, $4.00; structures, $706.00; and engineering, $72.65.

Annual Costs per Mile

There were 824 miles of county local roads in Story County in 1938. The annual costs per mile were determined as follows:

1. Depreciation:	
Grading (grading plus equipment, $767 a mile; life assumed, 100 years; salvage, 50%)	$3.84
Structures (annual depreciation for the system, $10,797; Appendix F)	13.10
Tiling ($50 a mile depreciated at 1% a year)	0.50
Engineering (annual depreciation for the system, $234; Appendix F)	0.28
Total depreciation	$17.72
2. Interest ($2,346 at 2.25%)	52.79
3. Maintenance (Appendix F)	119.31
4. Administration of motor-vehicle laws (administration costs for the system, $1,824; Table 12)	2.21
Total costs	$192.03

I. Estimated Replacement Cost and Annual Cost of a Basic Street System for Urban Streets in Story County

The basic investment for mileage already paved is assumed to be that of a street surfaced with stabilized gravel and bituminous asphalt; investment in grading and curb and gutter is included. This type of improvement was widely used in Ames, the county's largest city, during 1935-1938. To obtain a total basic investment in urban streets, average costs were applied to all urban mileage in the county which previously had been paved with concrete, asphalt, brick, or stabilized gravel.

The average unit costs used were as follows: Finished surface, 58.3 cents per square yard; grading, 11.9 cents per square yard; and curb and gutter, 81.0 cents per linear foot. The cost per mile of a street 30 feet wide with 27 feet of surface was $19,531, and comprised finished-surface costs of $9,255, grading costs of $1,742, and curb-and-gutter costs of $8,554. Where streets were wider or narrower than 30 feet, costs per mile varied somewhat from the $19,531 cost for a typical mile, but this variation was taken into consideration in assembling the summary table on replacement cost of the basic system (Table 50).

Certain other investment elements of the present system (drainage, structures, right of way, and miscellaneous items) were included as part of the basic system as well. These elements were included at their replacement costs as given in Appendix D. All investment in the Ames underpass, both in structures and right of way, was excluded from the basic system.

It was necessary to estimate the investment in engineering in the basic system. This was done by computing the ratio of engineering to gross investment in the actual system and applying the same percentage to the basic system.

Annual costs were determined by using the same procedures as elsewhere in this study, but since it was not possible to estimate a depreciated investment value for the basic system, the annual interest charge was determined by using replacement cost undepreciated. When annual costs of the basic system are compared with those of the actual system, therefore, the interest charge used for the actual system is based on an undepreciated replacement cost.

SUMMARY OF ANNUAL COSTS FOR A BASIC STREET SYSTEM

Primary Urban Extensions	
1. Depreciation (Table 50)	$5,985
2. Interest ($246,079 at 2.25%)	5,537
3. Maintenance (same as for actual system)	4,325
4. Administration of motor-vehicle laws (same as for actual system)	2,340
Total costs	$18,187
Other Urban Streets	
1. Depreciation (Table 50)	$20,642
2. Interest ($785,049 at 2.25%)	17,664
3. Maintenance (same as for actual system)	53,229
4. Administration for motor-vehicle laws (same as for actual system)	2,056
Total costs	$93,591

J. Determination of Annual Costs Chargeable to Vehicle Users and General Public Under the Basic-System Method

In determining the annual costs for the basic investment on each road or street system, the valuation base used was the undepreciated replacement cost. In comparing basic costs with actual costs, therefore, it was necessary to use the same type of valuation base. Then the ratios between basic and adjusted actual costs (using undepreciated replacement cost) were obtained and applied to actual costs as previously computed on a valuation of depreciated replacement cost. This gave the annual costs for a

TABLE 50. INVESTMENT COST AND DEPRECIATION FOR A HYPOTHETICAL BASIC STREET SYSTEM

Type of investment	Present construction cost	Salvage	Cost subject to depreciation	Estimated service life, years	Annual depreciation
PRIMARY URBAN EXTENSIONS					
Excavation	$5,557	$5,557	0	Infinite	0
Curb and gutter	42,079	21,040	$21,039	40	$526
Surfacing	71,654	17,914	53,540	15	3,584
Drainage	3,053	0	3,053	100	31
Structures	100,202	0	100,202	60	1,673
Right of way	1,539	1,539	0	Infinite	0
Miscellaneous	1,708	0	1,708	31	56
Engineering	4,448	914	3,534	31	115
Subtotal	240,220	39,864	182,907	31	5,985
Gravel mileage	5,859				
Total	246,079				
OTHER URBAN STREETS					
Excavation	34,687	34,687	0	Infinite	0
Curb and gutter	280,132	140,066	140,066	40	3,502
Surfacing	304,599	76,150	228,449	15	15,238
Drainage	13,873	0	13,873	100	139
Structures	33,557	0	33,557	60	560
Miscellaneous	14,298	0	14,298	21	668
Engineering	18,118	6,675	11,443	21	535
Subtotal	699,264	222,891	441,686	21	20,642
Gravel mileage	85,785				
Total	785,049				

TABLE 51. INCREASED ANNUAL COSTS PER MILE FOR IMPROVING THE GRAVELED ROADS OF STORY COUNTY TO AN INTERMEDIATE STAGE

Cost element	Additional investment required	Estimated salvage	Estimated service life, years	Estimated annual cost
Depreciation:				
Grading	$1,000	$500	100	$5.00
Surfacing	5,500	1,375	10	413.00
Structures	1,000	0	60	17.00
Right of way	200	—	Infinite	0.00
Total	7,700			435.00
Interest (2.25%)				192.50
Total costs				627.50

basic system chargeable to the general public, and the remainder of the annual costs were charged to vehicle users.

PRIMARY RURAL ROADS

From Appendix H, the annual cost per mile of county local road is $192.03. This gives a total annual cost of $17,398 for 90.6 miles of basic road. The actual annual costs for the primary rural roads in Story County would be $136,347, if the annual interest charge is computed on an undepreciated valuation base as outlined in the preceding paragraph.

The basic costs are thus 12.76% of the actual costs, and the annual costs chargeable to the general public are 12.76% of the actual costs ($128,379), or $16,381. The remainder of the annual costs, $111,998, are chargeable to vehicle users.

COUNTY TRUNK ROADS

The annual cost of a mile of basic road is $192.03 (Appendix H), and the total annual cost for the 136.5 miles of basic county trunk roads is $26,212. The actual annual costs for the county trunk roads when the annual interest charge is computed on an undepreciated valuation base would be $51,279, so that basic costs are 51.12% of actual costs. Thus the annual costs chargeable to general public are 51.12% of actual costs ($49,138), or $25,119. The remainder of the annual costs, chargeable to vehicle users, are $24,019.

COUNTY LOCAL ROADS

All costs of county local roads, $131,461, are considered to be chargeable to general taxpayers.

PRIMARY URBAN EXTENSIONS

The annual costs for a basic road on the primary urban extensions are $18,187, 41.0% of the adjusted actual annual costs of $44,358. Thus the costs chargeable to the general public are 41.0% of actual costs ($40,471), or $16,593. The remainder of the annual costs, $23,878, are chargeable to vehicle users.

OTHER URBAN STREETS

The annual costs of a basic road on all urban streets other than primary urban extensions are $93,591, 79.24% of the adjusted actual annual costs of $118,113. Thus, the costs chargeable to the general public are 79.24% of actual costs ($108,649), or $86,093. The remainder of the annual costs, $22,556, are chargeable to vehicle users.

K. Economic Merit in Further Improvement of Rural Graveled Roads in Story County

The estimated increase in annual costs per mile which would be involved in changing graveled roads to bituminous roads was made after consul-

tation with the county engineer. It represents his judgment as to the increased investment per mile which would be required to bring such mileage up to farm-to-market standards under present federal-aid legislation, with an added estimate of the investment cost per mile for an intermediate type of surfacing of a bituminous or soil-cement character.

The increases in annual costs per mile are shown in Table 51.

Table 52 presents the estimated gross savings to vehicle users that would result if selected stretches of graveled road in Story County were improved to bituminous surface. A net saving in vehicle operating costs would occur with this change for those roads having a ratio of gross savings to increased annual cost of more than 100%.

TABLE 52. ESTIMATED SAVINGS IN VEHICLE OPERATING COSTS FOR SPECIFIC STRETCHES OF GRAVELED ROAD IN STORY COUNTY IF IMPROVED TO THE INTERMEDIATE STAGE

Location of road	Length, miles	Annual traffic per mile*	Annual savings per mile†	Ratio of gross savings to increased annual costs, percent
PRIMARY RURAL ROADS				
Story City to Roland	5.21	187,610	$1,688	268.8
Slater to Highway 211	7.20	113,515	1,022	162.7
McCallsburg to Zearing	3.77	99,280	894	142.4
Highway 210 from Highway 211 to Trunk B	6.50	64,605	581	92.5
COUNTY TRUNK ROADS				
Trunk D from Roland to McCallsburg	4.84	146,730	1,321	210.4
Trunk D from Zearing to Marshall County	4.00	109,500	986	157.0
Trunk H from Trunk E to Highway 30	4.00	90,885	818	130.3
Trunk K from Trunk E to Highway 65	3.25	82,885	746	118.8
Trunk B from Trunk E to Highway 30	4.00	68,255	614	97.8
Trunk G from Maxwell to Marshall County	9.75	61,320	552	87.9
Trunk H from Nevada to Trunk Y	6.50	56,940	512	81.5
Trunk B from Highway 30 to Iowa Center	6.80	56,210	506	80.6
Trunk H from Trunk D to Trunk E	6.00	55,480	499	79.5
Trunk Y from Cambridge to Marshall County	3.60	53,655	483	76.9
Trunk E from 1 mile east of Ames to Trunk H	9.00	45,990	414	65.9
Trunk C	5.50	42,340	381	60.7
Trunk B from Hardin County to Trunk E	8.40	36,135	325	51.8
Trunk A from Highway 69 to Story City	6.00	29,930	269	42.8
Trunk E from Trunk H to Marshall County	12.00	22,995	207	33.0

*Estimated traffic per mile is based on the 1936 and 1937 studies of the Highway Planning Survey.

†Based on estimated savings in shift from gravel to bituminous surface of 0.9 cents per vehicle-mile. Source: Moyer, R. A. Economic Selection of Projects and Self-Liquidating Facilities. Short Course in Highway Economics, Iowa State College. January, 1940. Mimeographed.

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