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RELATIONSHIPS.

Michigan State University, Ph.D., 1976
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THE MICHIGAN MOTOR VEHICLE HIGHWAY FUND:
AN ECONOMIC ANALYSIS OF STATE
AND LOCAL RELATIONSHIPS

By

Richard William Willits

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ABSTRACT

THE MICHIGAN MOTOR VEHICLE HIGHWAY FUND: AN ECONOMIC ANALYSIS OF STATE AND LOCAL RELATIONSHIPS

By

Richard William Willits

This study expands the analysis of state highway finance beyond the limited analysis usually conducted after a cost inventory of state highway deficiencies is completed. Two issues are examined for Michigan highways: (1) the choice of the type of taxation to finance highways and (2) the geographic distribution of highway expenditures relative to resources. Income taxation and motor fuel taxation are compared as typical ability-to-pay and benefit-based taxes respectively.

The motor fuel tax is examined with respect to geographic location of collections, stability of revenue, effect on use of the highway system and short-term incidence of the tax. A flat-rate income tax is the primary taxation alternative examined. Other taxes that receive limited examination are the property tax, congestion tolls and weight tax.

Results of the study suggest that the choice between income or motor fuel taxation depends on the goals desired for the tax system. In financing highways, motor fuel taxes grow with the increase in vehicle use, offer a mild fuel conservation effect and are easily earmarked. Income taxation offers greater budget flexibility, more progressive taxation as related to income and responsiveness to changes in the price level. Other taxes examined are found to be useful only for meeting specific highway finance problems. Property taxes are most useful for financing lightly traveled roads that are designed to serve local property. Congestion charges are useful only in the limited areas of the state which suffer severe congestion. These charges pose collection and income-distribution problems. Weight taxes offer a means of charging heavier vehicles for the more costly paving they require.

The geographic distribution of the costs of building and maintaining the highway system to uniform standards are compared with the geographic distribution of motor fuel tax collections and with income tax collections. The tax rates necessary to meet the total cost of the uniform standards are found to be approximately twice the amount of revenue currently available for highway purposes in Michigan at the state and federal levels. The motor fuel tax results in subsidization of less heavily traveled highways by more heavily traveled highways in both urban

and rural areas. The income tax results in cities subsidizing county highways.

Highway expenditures for 1972 were regressed on income, costs of building and maintaining highways and highway system characteristics, using cross-section data for all states. The results showed that Michigan highway expenditures were below the national average when corrected for the above mentioned factors. These highway expenditures were still slightly below the national average when the gasoline tax increase of 1973 was included. The costs of building and maintaining the highway system to uniform standards were constrained using the regression and current tax rate information.

The distribution of motor vehicle highway funds by existing state formula to local jurisdictions is compared with the distribution based on the costs of meeting the standards, motor fuel consumption and the income tax base. The existing formula shows no clear urban or rural bias in relation to highway costs. However, the proxies used currently to distribute highway funds frequently fail to meet either highway costs or highway use. Highway costs tend to be somewhat less concentrated in highly traveled areas than use. Direct measures of costs and use provide clearer measures of highway financing requirements than do the proxies for these items.

To My Parents

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CHAPTER I

INTRODUCTION TO THE PROBLEM

Background

Michigan and other states have developed over the past 60 years a system of highway finance based primarily on user revenues collected by the state governments. Another general characteristic of highway finance is the administration of these monies through a special fund for highway purposes. These revenues are also augmented by federal aid which is derived largely from user revenues deposited in the Highway Trust Fund. Most federal aid goes to the state highway department where it is either spent on the state highway system or directed to specific projects on the highway systems of counties and cities. Local revenues, often from general taxation sources, are added to state and federal funds. Locally-raised revenues are especially important for minor and local highways and streets. The system of finance outlined in this paragraph is used in most states, including Michigan.¹ It has been

¹Federal Highway Administration, Highway Statistics, 1971 (Washington, D.C.: Government Printing Office, 1973), Table MF-3, p. 11. In 1971, only 24 states allowed the use

in effect in its present form in Michigan since Act 51 of 1951 established the Motor Vehicle Highway Fund and its allocation formulae, but some of its characteristics, such as earmarked gasoline taxes, date back to the 1920s.¹

Under the provisions of Act 51 of 1951 as amended, revenues raised from motor fuel taxes and motor vehicle weight taxes are placed in a special fund earmarked for highway purposes. A 1973 amendment to the Act placed one-half cent of the gasoline tax into a special fund for public transportation projects. The remainder of the fuel and weight taxes in the Motor Vehicle Highway Fund is distributed to the state and local government for highway purposes. Currently, the state receives 44.5 percent, counties 35.7 percent, and cities and villages 19.8 percent of user taxes. The county, city, and village shares are distributed to individual units on the basis of vehicle registrations, road mileage, and population.

As a part of the administration of highway programs, the states study the highway construction requirements and the taxes needed to finance construction and maintenance. Such studies tend to be shaped and confined by existing practices in highway finance. This was the case with

of some highway motor fuel tax receipts for non-highway purposes. Only five states deposit these funds in the general fund, making them subject to general budget policy.

¹John T. Rice (Ed.), Michigan Statutes Annotated (Chicago: Callahan & Co., 1971), Act 150, 1927, Sections 7.291-7.315, pp. 606-30.

Michigan Highway Fiscal Analyses, 1970-1990, undertaken by Wilbur Smith and Associates, which is the most recent study available in Michigan. It accepted the present earmarked taxes and only slightly modified the existing distribution formulae. While most, if not all, of these studies examine such important questions as cost allocation among vehicles, they ignore the impact of choosing an alternative combination of taxes for financing highways, roads, and streets. In addition, these studies frequently fail to incorporate available cost and demand data into the allocation formulae for state highway funds, although such studies are used in the development of the distribution system and use-proxies are utilized in current distribution formulae.¹

This dissertation seeks to examine several questions outside the traditional highway study. The study focuses on the geographical allocation of highway funds, the related problems of taxation and the distribution formulae for highway funds. The geographical allocation of highway

¹Current practice in Michigan is to use the use and cost data from highway studies as a secondary consideration in a bargaining process to divide the available highway funds among the state highway department, the counties and the cities. This is important because all three operate politically separate highway systems. Secondly, proxies for highway "need" are used to distribute money to individual counties and cities. In the case of counties, these proxies are vehicle registrations, mileage and rural population, while cities and villages use mileage and population. Ease of measurability is the major factor in the choice of proxies.

funds is also compared with the intercounty differences in income and highway costs.

Statement of the Problem

The central problem examined in the dissertation is to inquire into the effect on the intercounty allocation of highway resources of alternative tax bases and of alternative distribution formulae. The goal is to calculate, for selected alternative tax bases and distribution formulae, which counties will be major losers or gainers on an annual basis.

In order to complete such a project, a step-by-step procedural development is required. The following paragraphs outline this procedure.

First, an initial chapter is presented which outlines the theory and development of the whole of the study. This chapter also includes an algebraic outline of a framework for evaluating the formulae.

The second step is to distribute highway funds among the counties of the state according to amounts based upon the alternate tax bases. The alternate tax bases are chosen because they have been suggested by public finance studies as possible alternative sources of highway finance. The comparison of the gasoline tax base and the personal income tax base will be the primary alternatives to be examined. Minor digressions will discuss the congestion toll as it would relate to the income and user taxes, and

the property tax as it is currently in use on local highway systems. The weight tax is given limited consideration because it, too, is also used currently. The gasoline tax base is derived from highway use in each county and reflects local use of the highways. The personal income tax base is emphasized because it is the basic source from which nearly all taxes must be paid and it is the most viable alternative to highway user taxation.

The third step will examine several economic effects involved in the choice of an alternative tax base:

- a. The comparative rate of growth of the alternative tax bases will be studied. This factor is important, because user charges are earmarked, and this introduces a rigidity which could result in either the over- or under-financing of highways.
- b. The effects of existing user charges on highway use will be reviewed. This part of the study will use existing information on the price elasticities of gasoline, oil and automobiles.
- c. The effects of the alternative taxes on income distribution will be studied. This part of the research will rely on existing incidence studies and will concentrate on the probable impact of alternative taxes on income redistribution in Michigan.

The fourth step in the study is the distribution of construction and maintenance cost data to each county.

This cost information is derived in such a way as to meet uniform construction standards based upon use of the highway. These data are used to show the reallocation of resources required to meet such cost standards.

For the fifth step, the intercounty allocation of resources will be calculated by distributing the highway funds in such a manner as to meet the highway costs. The effect on intercounty allocation of using either the gasoline tax base or the personal income tax base will be shown.

The sixth step is to constrain the cost data to reflect current levels of taxation. The method of constraint will be to calculate the average level of support for highways nationally. The average will be adjusted to reflect the characteristics of Michigan highways, such as the use of highways in Michigan as compared to other states. The costs constrained by this statewide average will then be distributed to each county and the effect of meeting these costs will be calculated as in step five.

Finally, the results of distributing highway funds so as to meet the projected highway costs as well as the constrained highway costs, as calculated in steps five and six, will be compared with the current distribution of Motor Vehicle Highway Fund monies. This will indicate how well the current highway fund distribution compares with the costs of building a highway system based upon the uniform cost standards, with the current use of highways in

each county, and with the intercounty distribution of income.

From the above procedural steps, the dissertation will show the geographic distribution of resources resulting from current law as compared to meeting the uniform cost standards. This will tell whether the current traffic demands, urban traffic needs, or rural traffic needs are being served. Such comparisons can easily be made by calculating which counties have the highest percentage of their highway needs met, as measured by the uniform cost data, by the current distribution formulae. Also compared will be the effects of income tax versus user charge financing on the distribution of highway costs.

Chapter II will outline the theory and development of the entire study. The chapter contains three parts. Part I covers the choice of tax bases by giving greater detail on the distribution of tax bases and the economic effects of the choice of tax base (essentially steps two and three above). Part II provides more detail on the costs of building a statewide uniform system and on constraining those costs (largely indicated in the fourth and sixth steps). Part III outlines the framework for evaluating the formulae which relate the cost information to the tax information, and suggests possible conclusions from the analysis.

CHAPTER II

STRUCTURE OF THE STUDY

Part I--Comparison of Tax Bases

Part I of this study is an examination of alternative tax bases that could be used to finance highways. The purpose of such an analysis is to compare some of the strengths and weaknesses of benefit-based user charges with general taxes. The taxes are compared on the basis of their allocative and distributive effects.

In order to determine the allocative effects of a tax base among governmental units, the amount of a tax base that is located in each county must be determined. This is necessary in order to show the amount of revenue that could be raised in a given county to meet highway costs with a uniform statewide tax rate. This information is also needed for the calculation of the intercounty distribution of highway funds in the latter portion of the study. Without knowledge of the geographical distribution of the tax bases being compared, it would be impossible to measure the intercounty distribution of highway funds caused by any highway fund distribution formula.

The second consideration in evaluating the allocative effects of using a given tax base for highway finance is to estimate the effect that such taxation will have on the use of the current highway system. This is of importance because congestion frequently develops on highways, imposing a new cost on the motorist and causing pressure to expand the transportation system. If a motorist uses a roadway at a time of congestion, the user imposes a delay on both himself and on all others using the highway at that time. However, on a highway carrying a vehicle load well below its engineered capacity, an added vehicle imposes negligible congestion costs.

Several prominent economists have supported the use of highway user charges to control congestion.¹ These economists argue that congestion costs on heavily-traveled urban roadways greatly exceed current user charges. They also argue that congestion cost is a major marginal cost in highway use. Marginal cost in this case refers to the added cost of an additional vehicle using the highway. These writers support equating the price, i.e., taxes, paid by the motorist to this marginal cost. This argument

¹ Among proponents of the congestion tax approach are: James M. Buchanan, "Pricing of Highway Services," National Tax Journal, Vol. 2, No. 2 (June, 1952), 98-107; A. A. Walters, "The Theory and Measurement of Private and Social Costs of Highway Congestion," Econometrica, Vol. 29, No. 4 (October, 1961), 676-99; and Robert Dorfman (Ed.), Measuring Benefits of Government Investment (Washington, D.C.: The Brookings Institution, 1965), pp. 231-91.

further maintains that in a competitive economy such pricing leads to more efficient highway use. This is developed from the idea that one vehicle entering a congested highway imposes delay on other vehicles using the highway. By charging for this delay, the vehicle operator is forced to consider the delay imposed upon other vehicles. In addition, motorist response to the congestion tolls would give better data on the value of travel time for use in making decisions on highway expansion.

In this study, each user tax is analyzed with a view to the effect that taxes levied upon such a base would have on congestion. This is done using estimates of price elasticity for gasoline and oil calculated by other writers. Nonuser taxes will, of course, have no direct price effects on the use of the highway system.

Congestion is estimated by applying the hourly traffic flow summary data to the 1970 average daily total traffic counts published by the Department of State Highways. The hourly data are derived from permanent traffic counting stations on the state trunklines and studies of hourly peaks carried out in selected cities. The reduction in speed caused by the level of congestion can be calculated using tables developed from traffic flow studies and

summarized in the Highway Capacity Manual, 1965.¹ The amount that speed is reduced indicates the time delay for each vehicle on the length of road.

The study of congestion outlined above contains a number of limitations. First, the true value of time differs for individual drivers and is impossible of determination for many drivers. Indeed, only commercial vehicle drivers' time is capable of easy evaluation. Secondly, moderate amounts of congestion delay are often designed into a given highway simply because a level of congestion is estimated to be less costly than further construction. Lastly, congestion frequently results from emergency conditions or from isolated bottlenecks in the highway system, while available data allow only for the calculation of average levels of congestion.

A final characteristic of the tax base that influences allocation is the rate of growth of the tax base. The rate of growth of the tax base is of importance because of the inertia of political bodies to adjust a tax rate to changing circumstances. It is often argued that highway building was encouraged in the past because its earmarked user tax base grew faster than general taxes.²

¹Highway Research Board, Special Report 87--Highway Capacity Manual--1965 (Washington, D.C.: 1965), Chapters 3, 9, and 10.

²For example, see Elizabeth Deran, "Earmarking and Expenditures: A Survey and a New Test," National Tax Journal, Vol. 17 (December, 1965), 354-61.

A comparison of the rate of increase of each tax base over a period of years is the basic test of the ability of the tax base to supply revenue. Comparison of alternative rates of growth of tax bases yields a comparison of user tax base growth with the growth of non-user tax bases. Highway gasoline consumption is used as a measure of growth in highway use and of one alternate tax base. Yearly rates of growth are compared for the property tax base, vehicle registrations and, particularly, income. Income as a base is especially important because it is the flow out of which most taxes must be paid. This portion of the study answers the question of whether user taxes in fact have a faster growing base than income or property taxes.

After completing the analysis of the allocative effects of alternative highway tax bases, the study turns to the distributive effects of alternative taxes. The impact of alternative taxes on the distribution of income are secondary issues in this study, and their study will consist largely of a survey of the literature. Mention is made of the distributive effects because such effects cannot be ignored in a program which involves more than 1 percent of the personal income of the state and makes up 13.6 percent of total state-level tax collections in Michigan.

The primary alternative tax bases analyzed under the above criteria are the motor fuel and the personal income

taxes. Property taxes and weight taxes are given more limited consideration but are included because of their current use. Congestion tolls are given minor consideration. The motor fuel and weight tax bases are the currently used taxes for state-level highway finance. Personal income is included because it is the source of most taxes and is a good indication of the effect of using a general tax source. The property tax is given less consideration because it is used only at the local level in highway finance. Lastly, congestion tolls are included mainly to develop the limitations of this type of highway finance on the allocative and distributive issues outlined above.

Part II--Cost Factors and Highway Expenditures

The amount of taxation for highway purposes and the distribution to various geographical areas of money for highway construction and maintenance are developed in this section of the study. Three possible methods of distributing highway monies are examined. They are described in the following subsections.

Cost Factors

The first method of distributing highway monies is through the calculated costs of upgrading and maintaining the highways at a given level of engineering standards through 1990. These standards have been developed by the American Association of Highway Officials and are modified

for local conditions in Michigan. The standards are based upon the amount and type of traffic the highways are expected to carry. These standards were converted to dollar values by using cost factors for urban and rural areas. The resulting costs of meeting these standards were summarized by geographical areas.¹

The cost data developed as described above gives the 1970 cost of meeting a set of uniform standards across the state. The standards were developed from engineering tests for safety and durability of construction. This method of distributing highway funds guarantees that each area receives money equal to its costs of meeting the engineering standards if the costs are fully funded.

Constrained Cost Factors

The engineering standards used in the calculation of costs for the 1970 Needs Study were very high. The standard applied incorporated the best engineering and safety knowledge available. The result was that costs ran higher than available funds. This requires some method of constraining expenditures for highways to levels reflecting available revenues.

The determination of the amount that citizens are willing to spend on highways is a difficult problem. Most

¹Wilbur Smith and Associates, Michigan Highway Needs Summary 1970-1990 (New Haven, Conn.: December, 1972), pp. C-1 to C-21.

benefits of highway building and maintenance accrue initially to motor vehicle users. Relying on this relationship, highway planners construct the highway system on the basis of expected traffic flow. However, individual vehicle operators can operate on highways with lower engineering standards and thus lower costs simply by enduring somewhat increased travel time and a slight increase in vehicle wear.

The only information on the amount that citizens are willing to spend on highways is derived from the political process and is reflected in current expenditures. This expenditure information can be correlated with variables which influence highway expenditures in each political unit. In this way it is possible to adjust the level of expenditure to the value that would be expected if expenditures in Michigan respond to these variables as do expenditures in other states. This method of deriving expenditures allows adjustments for characteristics that may influence the demand for highway services.

More specifically, data from the 50 states on highway expenditures are correlated with characteristics from those states that theory or institutional practice tells us would influence highway expenditures. The function derived from this calculation can then be used to estimate how much Michigan would have spent if it had operated as an average state. Independent variables for the function would be chosen to reflect the following factors: income available for the purchase of highways,

comparative quality of the highway system, growth of the user population, availability of federal aid, and difficulty of providing the system in each state.

An expenditure function of the type described in the preceding paragraph can be used to determine the average level of expenditure on highways for a state with a road system similar to Michigan's. The function can serve to test the hypothesis that Michigan has higher than average expenditures because of the importance of the automobile industry in the state. The total expenditure figure derived from the function described can be distributed to each geographical area of the state on the basis of the percentage that the costs, as calculated earlier in the 1970 Needs Study, are of total costs.

Data to calculate the overall average level of expenditures must come from a comparison of the 50 states. Most of the data can be drawn from the U.S. Census of 1970¹ and the publication Highway Statistics.²

These data can be supplemented by expenditure data for cities and counties within Michigan for local streets and roads. The local expenditure data can give much

¹U.S. Department of Commerce, Bureau of the Census, Census of Population, 1970, General Social and Economic Characteristics (Washington, D.C.: Government Printing Office, 1972).

²U.S. Department of Transportation, Federal Highway Administration, Highway Statistics--1970 (Washington, D.C.: Government Printing Office, 1971).

information on local willingness to support these roads because the funds are often raised by a direct vote of the people. Information derived using county data can be used to calculate average local support for county local roads and for city streets.

The data for the expenditure functions can be analyzed by regression analysis. The regressions are fit to cross-section data and give an indication of the major expenditure determinants. Such a function offers a method for summarizing the expenditure information. In addition, it provides a basis for evaluating the effect of a given expenditure determinant.

It should be noted that the regression technique has several limitations. The expenditure functions as outlined above are based upon a fixed period of time. They are valid only in the range of the variables at the time they are fit. A sharp shift in technology or of external economic forces could shift these relationships out of their present values. Another limitation is the fact that present expenditure functions are tied to existing institutional patterns, including federal trust funds, state trust funds, and user taxes. While the expenditure functions can consider some of these factors, it is not possible to isolate specific political patterns in each state that may influence funding levels.

Costs Constrained by Local Resources

In this approach, the current highway taxes are taken as given and distributed to each county in the proportion that they were raised. This exercise shows the percentage of costs, as calculated in the 1970 Needs Study, that can be met using the statewide user tax rates and the local share of the base. This shows the effect of using a formula that provides for no redistribution of funds among counties.

This exercise can be used as a point of comparison to show the intercounty allocative effects of distributing highway funds according to cost factors. It also illustrates the problem that remote rural areas face from the cost of bridging large distances which are lightly traveled and which contain few taxable assets and low incomes. Dense urban areas also face the social and economic costs of relinquishing land for highway building, since they must disrupt current use patterns on valuable land.

Part III--Relationship Between the Base Costs and Expenditures

The third section of this study summarizes the information developed in Part I and Part II of this chapter. It also seeks to show the effect that the choice of a given tax base or of meeting a given level of costs has on the intercounty allocation of highway funds. These

allocations can then be compared to the current allocations in each county.

A simple formula may be used for summarizing the procedure to be used. The formula was developed to show the allocation of resources required to provide a uniform level of services within the state. It is original in its definition of variables and application to highway finance, although the idea of equalizing formulae in intergovernmental relations is well developed.¹

The formula is written as follows:

$$E_i = \alpha N_i - \gamma V_i \quad \text{where}$$

E_i = net transfer (positive or negative) of aid to county i.

N_i = costs in county i for highway construction and maintenance developed from the use of uniform engineering standards.

V_i = tax base in county i being used to finance the highway system. Several different tax sources are considered to finance highways.

α = the proportion of costs met statewide, a policy parameter reflecting current decisions.

γ = the parameter representing the tax rate that must be applied to any given tax base to meet the level of highway expenditures estimated by α and N .

¹For earlier work in designing equalization formulae with a different emphasis, see National Bureau of Economic Research, Public Finances, Needs, Sources and Utilization (Princeton: Princeton University Press, 1961), particularly pp. 97-135.

The formula states that the net gain or loss for a county under a given choice of tax base equals the difference between the two terms in the above formula. This difference equals the cost of providing construction and maintenance, adjusted by a parameter which reflects the percentage of these costs that will be met by the community, minus the tax base times the tax rate. The formula is very flexible. For example, α and γ may be statewide averages or individualized so as to differ for each county.

The formula can be given greater clarity by outlining its uses. Many combinations of tax bases, levels of spending and costs can be compared by use of the formula. This study compares both the current user tax base and the personal income base in the formula. This enables one to compare the intercounty allocation effect of the choice between user taxes and a personal income tax.

In distributing money raised from these tax bases, consideration is given to ways to incorporate information on the supply and demand for highways. This is the purpose of Part II above, and the alternatives tested are outlined again here. One alternative is to use the costs calculated by the 1970 Needs Study at full value. This approach guarantees a highway system based upon uniform standards for each level of traffic flow. In the notation of the formula, N_i equals total costs of meeting the standards in county i and α is equal to one. For the portion to be met by centralized finance, the tax rate is calculated by

setting the total costs to be met by centrally raised taxes equal to the total tax base times the rate. The tax rate is then given by dividing total costs by the total base. There is now sufficient information to calculate the gain or loss for each county in the system.

Under the program for constraining the costs of the system developed in the 1970 Needs Study, α is calculated by taking total expenditures as derived by the expenditure function divided by total costs. The formula can then be used in a way very similar to that developed in the preceding paragraph.

The formula can be further modified to incorporate information derived from local governmental expenditures to finance local road building. This information can be incorporated into an average that enables local units to provide a uniform level of service on these secondary roads.

The final method of dividing the funds uses N_i as the costs from the Needs Study but uses the current tax rate in use in the state. This indicates the percentage of costs that can be met using the current taxes and returning them to the county where earned. This approach uses a user tax base. It is designed to illustrate the ability of the current system to support itself on current revenue.

The completed analysis gives a measure of the allocative effect of choosing a given tax base. It shows the intercounty redistribution needed to meet a uniform set of service standards across the counties of this state.

The study also compares the level of highway funding in Michigan to that in other states.

The study of alternative tax bases gives information on the allocative and distributive effects of income and user taxes. This is of current importance since slowing growth of user tax receipts in recent years (Michigan suffered an actual decline in 1974) and urban congestion problems are raising challenges to current highway finance methods. The study compares local highway costs to local resources, and compares state spending on highways to other states by regression analysis. This information will be useful in examining the adequacy of highway finance as presently constituted. The study can be used as a basis for suggesting changes in the distribution of state highway monies so as to insure greater uniformity of service levels.

CHAPTER III
INTERCOUNTY ALLOCATION OF ALTERNATIVE
TAX BASES

Purpose of the Chapter

This chapter describes the possible use of several alternative tax bases for Michigan highway finance and illustrates their geographic distribution within the state. The tax bases to be examined are: (1) the gasoline tax, (2) the weight tax, (3) the income tax, (4) the property tax, and (5) the congestion tax. In developing this chapter, a brief statement of the justification for using each tax base is included. Then each base is defined as to the items that are included in the base. The base is geographically distributed among the counties, allowing a comparison of the allocation to each county under each of the several tax bases.

The work to be conducted in this chapter is important for a number of reasons. One purpose is to determine the distribution of possible tax resources for comparison in future chapters with the distribution of highway costs. This comparison is necessary to evaluate in later chapters

the extent of intercounty reallocation of tax resources by selected highway distribution formulas to meet highway building and maintenance costs. A second purpose is to determine the effects on geographical distribution of the taxes if a new revenue source, particularly the income tax, is used to finance highways. This has current importance because relatively slow user tax growth and rapidly rising costs have caused local governments to look to alternative highway finance methods. In addition, general taxation for financing highways has been suggested for reasons of budgetary control,¹ equity, the "need" for subsidy or the public good nature² of highway services.

User Charges

Michigan currently raises almost all state-level highway funds from two user taxes. These taxes are the motor fuel tax and the weight tax. Both are based upon the benefit principle. Tax payments are held to be proportional to the benefits received by motor vehicle users. Since these taxes are used to support highway construction and maintenance, the benefit principle is applied by distributing these costs to each vehicle type. Both taxes have higher charges for heavier vehicles, which is held to be

¹Walter W. McMahon and Case M. Sprenkle, "Earmarking and the Theory of Public Expenditure," National Tax Journal, Vol. 25 (June, 1972), 229-30.

²A. A. Walters, The Economics of Road User Charges (Baltimore: Johns Hopkins Press, 1968), pp. 9-22.

appropriate because heavier vehicles require more expensive reinforced structures and pavements.

The motor fuel tax is levied on all motor fuel used for highway purposes. It is levied on gasoline, diesel fuel and liquid petroleum gas. This tax provides payment for highway use in proportion to the use of the highway by the vehicle. The base used to distribute this tax among the counties of the state is the motor fuel consumed (in gallons) in each county. The amount of motor fuel consumed in each county is calculated from the annual vehicle miles driven in each county in the state. Annual vehicle miles for each county are developed by summarizing 1970 traffic count data¹ from the data base of the 1970 Needs Study. The annual vehicle mile data were totalled for all highways in each county. The annual vehicle miles were then converted to gallons by using the statewide average of vehicle miles per gallon of motor fuel. This statewide average is 13.65 miles per gallon. This figure was derived from using gallons of motor fuel obtained from tax collections and vehicle miles derived from summarized traffic count data.

The weight tax is a registration fee based upon the weight of the vehicle. In Michigan it currently ranges from a minimum of \$12 for passenger cars weighing less than 2,200 pounds to \$1,010 for trucks with gross weights in

¹Michigan Department of State Highways, unpublished data base of the 1970 Needs Study.

excess of 130,000 pounds. The weight tax is paid as a lump sum payment for the use of the roads each year, and is paid in the county in which the vehicle is registered.

Vehicles may be driven through many counties even though they are registered in one county. In order to take this into consideration, the collections from the weight tax were distributed in proportion to the vehicle miles driven in each county. The distribution among counties was further adjusted to consider the distribution of commercial vehicles, which have a greater weight.

Table 1 is designed to show the effect of allocating current registration fees by the county of registration and by the county of vehicle use. In designing Table 1, registrations other than commercial vehicles were distributed on the basis of vehicle miles driven in each county by such vehicles. Commercial vehicle registration fees were distributed on the basis of commercial vehicle miles driven on the trunklines of each county.¹ Data limitations prevented a finer breakdown of vehicle sizes. Table 1 compares actual registration fee (weight tax) collections in each county with the amount that would be earned through charges of the same amount on the use of the highways of that county.

¹These data were developed by the author by summarizing Michigan Department of State Highways traffic count data.

Table III-1.--Comparison of the Taxes Based upon Weight Distributed by
County of Collection and by County of Vehicle Use
(Amounts are in Thousands of Dollars).

County	(2) Registration Fees Distributed Accord-		Differences (2)-(1)
	(1) Registration Fees by County of Collection	ing to Highway Traffic Use	
Alcona	\$ 119.6	\$ 159.4	\$ 39.8
Alger	111.5	158.6	47.1
Allegan	958.9	1,172.6	213.7
Alpena	502.9	319.2	-183.7
Antrim	172.9	282.0	109.1
Arenac	159.5	326.8	167.3
Baraga	124.3	180.8	56.5
Barry	450.2	473.0	22.8
Bay	1,747.8	1,686.0	-61.8
Benzie	130.6	218.5	87.9
Berrien	2,560.3	3,141.9	581.6
Branch	636.5	683.4	46.9
Calhoun	1,943.7	2,842.9	899.2
Cass	604.8	735.7	130.9
Charlevoix	232.4	220.1	-12.3
Cheboygan	246.4	377.7	131.3
Chippewa	381.8	427.8	46.1
Clare	236.1	447.5	211.4
Clinton	543.4	1,052.0	508.6
Crawford	93.9	253.5	159.6
Delta	595.2	492.9	-102.3
Dickinson	401.3	240.5	-160.8
Eaton	956.2	1,355.0	398.8
Emmet	309.6	285.2	-24.4
Genesee	5,971.4	5,130.2	-841.2
Gladwin	182.3	237.4	55.1
Gogebic	281.6	247.0	-34.6
Grand Traverse	679.0	347.3	-331.7
Gratiot	713.6	645.6	-68.0
Hillsdale	589.0	612.4	23.4
Houghton	399.4	466.5	67.1
Huron	563.3	511.0	-52.3
Ingham	3,458.0	3,147.2	-310.8
Ionia	612.9	845.2	232.3
Iosco	308.7	303.3	-5.4
Iron	209.0	226.5	17.5
Isabella	511.5	628.7	117.2
Jackson	1,923.4	2,614.2	690.8
Kalamazoo	2,627.8	2,930.4	302.6
Kalkaska	81.6	200.2	118.6
Kent	6,760.0	4,775.5	-1,984.5

Table III-1.--Continued.

County	(2) Registration Fees Distributed Accord-		Differences (2)-(1)
	(1) Registration Fees by County of Collection	ing to Highway Traffic Use	
Keweenaw	\$ 22.5	\$ 70.8	\$ 48.3
Lake	73.8	204.8	131.0
Lapeer	649.3	787.1	137.8
Leelanau	146.9	256.5	109.6
Lenawee	1,205.8	1,197.8	-8.0
Livingston	722.6	1,619.0	896.4
Luce	94.8	98.1	3.3
Mackinac	114.5	342.9	228.4
Macomb	7,510.5	5,772.9	-1,737.6
Manistee	331.7	333.5	1.8
Marquette	730.2	753.8	23.6
Mason	311.5	310.3	-1.2
Mecosta	334.7	405.5	70.8
Menominee	413.0	379.5	-33.5
Midland	839.6	824.2	-15.5
Missaukee	102.3	147.8	45.5
Monroe	1,708.0	2,914.5	1,206.5
Montcalm	597.2	587.5	-9.7
Montmorency	85.6	96.7	11.1
Muskegon	2,184.5	1,720.2	-464.3
Newaygo	445.2	439.8	-5.4
Oakland	12,026.5	11,230.6	-795.9
Oceana	249.0	313.6	64.6
Ogemaw	209.1	262.6	53.5
Ontonagon	139.1	219.7	80.6
Osceola	229.2	399.9	170.7
Oscoda	84.0	140.4	56.4
Otsego	167.2	241.7	74.5
Ottawa	1,979.3	1,470.5	-508.8
Presque Isle	163.9	278.5	114.6
Roscommon	178.0	397.6	219.6
Saginaw	3,030.7	2,662.1	-368.6
St. Clair	1,694.6	1,472.7	-221.9
St. Joseph	795.2	935.9	140.7
Sanilac	587.4	568.5	-18.9
Schoolcraft	118.2	236.0	117.8
Shiawassee	866.9	906.0	39.1

Table III-1.--Continued.

County	(1)	(2)	Differences (2)-(1)
	Registration Fees by County of Collection	Registration Fees Distributed Accord- ing to Highway Traffic Use	
Tuscola	\$ 703.9	\$ 722.6	\$ 18.7
VanBuren	825.2	1,518.0	692.8
Washtenaw	2,563.5	4,258.4	1,694.9
Wayne	35,928.1	33,399.3	-2,528.8
Wexford	319.7	333.2	13.5

Sources: Column (1) Michigan Department of State, Registrations of Motor Vehicles, Titles, Operators, Chauffeurs, for Fiscal Year July, 1969 through June, 1970 (Lansing, 1970).

Column (2) Computed from data of Michigan Department of State Highways, Average 24 Hour Traffic Flow Map, 1970 and Average 24 Hour Commercial Traffic Flow, 1970.

In keeping with the convention used for the gasoline tax (that a user charge should be attributed to the county of use), registration fees are distributed according to column 2 for the purpose of comparing the geographic distribution of the taxes studied. Column 2 of Table 1 is based upon the miles driven by the vehicles. Any increased registration fee can be distributed in the same proportions as the current registration fees if the increases are proportional to current charges for all weights of vehicles.

In general, shifting weight tax collections from county of registration to county of use has the effect of crediting more money to rural counties and those with major trunklines. Losers are mainly populous counties with many vehicles registered in the county and the location of the home offices of trucking firms. A few smaller counties lose because they are the business center for a surrounding rural area.

The motor fuel tax base and the weight tax base distributed as described above, will be used in later chapters to calculate the intercounty allocative effect of alternative distribution formulae. The current distribution formula and distribution according to cost data will be the approaches studied.

General Taxation

The use of general taxes for financing highways as opposed to user charges is supported traditionally on two grounds. The first of these is the concept of nonuser benefits, while the second is the concept of highways as a public good.

Highway finance has long stressed the concept of nonuser benefits. These nonuser benefits normally are defined as land access and community service. The land access benefits consist of better transportation to local market centers and improved access to residences. Persons who share in the above benefits may desire to subsidize highway construction at a higher level than user charges earned on the highways would warrant. The subsidy is required because use of the highway alone would not warrant its construction, but the highway has a positive benefit-cost ratio when nonuser benefits are considered.

The community service function poses a somewhat similar rationale for a subsidy. The community as well as residents along the proposed highway would benefit from such services as school buses, fire protection and police protection. These vehicles are frequently the heaviest to use a highway and thus raise its construction and maintenance costs considerably. Highway policy in Michigan further supports a general tax contribution for local community service vehicles, because most community service vehicles are exempt from the weight tax and receive state gasoline

tax rebates. Administrative simplicity favors the nonuser subsidy as a method of expanding highway improvement, since different user tax rates for different parts of the highway are difficult to administer.¹ User charges are set so as to pay for the highway with an average amount of travel. Therefore, some less-used highways cannot pay for themselves. If the residents on the highway desire better service, they may use their local taxing powers to raise more money for improved service. Special assessments for highways are a specific example of this.

As the above paragraph explains, the reasons for a nonuser payment apply to highways which have relatively low use but favorable benefit-cost ratios. In Michigan, these are largely city streets used by local traffic and rural roads with a largely local travel pattern. Since most of the travel on these highways is local, no serious costs are imposed on motorists from other areas if the local citizens feel that benefits are not sufficient to warrant improving the road system. Currently, Michigan requires local highways to be supported by some local money, i.e., money that does not come from highway user charges. The legal requirements in Act 51 of 1951, as amended,² are a 50 percent match on local road construction and a 25 percent match on

¹Milton Z. Kafoglis, "Highway Policy and External Economies," National Tax Journal, Vol. 16, No. 4 (December, 1963), 416-25.

²John T. Rice (Ed.), Michigan Statutes Annotated, sections 9.1097(12) and 9.1097(13).

local bridge construction. Currently, most cities meet these requirements while many counties do not.

To represent the ability to provide local funds, the general property tax is selected in this study. It is selected because it is currently the only tax base available to Michigan counties, townships and villages, and is the primary tax base for Michigan cities. A second reason for selecting the property tax is the fact that local road improvement helps to raise land and building values. In this way, the property tax fits the traditional benefit pattern.

The tax base used for the property tax will be the current base in use in Michigan. This is a fairly broad base covering most residential, commercial and industrial real property, and industrial and commercial personal property. The property is valued at 50 percent of its market value according to statute.¹

The other major approach to the use of general taxation to support highways is based upon the view that highways are a public good. If a highway is constructed to carry the heaviest vehicles using the highway, damage from increased use is very minor. Highways then take on one of the characteristics of a public good. That characteristic arises when the use of the facility by one person does not decrease the ability of others to use the facility. Many

¹Ibid., section 7.27.

highways also have legal speed limits that make it possible for them to carry several hundred vehicles per hour without imposing any congestion delays.

Under the system described above, users would be charged only for the costs that they actually impose on the highway authority or on other motorists. Therefore, user charges would cover only the costs that are attributable to each additional user, and congestion taxes could be used for this purpose. Highways could then be placed in competition with other capital proposals submitted to the government. Those projects with the greatest excess of benefits over costs would be built.¹

Arguments in favor of the use of general taxes include: (1) eliminating losses of benefit to society because motorists are discouraged from using a road by a user charge greater than the marginal cost of providing the service; (2) allowing highway finance to be placed on an ability-to-pay rather than a benefit basis; and (3) placing highways under the same budgetary controls as other public works.

The above method of highway finance has not been used in the United States to any great extent. One problem of application is that general taxation would tax many persons who have little use for highways and who receive

¹Tillo E. Kuhn, Public Enterprise Economics and Transport Problems (Berkeley: University of California Press, 1962), pp. 166-76.

only minor direct benefits from them. Many persons would be forced to support highways that they would never use. Secondly, vehicle owners would be exempt from major capital costs of road building. This gives a subsidy to the trucking industry, since its right-of-way is paid for by the public, while railroads must pay for maintaining their right-of-way. This defense of general taxation can also be viewed as excessively short run, since it suggests charging only for those costs directly attributable to the use of the highway by a vehicle. These costs--congestion delay and highway wear attributable to vehicles--can be viewed as short-run marginal costs. However, the costs of constructing highways and maintaining them against weather damage constitute considerable long-run costs that are necessary to serve highway users.

In summary, this section has described several persuasive reasons for a nonuser share on at least some types of highways. The major reasons include low-volume roads that offer nonuser benefits warranting a subsidy and the transfer of a portion of highway finance to taxes based on ability to pay.

To determine the effect on the intercounty distribution of the tax burden by the use of an income tax to finance highway costs, an income tax base is distributed among the counties of the state. The base is a close approximation to the current Michigan tax base before exemptions or credits. The data base was developed by

starting with local area personal income as published in the Survey of Current Business.¹ This information was then adjusted by the author to remove the untaxed items of imputed rent, imputed interest, employer payments to fringe benefits and transfer payments. The imputed rent was attributed to each county on the basis of the value of owner-occupied homes in each county. Imputed interest was distributed on the basis of dividend and interest income. Employer fringe benefits were distributed among the counties in proportion to private payrolls. Transfer payments were also removed because they consist largely of social security, medicare, and welfare payments.

In addition, the portion of capital gains included in adjusted gross income had to be added into the tax base. Again, only a statewide estimate of these capital gains was available. They were distributed to each county on the basis of that county's proportion of the total number of families in the state with an income over \$12,000. This method was chosen because approximately 80 percent of capital gains accrued to families with income over \$12,000 in 1969.

The base for the personal income tax is distributed to place-of-residence. This is necessary because the place of earning income would distort the property income and

¹United States Department of Commerce, "Local Area Personal Income," Survey of Current Business, Vol. 54, No. 5 (May, 1974), pp. 10-13.

capital gains portions of the tax base. The total size of the tax base is calculated from calendar 1969 data so that it is comparable to the bases for motor fuel consumption, weight taxes and property taxes.

In the initial test of the distribution of income tax collections, the tax will be distributed among counties in proportion to the tax base in each county. This will facilitate the comparison of the distribution of each type of tax base. Secondly, such a distribution gives the exact distribution of a proportional income tax. The use of a proportional income tax does not constitute a policy recommendation, but is used to simplify the analysis and to reflect best the location of total taxable income.

A comparison of the distribution among the counties of Michigan is given for the four taxes discussed in this chapter in Table 2. This table compares the intercounty distribution of the motor fuel tax, the weight tax, the property tax, and the income tax. In order to compare the intercounty distribution of the different tax bases, a uniform statewide rate for each tax is assumed. Table 2 illustrates the distribution of a tax levied at a uniform rate on the entire base at a statewide level. This table also reflects the proportion of each tax base located in each county. For purposes of comparison, it was assumed that \$1 million was raised statewide by each tax.

Table 2 shows that both taxable property and taxable income are geographically more concentrated than

Table III-2.--Distribution of Alternative Tax Bases (Each Base Raising \$1 Million by a Proportional Tax) .

County	Motor Fuel	Vehicle Weight	Property	Personal Income
Alcona	\$ 1,363	\$ 1,300	\$ 1,342	\$ 436
Alger	1,288	1,293	773	476
Allegan	8,783	9,559	6,632	5,593
Alpena	2,927	2,602	3,642	2,532
Antrim	2,788	2,299	2,018	947
Arenac	2,863	2,664	1,267	788
Baraga	1,397	1,474	651	543
Barry	4,426	3,856	3,437	3,358
Bay	14,266	13,745	12,717	11,272
Benzie	2,147	1,781	1,264	692
Berrien	22,043	25,613	18,272	17,689
Branch	4,607	5,571	3,373	3,242
Calhoun	18,267	23,176	14,083	14,557
Cass	5,961	5,997	3,907	4,295
Charlevoix	2,065	1,794	2,472	1,303
Cheboygan	3,467	3,079	2,086	1,185
Chippewa	4,205	3,488	2,108	2,652
Clair	4,006	3,648	2,488	964
Clinton	8,576	8,576	4,017	4,933
Crawford	2,280	2,067	901	396
Delta	4,222	4,018	2,946	2,528
Dickinson	2,529	1,961	1,789	1,983
Eaton	9,420	11,046	6,772	7,761
Emmet	2,424	2,325	2,545	1,694
Genesee	45,361	41,822	54,851	53,377
Gladwin	2,260	1,936	1,329	968
Gogebic	2,441	2,013	1,416	1,359
Grand Traverse	3,497	2,831	4,403	3,574
Gratiot	5,120	5,263	3,858	3,549
Hillsdale	4,870	4,992	2,995	3,396
Houghton	3,537	3,803	1,657	2,126
Huron	4,786	4,166	4,655	2,909
Ingham	25,485	25,656	28,244	2,202
Ionia	6,039	6,891	3,666	9,055
Iosco	2,744	2,473	2,632	2,378
Iron	2,075	1,847	1,467	834
Isabella	5,752	5,125	3,096	3,454
Jackson	17,889	21,311	14,174	15,552
Kalamazoo	22,675	23,889	23,874	21,282
Kalkaska	1,760	1,632	676	348
Kent	40,490	38,931	42,836	42,878
Keweenaw	570	577	279	141
Lake	1,884	1,669	869	315
Lapeer	6,621	6,416	4,664	4,794

Table III-2.--Continued.

County	Motor Fuel	Vehicle Weight	Property	Personal Income
Leelanau	\$ 2,439	\$ 2,091	\$ 1,843	\$ 845
Lenawee	10,233	9,765	8,629	8,154
Livingston	11,157	13,198	7,229	6,639
Luce	873	800	428	527
Mackinac	3,002	2,795	1,365	662
Macomb	57,074	47,062	71,243	76,639
Manistee	3,170	2,719	2,328	1,487
Marquette	6,632	6,145	4,383	5,826
Mason	2,838	2,530	2,483	2,129
Mecosta	3,559	3,306	2,306	1,823
Menominee	2,939	3,094	1,791	1,746
Midland	8,080	6,718	11,387	7,249
Missaukee	1,353	1,205	869	518
Monroe	17,208	23,759	12,307	12,506
Montcalm	4,441	4,789	3,921	3,250
Montmorency	836	788	903	348
Muskegon	16,334	14,024	14,337	13,793
Newaygo	4,019	3,585	2,548	2,259
Oakland	105,710	91,554	122,798	139,000
Oceana	2,921	2,556	1,511	1,309
Ogemaw	2,626	2,141	1,617	727
Ontonagon	1,854	1,791	1,379	916
Osceola	3,667	3,260	1,655	1,018
Oscoda	1,648	1,145	753	218
Otsego	2,363	1,970	1,456	830
Ottawa	12,345	11,988	12,383	12,285
Presque Isle	2,678	2,271	1,512	864
Roscommon	3,749	3,241	2,370	692
Saginaw	23,060	21,702	25,709	24,502
St. Clair	13,149	12,006	16,027	12,392
St. Joseph	6,775	7,630	5,324	4,643
Sanilac	5,177	4,634	3,893	2,973
Schoolcraft	1,898	1,924	847	442
Shiawassee	7,523	7,386	5,440	6,981
Tuscola	6,927	5,891	4,883	4,498
VanBuren	9,158	12,375	5,404	4,690

Table III-2.--Continued.

County	Motor Fuel	Vehicle Weight	Property	Personal Income
Washtenaw	\$ 29,056	\$ 34,715	\$ 31,307	\$ 28,267
Wayne	256,442	272,277	298,541	316,604
Wexford	2,939	2,716	1,749	1,452

Sources: Motor fuel results developed from Michigan Department of State Highways, unpublished vehicle mile data; vehicle weight results developed from Michigan Department of State, Registrations of Motor Vehicles, Titles, Operators; Chauffeurs, for Fiscal Year July, 1969 through June, 1970 (Lansing, 1970); property taxes distributed according to data from Michigan State Tax Commission, memoranda on assessments and tax rates for 1970; and income data developed from U.S. Department of Commerce, Survey of Current Business and supplemental income reports.

is motor vehicle driving. The rural areas supply a higher percentage of the motor fuel and vehicle weight tax bases. This is derived from two causes. Rural residents drive greater distances because they must travel further to reach essential services. A more important cause is the existence of large numbers of visitors and part-time residents from outside the rural counties to these counties. The sharpest differences between taxes based upon personal income and on gasoline are found in resort counties that do not contain the urban service center for that region. Some examples are Kalkaska, Crawford, and Antrim counties in northern Michigan. Grand Traverse county, which is the service and marketing center for the Traverse Bay area, does not show the disparity between user charges and income or property taxes that other counties in the area show. Some counties receive large shares of the user charges because major trunklines are located within their boundaries. This influences such counties as Berrien and Calhoun on the main Chicago to Detroit route.

Table 2 gives a clear comparison of the relative amounts of taxable resources in each county for each tax base. It shows that shifting to reliance on personal income taxation would shift the burden of highway support toward urban areas, particularly the Detroit metropolitan area of Wayne, Oakland, and Macomb counties. Property taxation has a similar but less pronounced effect. Shifting from gasoline to weight taxes within the user

family would not have any great effect on the intercounty allocation of highway taxes.

Table 2 shows only the distribution of tax base for four taxes. It will be combined with cost data for improving each county's highway system in later chapters. Special attention will be paid to motor fuel taxation as the primary user charge and personal income taxation as an alternative tax system.

Congestion Tolls

Congestion tolls were mentioned earlier in this chapter, but they were not included in Table 2 because sufficient data are not available to calculate total congestion in each county. In addition, the congestion toll should not necessarily be set so high as to pay all highway construction and maintenance costs. The congestion toll has been suggested as a means of controlling highway congestion. The receipts from the tolls could be devoted to the general fund or toward easing the congestion. Efforts to ease congestion would cover mass transit as well as highway building. Mass transit frequently can ease congestion problems in high density urban areas at lower cost than highway building.

The congestion toll is supported as being efficient because it bases price upon the short-term marginal cost for congested highways. The marginal cost is the cost of congestion delay imposed by one vehicle on others using

that highway at the same time. It is argued that the cost of these delays in time may exceed all other costs of the type that increases with the increasing use of the highway. Underlying almost all congestion cost is the time cost of delay.

One method of measuring this delay is through comparison of the legal speed limits on a highway and the speed of traffic under heavy congestion. Table 3, which shows average speeds on certain major highways, illustrates the magnitude of these delays. Stretches of major highways are chosen in urban and rural portions of the state. The estimate of congestion is based upon the number of vehicles using a section of highway during a peak hour of the day. This estimate is determined by applying the average for the 200th high hour of annual traffic flow on major lower Michigan trunklines to the 1970 average daily total traffic flow on the state trunkline traffic count map. The 200th high hour is used on rural roads because it eliminates the very high short-term traffic counts found on some rural roads. It also is comparable to traffic counts on some urban freeways based on the number of vehicles in motion at the peak daily travel hour. The traffic count is converted to speed by relying on the tables published in the Highway Capacity Manual.¹ Using these data, speeds can be compared on high-congestion highways in rural and urban areas.

¹Highway Research Board, Highway Capacity Manual, pp. 245-337.

Table III-3.--Relative Congestion Delays on Selected Sections of Michigan Trunklines.

Road	County	Average Daily Total of Traffic ^a	200th High Hour Traffic Flow	Volume* Capacity	Average Speed in MPH
<u>Rural</u>					
I-75	Saginaw	24,500	1,987	.534	47
U.S. 23	Livingston	23,500	1,229	.331	52
I-94	Washtenaw	28,000	1,464	.394	50
I-94	Calhoun	24,000	1,255	.338	52
I-75	Monroe	30,000	1,569	.422	49
I-94	VanBuren	17,200	900	.242	54
U.S. 131	Allegan	11,700	612	.165	56
I-96	Ingham	18,000	941	.253	54
U.S. 27	Clinton	15,500	1,221	.328	52
I-96	Ionia	12,500	654	.176	56
I-96	Ottawa	14,000	732	.197	54.5
U.S. 27	Roscommon	9,345	1,040	.280	52.5
I-75	Otsego	6,600	735	.198	54.5
I-75	Chippewa	4,500	422	.113	57.5
I-75	Mackinac	3,658	343	.092	58
I-96	Rural Oakland	41,500	2,170	.389	50
I-94	Rural Wayne	47,000	2,458	.440	48.5
<u>Urban--Detroit Area</u>					
I-94	Wayne	156,000	2,886	1.443	Unstable <30
U.S. 10	Wayne	165,000	3,053	1.526	Unstable <30
I-75	Wayne	98,000	1,363	.733	43
M-39	Wayne	126,000	2,331	1.166	Unstable <30
U.S. 24**	Wayne	72,000	999	.750	53
M-1**	Wayne	66,000	916	.688	34

^aColumn derived from Michigan Department of State Highways, Report No. 223--Average 24 Hour Traffic Flow Map (Michigan, 1970).

*The ratio of volume of traffic flow per lane on that road to capacity of that lane to carry vehicles. Capacity is approximately 2,000 vehicles per hour adjusted for truck traffic on freeways.

**These highways are not freeways, therefore delay is caused by waiting for traffic lights.

Table 3 indicates the speeds possible on sections of highway selected because of their heavy use. These values are based on estimates of use for the 200th high hour as explained above. The table gives an estimate of congestion delays statewide; it shows that even in the heavily traveled urban fringes, congestion delays are small for rural trunklines. Traffic is moving at very close to the legal speed limit of 55 miles per hour, and even higher speeds would be attainable at a higher legal speed limit, since these figures were based upon a maximum allowable speed of 60 mph.

The Detroit area represents by far the heaviest traveled highways in the state. Serious congestion appears on the older expressways at peak hours of use during the day. This condition exists along short sections of the older freeways. Congestion delays exist on these highways during much of the afternoon.

Table 3 shows that most congestion delay is restricted to the inner parts of urban areas. Detroit was chosen as the example of urban congestion because traffic volume there far exceeds that of other Michigan cities. Indeed, only three urban sections of trunkline outside the Detroit area carried more than 40,000 vehicles (average daily total) per day in 1970.¹ Some of the heavier traffic volumes occurring on rural highways shown in the table are

¹Ibid., Report No. 223.

similar to traffic flows on much of the urban trunkline system. The urban highways in the table represent the most severe congestion in the state. On the freeways, the speed of "unstable under 30 miles per hour" means a traffic flow so dense that traffic cannot move at more than 30 miles per hour with a 60 mile per hour maximum allowable speed, and that the traffic flow will periodically slow to even lower speeds or come to a complete stop. While the non-freeway arterials seem to have less congestion, these highways have the added delay caused by lower maximum speed limits when not congested, and the delay caused by traffic signals. Many city streets give no better service than congested freeways because of traffic signals, on-street parking, and turning vehicles. This accounts in part for the willingness of motorists to tolerate severe congestion on some urban freeways.

Congestion delay tends to concentrate in portions of urban areas. Moreover, congestion tends to concentrate in certain hours of the day. The heaviest use of highways in the metropolitan area of Detroit occurs in the late afternoon and evening. The peak hours are 4:00 p.m. to 7:00 p.m.; the peak occurs about 6:00 p.m. with over 8.5 percent of total daily traffic flow occurring within an hour of that time.¹ Almost all congestion occurs in

¹Detroit Regional Transportation and Land Use Study, Growth Change, . . . and a Choice for 1990, Vol. 1 (Detroit, 1969), p. 11-B-13.

the afternoon and early evening, even on the most seriously congestion sections of highway. However, the hours of congested use vary considerably for different highways. The wide differences in geographic distribution and timing of congestion make congestion difficult to tax. A tax sufficient to restrain use of the highway on a highly congested section will restrain traffic on uncongested highways nearby, even though those highways are not fully utilized. This leaves large portions of the system used at levels well below those which the system was designed to handle. This would require the use of complex electronic monitoring on both vehicles and highways to gather exact congestion data and to calculate charges for congestion. Otherwise congestion would have to be based upon average measurements similar to other user charges.

A system of automatic vehicle identification could provide a method of varying charges by time of day and zone of operation with reasonably good enforcement. Unfortunately, such an enforcement system would require every vehicle, including those seldom used in congested areas, to be furnished with additional equipment. This equipment is estimated to cost about \$33 per vehicle if the production run is sizable.¹ Total equipment and facility cost would

¹Kiran Bhatt, Road Pricing Technologies: A Survey (Washington, D.C.: The Urban Institute, August, 1974), p. 22.

be in the neighborhood of \$35 to \$45 million for even a modest system in a large city.¹

A second difficulty with congestion charges stems from the claim of some congestion toll advocates that individual motorists fail to recognize the marginal cost that their use of the highway imposes on other motorists. This argument is often overstressed by its proponents because the cost of delay that one vehicle imposed on all others is frequently only slightly greater than the cost of delay that the other vehicles on the highway impose on the newcomer. Therefore, motorists already know the degree of congestion delay involved in a given trip at a given time of day. A congestion toll would only allow the substitution of a toll for the time cost of delay. This would substitute price for the current time delays in rationing existing highway space.

The congestion toll has four major limitations as a primary highway tax. First, as already noted, it is difficult to calculate the amount of congestion delay, and to charge for that delay. A system of charging for congestion that is administratively feasible would overcharge some vehicles while undercharging others. Secondly, the amount of the congestion charge would be difficult to determine. Only an estimate of congestion costs can be made from existing information. Charges would have to be varied

¹Ibid., p. 35.

until a charge sufficiently high to restrain congestion to a "tolerable" level is determined. That level would have to be set by the highway authority. Thirdly, such charges for congestion might shift traffic to highways less well designed for heavy use, since those forced off the main route by the toll might well value time less than money. The fourth problem is the limitations on mobility imposed on lower income people.¹ The highest peak congestion is found during the afternoon work-to-home trips. Therefore an adequate mass transit system would be needed with a congestion toll system in order to prevent even further limitation to job-access for the poor.

Serious congestion delay exists at only a few places in Michigan. Even in these, it lasts only a few hours each day. A few of the older highways in the Detroit metropolitan area are the most serious examples. Serious economic and administrative difficulties, as outlined above, must be overcome to tax congestion. Therefore, congestion taxes are not pursued as a major possible means of highway finance in Michigan.

For the above reasons, congestion tolls are not stressed in the remainder of this study. This does not mean that congestion is not important to overall

¹Damian J. Kulash, Income-Distributional Consequences of Roadway Pricing (Washington, D.C.: The Urban Institute, July, 1974), pp. 8-32. Model congestion tolls were found regressive in Boston, Washington, D.C., and San Francisco.

transportation planning. Congestion costs remain an important consideration in expanding a highway or in building a new one. Persistently high congestion in an urban area also serves as a signal that transportation dollars may be spent more effectively on a public transportation system to ease the pressures of congestion.

CHAPTER IV

COMPARATIVE GROWTH RATES FOR ALTERNATIVE TAX BASES

This chapter examines the growth and stability of the user tax bases, the personal income tax base and the property tax base. The next two chapters provide a brief survey of information on the effect of existing user charges and a limited survey of recent data on the incidence of the user charges. Those three chapters constitute step 3 as outlined in Chapter I of this study.

An important aspect of any tax is its growth rate. This rate becomes very important when a tax from a specific source is earmarked for use in one expenditure program. That program then is dependent upon the growth and stability of only one revenue source.

As explained earlier, the state-raised revenues for highway construction and maintenance are derived almost entirely from the fuel tax (approximately 73 percent of state-level financing) and the weight tax (approximately 27 percent). The growth of these tax bases is important to the maintenance and expansion of the highway system.

These taxes are to be compared to two common bases of general taxation: the personal income tax and the property tax.

The comparison of the tax bases seeks to illustrate the rate of growth and the stability of the tax bases. The method employed is to calculate the changes in each tax base over the last 26 years. The period begins with the change in each tax base from 1948 to 1949. This is chosen because most of the adjustment to the removal of price controls in effect during World War II was accomplished and the post-war catch-up in demand was completed. The year 1949 saw the first post-war recession.

The tax bases compared in Table 1 are defined in the units of the tax base to reflect changes only in tax base rather than rates. The fuel tax base consists of millions of gallons of fuel, while the weight tax base consists of the number of registrations for automobiles, trucks, and trailers. The personal income tax base is the personal income of the state with nontaxed items of income removed. The property tax base is each year's state equalized value, which is approximately one-half of the market value of taxed property. The user tax bases, therefore, do not reflect inflation while the personal income and property taxes do.

In the years since 1949, the fuel tax base and the weight tax base have been rather stable. Both bases declined only once in the entire period. The weight tax

base fell in the recession of 1958, while the fuel tax base fell in 1974 when restricted supplies affected consumption in the beginning of the year and a recession restricted consumption in the last quarter of the year. The average annual change for both user taxes is between 4 and 4 1/2 percent. Recessions have usually caused increases below this average rate, while periods of expansion in the general economy and the resulting increase in personal income resulted in above-average increases in fuel consumption and registrations.

As indicated in Table 1, the personal income tax base has grown somewhat faster (6.2 percent annually) but with less stability than was found with the user tax bases. Nominal taxable personal income in Michigan declined four times since 1949. Personal income would have declined in 1970 (because of the recession and the strike at General Motors) and in 1974, if the decline in purchasing power due to inflation had been included. Year-to-year increases, while generally paralleling the user taxes, tended to be of larger magnitude. Eight times since 1949 the year-to-year increase in taxable personal income increased more than 10 percent, while user tax bases did not rise that much in any year since 1949.

The property tax base also has grown faster than the user tax base. This is of less importance to highway construction and maintenance because only about 11.7 percent of highway funds currently is derived from local revenue

Table IV-1.--Percentage Growth of Alternative Tax Bases.^a

Year	Motor Fuel Tax	Weight Tax	Personal Income Tax	Property Tax
1974	-8.06	3.07	5.45	8.97
1973	4.65	4.64	11.60	7.02
1972	7.39	6.63	11.48	6.82
1971	4.05	3.29	6.21	8.03
1970	1.82	2.61	0.53	9.83
1969	6.02	7.64	8.62	9.55
1968	7.67	4.12	10.43	7.19
1967	2.81	1.70	3.91	5.97
1966	5.73	1.61	8.57	4.16
1965	5.88	4.78	11.68	2.77
1964	7.14	5.46	9.86	2.14
1963	6.45	3.99	7.51	2.44
1962	3.30	2.91	7.26	-0.08
1961	0.77	1.95	-1.40	1.34
1960	3.22	2.66	3.66	1.08
1959	4.38	3.12	7.80	1.29
1958	0.52	-1.68	-4.89	2.55
1957	3.48	2.39	1.22	13.95
1956	1.48	1.13	3.55	8.01
1955	8.61	9.07	10.59	4.96
1954	2.59	3.59	-4.45	6.37
1953	9.86	8.57	12.65	15.30
1952	3.81	0.26	6.58	6.87
1951	5.44	4.89	12.74	7.09
1950	9.47	9.76	12.36	3.02
1949	5.09	7.83	-2.09	15.57
Twenty-six Year Average Annual Change:				
	4.39	4.08	6.21	6.24

^aPercentage changes for each year represent the percentage change from the previous year.

Sources: Gasoline use data from the United States Department of Transportation and the Michigan Department of State Highways; registrations from the Michigan Department of State; personal income data from the United States Department of Commerce; and state equalized value from the Michigan State Tax Commission.

sources. However, the property tax is a major source of locally-raised revenue. The growth rate of the property tax base varies among local units. Growing suburban areas usually have the fastest growth in valuation, which helps such areas to meet the needs for infrastructure, including roads. Mature or declining cities usually have the lowest increases, although some of these cities must make improvements on depreciated capital. Damage from weather and use, which accumulates with time, as well as shifts in travel patterns, may cause older cities to rebuild or expand existing roads. In general, the property tax base has grown and has provided a steadily rising source of revenue for the needs of local government in Michigan.

Table 2 throws a somewhat different light on the stability of user taxes. This table compares the purchasing power of motor fuel taxes with real, taxable personal income. The time series on motor fuel taxes was developed by dividing the nominal, annual fuel tax collections by the price index for federal-aid highway construction.¹ Real income was derived by dividing nominal income by the consumer price index compiled by the Bureau of Labor Statistics. Real income was used in the table because this gave the clearest reflection of economic growth, and for the period

¹U.S. Department of Transportation, "Price Trends for Federal-Aid Highway Construction" (Washington, D.C.: Government Printing Office), First Quarter, 1974.

Table IV-2.--Comparison of the Purchasing Power of the Fuel Tax and Real Taxable Income.

Year	Purchasing Power of Motor Fuel Taxes if Spent in Highway Construction (in Millions)	Percentage Change in Purchasing Power of Motor Fuel Taxes	Real Annual Taxable Income (in Millions)	Percentage Change in Real Annual Personal Income
1974	\$184.5	-25.05	\$27,633	-4.87
1973	246.1	11.99	29,049	4.71
1972	219.8	2.58	27,741	7.50
1971	214.2	-0.59	25,805	2.46
1970	215.5	-6.15	25,186	-5.29
1969	229.7	-1.38	26,592	2.43
1968	232.9	17.62	25,962	5.86
1967	198.0	-0.47	24,521	0.48
1966	198.9	-0.86	24,403	3.97
1965	200.6	1.90	23,471	8.64
1964	196.9	5.48	21,604	9.52
1963	186.7	3.21	19,726	6.43
1962	180.9	1.46	18,534	7.02
1961	183.5	0.31	17,319	-1.96
1960	183.0	5.33	17,665	2.72
1959	173.7	9.73	17,197	7.93
1958	158.3	2.36	15,934	-6.30
1957	154.7	-2.80	17,006	-1.60
1956	159.1	2.98	17,283	1.58
1955	154.5	31.85	17,015	10.72
1954	117.2	8.92	15,367	-4.80
1953	107.6	15.60	16,141	10.86
1952	93.1	14.80	14,560	4.07
1951	81.1	11.07	13,991	5.16
1950	73.0	15.19	13,305	9.76
1949	63.4	11.52	12,121	0.87

Sources: Calculations based upon price level data from U.S. Department of Transportation, Federal Highway Administration, Price Trends for Federal-Aid Highway Construction, First Quarter, 1974; fuel tax data constructed from U.S. Department of Transportation and Michigan Department of State Highways; income data adapted from U.S. Department of Commerce, Bureau of Economic Analysis, Income by Place of Residence--Intermediate Table, Michigan (December, 1974); and U.S. Department of Labor, Bureau of Labor Statistics, Detroit Consumer Price Index, 1949-1974.

studied automobile use and ownership rose with real income.¹

Table 2 shows that the stability of the fuel tax disappears with a conversion to real values. This comes about because the fuel tax is a specific tax, fixed in cents per gallon, and the legislature is slow to make any changes in the rate. The inflation of recent years has had the effect of reducing the tax in most years since 1966. In fact, the increases in 1968 and 1973 represent increases of one cent and two cents in the tax rate per gallon respectively. An increase of one cent also occurred on December 31, 1961. Increases of one cent and one-half cent occurred on May 31, 1955 and June 1, 1951.

The sharp fluctuation in fuel taxes would not be remedied entirely by a shift to ad valorem taxation. Motor fuel prices vary widely and have changed rapidly in recent years. Throughout the late 1950s and early 1960s motor fuel prices lagged behind the increase in the consumer price index. In 1973 and 1974, these prices have shot up rapidly. An ad valorem tax also would be somewhat harder to administer, since vertically integrated companies might underprice the product at another stage of production than the retail stage. Additionally, retail outlets are more numerous to police than the current wholesale outlets.

¹Frank C. Wykoff, "A User Cost Approach to New Automobile Purchases," Review of Economic Studies, Vol. 40, No. 3 (July, 1973), pp. 877-89.

In summary, Tables 1 and 2 show that the earmarked user fees have no overriding advantage in either rate of growth or stability as sources of revenue for highway finance. Also shown in Table 2 are the year-to-year increases and decreases in real motor fuel tax collections and of real income. The changes in motor fuel tax collections reflect the fluctuations in the tax base, declines in purchasing power and changes of rate for the specific fuel tax. In this way the effects of the various causes of instability are found to be similar to those for real taxable personal income.

The main advantage of the earmarking process, from the point of view of highway development, is the insulation from competition with other demands in the budget process. User tax revenue cannot be transferred to other uses during financial stringencies. This provides continuity to the states investment in highways, which is greater than that for capital projects financed through the general fund. A tendency has developed to use the capital items to balance the budget. A balanced budget for the state government is a requirement of the present Michigan constitution.

The property tax has the primary advantage of enabling the business or home owner to improve a local road of special importance to that business or resident. Traffic volume on many local roads under user taxation may not warrant the level of service desired by local citizens.

An advantage of the income tax is a somewhat faster growth rate. The income tax also could encourage better budget control because arguments for earmarking would not apply.

CHAPTER V

IMPACT OF USER TAXES UPON USE OF THE HIGHWAYS

It is necessary to discuss the impact user charges have on the use of highways. This portion of the study examines the contribution that user charges make toward the control of congestion, and whether this control is a positive aspect of user charges.

User charges are levied at a rate which is uniform statewide in Michigan. This is done partly because of custom and partly because of administrative ease. In the case of the gasoline tax, the uniform rate greatly simplifies the collection from the small number of fuel wholesalers, who provide the fuel used in Michigan. The user charges are also unresponsive to differing market conditions. They are set legislatively and reflect the demand for highway services as developed through the political process. Changes occur only at intervals of several years. For example, weight taxes have not been changed since 1968, while the tax on gasoline (but not on diesel fuel) was increased in 1973. These two characteristics--statewide uniformity and relative inflexibility of tax rates--limit

the usefulness of user taxes as a tool for allocating highway services.

Motor Fuel Taxes

In order to estimate the effect the motor fuel tax has on the use of the highway, it is necessary to know the elasticity of motor fuel use to the rise in fuel costs. Several recent studies place the long-run price elasticity of gasoline and oil at between -0.5 and -0.7 based on time series data over the years that gasoline-using vehicles have been the primary source of land transportation.¹ A somewhat higher figure was derived for the elasticity of gasoline used by automobiles in the United States. The long-run price elasticity was found to be -0.92.² This higher elasticity is plausible, considering the more narrowly defined user category. In a further study, a single year elasticity of -0.77 was found by Ramsey, Rasche, and

¹Two important studies that may be cited are: H. S. Houthakker and L. D. Taylor, Consumer Demands in the United States: Analysis and Projections, second edition (Cambridge, Mass.: Harvard University, 1970), p. 186; and L. Philips, "A Dynamic Version of the Linear Expenditure Model," Review of Economics and Statistics, Vol. 54, No. 4 (November, 1972), pp. 450-88.

²Sorrel Wildhorn, Burke K. Burright, John H. Enns, and Thomas F. Kirkwood, How to Save Gasoline: Public Policy Alternatives for the Automobile, R-1560-NSF (Santa Monica, Calif.: Rand Corporation, 1974), pp. 56-66.

Allen.¹ This result was for private, noncommercial uses of gasoline, primarily in automobiles and motorcycles.

The studies cited above suggest that repeal of the current motor fuel tax of 9 cents per gallon would increase motor fuel usage by between approximately 379 million gallons for a $-.50$ elasticity and 698 million gallons for a $-.92$ elasticity. These calculations assume that the repeal of the motor fuel tax is the only change in relative prices. The Rand Corporation study suggests that 18 percent of the adjustment would be taken up by the use of larger vehicles. If this is correct, the increase in travel would consist of between 4.25 billion vehicle miles and 7.81 billion vehicle miles out of a total of 58.7 billion private and commercial vehicle miles.

The range of elasticity results from differing statistical data and from differing methods of estimation. The most likely value is about -0.7 because the motor fuel tax is levied on commercial fuel and diesel fuel as well as on automobile gasoline. This would suggest an increase in highway use of about six billion vehicle miles.

From the above information, it appears that the fuel tax makes a modest contribution to fuel conservation. Its contribution to the control of congestion is even more

¹James Ramsey, Robert Rasche, and Bruce Allen, "A Preliminary Analysis of the Private and Commercial Demand for Gasoline," Econometrics Workshop Paper No. 7039, Michigan State University, February, 1974, p. 12.

modest. This stems from the fact that truly severe congestion exists only in a few urban areas during some hours of the day and at a few rural bottlenecks. Table 3 in Chapter III illustrates the generally low level of congestion on major highways outside of Detroit. In addition, only 25.4 percent of vehicle miles driven on major highways are driven during busy times in urban areas.¹ This means that the fuel tax acts on average as a mild discouragement to the use of highway facilities which are not congested. Therefore, the fuel tax in its present form does not shape the use of the highways in such a way as to restrain congestion of heavily used highways while encouraging use of less congested highways.

Commercial vehicles paid approximately 14 percent of the fuel taxes in Michigan. Of these, commercial vehicles in excess of ten tons gross weight paid approximately 11 percent of the fuel taxes in 1972. The current fuel taxes increase the cost of truck transport by an average of 0.964 cents per vehicle mile.² This means that the average commercial truck owner spends just under one cent per mile on fuel taxes. This figure is slightly

¹This information was derived from traffic count data summarized by the author, plus information on the number of vehicles in motion in the Detroit urban area, developed by the Detroit Regional Transportation and Land Use Study, p. 11-B-13.

²The figure has been adjusted to inflate the 1972 figures for the gasoline tax increase from seven to nine cents per gallon in February, 1973.

higher for the largest freight haulers and much lower for light delivery trucks. Diesel vehicles receive a double advantage on the tax, with both more efficient engines and a lower tax rate (seven cents per gallon on diesel fuel as opposed to nine cents on gasoline) when compared to gasoline vehicles of similar size.

The effect of fuel taxes on commercial highway use is difficult to estimate precisely. The charge is not large per mile and, in the case of the larger vehicles, is actually lower on a ton-mile basis.

There is good reason to believe that changes of a few cents in fuel taxes would not have a major impact on truck use. The vast majority of truck miles are driven by trucks owned by companies subject to regulation, including utilities and hired trucking, and by industries where truck transport is a relatively small part of total costs (services and agriculture). More importantly, rail trackage seems to be available for only about 54 percent of the truck miles driven by commercial vehicles over ten tons. Even shifting that portion of truck miles with rail trackage available would require massive readjustment of present distribution practices. Today, many sites for agriculture, construction and trade lack rail service.

Fuel taxes have the expected excise effect of reducing travel and demand for fuel. They therefore offer a small conservation effect. In addition, they provide the simplest method of taxing highway users in proportion to

their use of the highway system. For vehicles of the same weight and engine efficiency, the fuel tax varies proportionally with use. Relying on the idea that the initial benefits of highways accrue to vehicle users, the tax distributes the capital and maintenance costs of highways. This remains the primary economic defense of its use in highway finance.

Registration Fees

The registration fee is, in effect, a tax on the weight of the vehicle. For passenger cars the tax is currently \$.55 per hundred pounds or \$12, whichever is the greater. The legislative act establishing weight fees contains many special schedules leading up to \$1,010 for trucks over 130,000 pounds gross weight.¹ Historically, the Michigan weight tax grew out of the property tax on motor vehicles. Early in this century, Michigan began to earmark property taxes on vehicles for county road improvement. By 1915 the legislature began the switch to registration fees in lieu of property taxes. Today, motor vehicles used on highways are taxed only by the earmarked weight tax and enjoy a complete property tax exemption.

The registration fee resembles the fuel tax in that it is an excise that motorists must pay and is a cost of doing business for commercial vehicles. Commercial

¹John T. Rice (Ed.), Michigan Statutes Annotated, Section 9.2501, pp. 613-20.

vehicles pay 38.7 percent of total registration fee collections, as against 14.1 percent of the motor fuel tax collections. The registration fee differs from the fuel tax in not being variable with the number of miles driven. It must be paid on all vehicles that are used on the highways.

The weight tax is based on the premise that larger vehicles require heavier construction of highways to prevent damage to road surfaces. A weight tax is the simplest method of distributing the extra costs of construction to the heavier vehicles. The 1970 Michigan Highway Fiscal Analysis¹ applies an incremental cost approach to cost allocation among vehicles. The incremental cost study shows that automobiles nearly paid for their increment of cost. A few middle-sized trucks actually paid more than their increment, while the largest trucks did not come close to paying their increment. The largest trucks (over 130,000 pounds gross weight) met only 51 percent of their annual costs and fell about \$2,500 short of meeting their increment of highway costs. An increase in gasoline taxes since 1972, while leaving diesel fuel and weight taxes unchanged, has increased the underpayment by large vehicles.

¹Wilbur Smith and Associates, Michigan Fiscal Analysis, 1970-1990 (New Haven, Conn.: Wilbur Smith and Associates, 1974), pp. 170-88.

It should be noted that the incremental cost method allocates highway costs on the basis of engineering tests of road wear. This method is based on benefit taxation only to the extent that the cost of the extra increment of highway reinforcement is allocated to the vehicles benefited. "Benefited," in this case, means that the reinforcement allows heavier vehicles to use the highway without damage to the vehicle or highway; alternatively, the improvement may allow heavier vehicles to use the highway in all weather conditions without damaging the highway.¹ The incremental cost approach makes no effort to measure benefits and is assigned only to allocate costs.

There is strong reason to infer that the impact of the registration fee on vehicle use is even less than for the fuel tax. The evidence is especially strong for automobiles and other light vehicles. The registration fee is smaller than the fuel tax as a percentage of annual operating costs. For a standard size automobile driven an average of 10,500 miles per year, registration fees would be just under 1.63 percent of annual costs per mile while fuel taxes are 4.40 percent of annual costs per mile.²

¹Clifton M. Grubbs, "Problems of Highway Cost Allocation," National Tax Journal, Vol. 16, No. 4 (December, 1963), 416-23. This article mentions the combined effects of weight and weather conditions on highway wear.

²U.S. Department of Transportation, Federal Highway Administration, Cost of Operating an Automobile (Washington, D.C.: Government Printing Office, 1974), p. 9.

Using the elasticity for gasoline as cited earlier (between -0.5 and -0.92), it is possible to estimate the effect of the weight tax on vehicle use. This depends on the assumption that gasoline taxes and weight taxes have similar effects on vehicle use. Since both taxes are excises on vehicle use, the assumption is reasonable. The main difference is that the weight tax must be paid regardless of how much the vehicle is used. This allows the vehicle owner to reduce the weight tax by making greater use of fewer vehicles. While this effect is not quantifiable, this increases the likelihood of a smaller reduction in travel because of weight taxes than because of fuel taxes. Using the gasoline price elasticities of -0.5 and -0.92 it is calculated that a maximum reduction of between 0.6 percent and 1.1 percent in vehicle registrations would result from the weight tax.¹

The effect of the weight tax on the use of truck transport also is difficult to estimate. However, less than one-half of commercial vehicle cargo is accessible to railroads. Therefore much commercial traffic must travel by truck or not be carried at all. Secondly, the weight tax is not a burdensome tax per ton-mile on commercial

¹The elasticity of motor vehicle registrations may be less than the lower bound gasoline price elasticity of -0.5 because the registration fee is a very small percentage of the operating costs of a passenger car. In addition, the registration fee can be reduced along with other operating costs by purchasing vehicles of smaller size.

vehicles in Michigan. Large trucks bear taxes per ton-mile that range between 70 and 90 percent of the amount per ton-mile paid by a two-ton sedan driven 10,000 miles per year.¹ This indicates that the weight tax on large commercial vehicles is not a larger burden on heavier vehicles if the weight they carry has the same benefit per ton-mile as do the lighter vehicles.

In summary, it is found that the current Michigan registration fees tax lighter vehicles more heavily than heavy vehicles on the basis of costs occasioned by each vehicle type. Secondly, the registration fees are slightly less on a ton-mile basis for heavier vehicles when both lighter and heavier vehicles are used an average amount. The probable effects of registration fees based on weight are to encourage smaller vehicles, more intense use of the vehicle stock, and greater use of rail transport. However, because of the small size of weight taxes relative to other costs of vehicle operation, these effects are of limited importance. Inflation in recent years has further reduced the impact of these fixed dollar registration fees.

This section of the study shows that the weight tax serves two purposes. The first purpose is to help cover additional costs imposed on the highway system by heavier

¹This was calculated from data of the U.S. Department of Commerce, Bureau of the Census, Truck Inventory--Michigan, 1972 Census of Transportation (Washington, D.C.: Government Printing Office, 1973), pp. 9-10.

vehicles. These costs are not entirely met by the combination of weight taxes and fuel taxes. Secondly, weight taxes provide some aid to the railroad industry by reducing the subsidy that smaller vehicles would pay to larger vehicles through subsidizing the roadway needed for the larger vehicles. As was shown, if the incremental cost method, as used in the 1970 Michigan Highway Fiscal Analysis, is accepted, large vehicles are not covering their costs in Michigan today.

CHAPTER VI

INCIDENCE OF MOTOR VEHICLE TAXES

Introduction

This chapter reviews some of the available information on the incidence of motor vehicle taxation. Motor vehicle taxation is emphasized because it is the current method of paying for highways. The information presented here will give an indication of the incidence of current user taxes, particularly the motor fuel tax. It will also give an indication of the incidence of congestion tolls on commuters.

A brief comment on the effect of general purpose taxes on income distribution is made at this point for comparison. Much of the tax analysis in previous chapters has dealt with the personal income tax. A proportional income tax is used because it best reflects the location of total taxable income by city and county. In later chapters the proportional income tax will be used to compare the geographical distribution of taxable resources to highway costs. Progressive income tax rates could be applied to the same base as is used for the flat rate tax. No serious

problems would be incurred by using progressive rates, although there would be somewhat greater elasticity of revenue with respect to income should such rates be used. Given a change in the Michigan constitution, the state income tax could be made as progressive as the citizens desire.

The property tax will not be fully reviewed because it is a relatively small portion of highway finance and because highway finance is a minor part of the property tax. Assuming that all locally raised highway revenue is derived from the property tax, this tax would provide 11.7 percent of highway revenues, and highway uses would account for only 3.7 percent of the property tax. These figures ignore the fact that "local" funds also may be obtained from either the state or the federal general revenue sharing programs. Federal and state sources are actually larger than property tax revenues for townships and are a considerable portion of city and county revenues.

The property tax base was derived as follows in 1974: 48.61 percent from residential property, 6.27 percent from agricultural, 18.00 percent from commercial, 22.02 percent from industrial, 4.59 percent from utilities, and 0.50 percent from timber.¹ The property tax rates on these bases were near the statewide average of 50.08 mills for

¹Michigan Economic Report of the Governor, 1975
(Lansing, Michigan, 1975), p. 183.

residential and industrial property. Commercial property had a slightly higher rate, while agricultural and timber properties had much lower rates.

Using the above information on bases and rates, the current split between residential and all business property tax collections is about 48 percent residential and 52 percent business. Michigan property classifications are not exact since many smaller rental properties are included in the residential category, while larger apartment houses and farm residences are classed as business properties. When this fact is taken into consideration, slightly more than one-half of the property tax is levied upon housing in Michigan.

If the assumption is made that whoever pays the tax also bears the incidence of the tax, we get the following results. The property tax on housing is regressive on income if the property tax credit program of the state is not considered. When the property tax credit is included, the property tax on housing becomes roughly proportional.¹ The business property taxes would be regressive on annual income if it is assumed that they are paid by the final customers of the taxed businesses. These taxes would be progressive if it is assumed that they are paid by the owners, i.e., capital.

¹James H. Haughey, Gerald H. Miller, and Robert J. Kleine, "The Michigan Excess Property Tax Burden Relief Act" (Lansing, Mich.: unpublished paper, Department of Management and Budget), p. 18.

In the most recent study of Michigan tax incidence, Roberts found that the 1970 Michigan property tax, which contained less progressive credit provisions than currently, was regressive on money income. This result held even for shifting assumptions which allowed 50 percent of the non-automotive manufacturing property taxes paid by state residents to be shifted to owners of the property.¹

The actual incidence of the property tax depends on many conditions. Among the influences are capital mobility, labor mobility, capital supply elasticity, labor supply elasticity, market structure and effective tax rate differentials. The complexities of the problem are outlined in the current controversy on the regressivity of the property tax.² Recognizing the wide local difference in the factors influencing property tax incidence, the tax is a poor one to use for income distribution purposes.

In conclusion, the use of the property tax in highway finance is defended on the benefit principle. Property tax money is spent on local roads to benefit adjacent lands and nearby residents. The type of travel on the roads financed by property taxes is largely by local residents for short distances.

¹Douglas Beedle Roberts, Incidence of State and Local Taxes in Michigan (unpublished Ph.D. dissertation, Michigan State University, 1975), pp. 144-68.

²Henry Aaron, Richard A. Musgrave, and discussants, "The Property Tax: Progressive or Regressive?" American Economic Association (May, 1974), pp. 212-35.

Motor Fuel Taxes

Motor fuel taxes are by far the most important source of highway funds and the largest specific tax levied by the state of Michigan. As noted in Chapter IV, these taxes make up approximately 73 percent of state-level highway taxes in Michigan. State-level fuel taxes totaled about 0.79 percent of personal income in 1973.

In addition to the state-level motor fuel tax, there is a four cent federal motor fuel tax levy which makes the total motor fuel tax 13 cents per gallon in Michigan. The two motor fuel taxes together totaled 1.14 percent of personal income in 1973. These data show the size of the motor fuel tax and, therefore, the importance of its incidence.

Based on 1972 mileage data, approximately 86 percent of the fuel taxes in Michigan was paid by private vehicles while 14 percent was paid by commercial vehicles. Therefore, the incidence of the motor fuel tax depends heavily on the distribution of private vehicle travel. It is difficult to find reliable information on motor vehicle travel by income class. The data are improved by supplementing Michigan data with national data. This procedure is acceptable because per capita miles driven and the

classification of trips by income are similar for Michigan and the entire United States.¹

The most complete and recent data on travel patterns for automobile drivers are the Survey Research Center's data on automobile miles driven by income. Using these data, it is possible to calculate the average percentage of income devoted to the non-commercial portion of the state-level gasoline tax in 1973. The results of this calculation are as follows:

Table VI-1.--Mean Gasoline Tax Payment as a Percentage of Mean Income.

Mean Income of Decile	All Families (Percent)	Auto Owners (Percent)
\$2,034	.78	2.33
3,975	.82	2.92
5,725	.82	1.16
7,625	.81	1.04
9,775	.75	.89
11,875	.78	.89
14,125	.65	.75
16,925	.62	.71
21,000	.53	.61
27,00	.42	.57

Source: 1973 travel/income data from unpublished tables of the Survey Research Center, Economic Behavior Program, the University of Michigan.

¹United States Department of Commerce, 1972 Census of Transportation, Travel During 1972 (Washington, D.C.: Government Printing Office, 1973), pp. 5-11 and 97.

The table shows the gasoline tax to be generally regressive if all families are included, but becomes more sharply regressive when only automobile owning families are included. This reflects the fact that a higher percentage of lower income families drive very little in a year because, in part, they do not own a car. One characteristic of automobile driving is the wide distribution of miles driven within any income class.¹ For example, in the third decile (mean income of \$5,725) of family income, 24.9 percent of the families drove zero miles in the year while 2.4 percent drove over 15,000 miles. A nine cent gasoline tax would take 4.03 percent of a \$5,725 income if the family drove 35,000 miles in an average-size car. This shows the wide differences in incidence within an income class.

Two other studies by Roberts, using federal tax return data² and Zupnick, using census data,³ reflect the regressivity of the motor fuel tax, especially at income levels above \$7,500. These results remain despite different definitions of income, categories of income, tax rates and years used for the study.

¹John Holmes, "The Relative Burden of Higher Gasoline Prices" (unpublished paper, Survey Research Center, University of Michigan).

²Roberts, Incidence of State and Local Taxes in Michigan, p. 162.

³Jan W. Zupnick, "The Short-Run Incidence of a Tax Induced Rise in the Price of Gasoline," Journal of Economic Issues, Vol. 9, No. 2 (June, 1975), 409-14.

The reasons for driving range from purely recreational to absolutely essential. The next two paragraphs examine some of the reasons for driving and some of the types of travel.

One-way trips of over 100 miles make up only about 6.9 percent of all driving in Michigan. An estimated 55.7 percent of these trips are to visit friends and relatives or for outdoor recreation.¹ The incidence of the motor fuel tax for trips of a one-way distance greater than 100 miles is regressive despite the high percentage of discretionary recreational trips.

As Table 2 shows, the motor fuel tax paid by each income class on these longer automobile trips declines as a percent of money income in that class as income rises. The percent of income spent on motor fuel tax for these trips falls from 0.13 to 0.05 for incomes less than \$5,000 to incomes over \$15,000 respectively.

Table 2 was calculated on the basis of the number of families taking at least one trip rather than the total number of families. Only the group with an income less than \$5,000 had a significantly smaller number of households taking trips than the number of households in the income class.

¹Calculations made from data in United States Department of Commerce, National Travel Survey, 1972 Census of Transportation (Washington, D.C.: Government Printing Office, 1973), pp. 6-11, 38, 97.

Table VI-2.--Incidence of Motor Fuel Tax for Non-Commercial Trips over 100 Miles.

Income Class	Tax as Percent of Income
Under \$5,000	.13
\$5,000 to \$7,499	.12
\$7,500 to \$9,999	.09
\$10,000 to \$14,999	.08
\$15,000 and over	.05

Source: Calculated from data of U.S. Department of Commerce, Bureau of the Census, Travel Survey, 1972 Census of Transportation.

The purpose and importance of automobile travel is difficult to determine. Using data on trip purpose developed for the Detroit Regional Transportation and Land Use Study, it is calculated that about 71 percent of the local automobile trips were for purposes of work, personal business or shopping.¹ Trips not beginning at home were distributed in proportion to the reason for trips that began at home. The greatest number of trips and the longest trips were work trips. Work trips were also more numerous than the other two categories combined. A study in the Flint area confirmed these findings for a smaller metropolitan area.²

¹Detroit Regional Transportation and Land Use Study, Growth, Change, . . . and a Choice for 1990, Vol. 1 (Detroit, 1969), pp. II-B-4 to II-B-14.

²Michigan Department of State Highways, unpublished origin and destination data.

Both study areas were of sufficient geographic size that they extended beyond intracity bus and commuter train service areas. The Detroit study encompassed approximately all of Wayne, Oakland, and Macomb counties plus the eastern two-thirds of Washtenaw County, including Ann Arbor, and a small portion of northern Monroe County. The study therefore reflected the travel habits of hundreds of thousands of people in the outer suburbs and rural areas who lack access to non-automobile transit as well as persons who have this alternative available.

The Detroit data showed that commuting from home to work made up approximately 21 percent of all local trips. These trips averaged 8.9 miles, which was longer than other local trips. These factors make commuting the single largest trip purpose in the Detroit area.

The University of Michigan's Survey Research Center has the best available data on commuting by income class. Table 3 illustrates the incidence of a nine cent motor fuel tax on commuting by heads of families. The motor fuel tax on commuting is heaviest in proportion to income for the lowest decile and is, again, regressive for incomes above the fourth decile, with a mean of \$7,084.

Table 3 shows that the motor fuel tax is slightly regressive to commuters. This result reflects the fact that the average amount of commuting is based on all the families. Approximately 40 percent of the family heads do not work or do not go to work by automobile. These family

Table VI-3.--Incidence of Michigan Fuel Tax on Commuters.

Mean Income of Each Decile	Percent Tax is of Income
\$ 1,450	.39
3,700	.16
5,334	.22
7,084	.26
8,908	.23
10,858	.23
13,072	.19
15,672	.19
19,350	.16
25,000	.13

Source: Computations based on unpublished tables from Panel Study of Family Dynamics, Survey Research Center, University of Michigan.

heads are concentrated in the lower-income categories. For example, 82 percent of the family heads in the lowest fifth fall in this category, while only 22 percent fall in this category in the highest fifth.¹ A limitation of the data is the fact that the survey includes only travel-to-work data for the family head but not for other persons in the household.

Similar to the findings with the data for all types of driving, the commuting distances vary widely within each income class. While it was noted above that a high percentage of family heads in the lowest income fifth did not do any commuting by automobile, 3.0 percent of family heads

¹James N. Morgan, "Gasoline Price Inflation," Economic Outlook U.S.A. (Spring, 1974), pp. 7-8.

in this class commuted more than 30 miles a day. A great spread in commuting distances existed in all classes. In the highest income fifth, almost as many family heads commuted one to ten miles as commuted more than 30 miles.

The commercial portion of the fuel tax is relatively small, about 14 percent of the total tax. This portion can be assumed to be largely shifted forward to consumers of transported products. In this case, the tax has an incidence similar to a general sales tax. This assumption is based upon the limited competition with rail transport. In addition, the fuel tax is not a high percentage of the costs of doing business for many truck-operating businesses, such as retail and wholesale trade, agriculture and utilities. Trucks owned by businesses not engaged primarily in the transportation of cargoes drove three-fourths of the truck miles in Michigan in 1972.¹ The current state fuel tax increases the cost of truck transport by an average of 0.964 cents per truck mile. This is also similar to taxes in neighboring states.

In summary, the motor fuel tax is found to be regressive relative to annual income. It becomes more regressive when only automobile drivers are included. The incidence of the tax on commuter driving also is regressive. The data suggest that the fuel tax is already a burden to

¹U.S. Department of Commerce, Truck Inventory--Michigan, 1972 Census of Transportation (Washington, D.C.: Government Printing Office, 1973), pp. 2-8.

those low-income families for whom driving is essential. Increases in the fuel tax would increase this burden.

Congestion tolls would impose a severe burden on the minority of low-income persons who commute to work. This would occur because congestion tends to peak at the time the work-to-home trip is undertaken. Some shopping and personal business trips would also fall in this time period. The data presented in this section suggest that congestion tolls would be regressive in much the same way as the fuel taxes.

One final point is the availability of public transit to automobile drivers. The Survey Research Center data show no strong difference in public transportation availability for current automobile users by income class. In the lowest income fifth, 28 percent report public transportation availability while a 32 percent availability is reported for the highest income fifth.¹ Further evidence on the availability of public transit comes from the fact that Michigan had 188,078 families and unattached individuals living in rural areas with incomes of less than \$5,000 in 1970. These people cannot be served easily by any existing public transportation system. At the same time, the cost of automobile transportation bears heavily on their income. Increases in motor vehicle taxes would

¹Morgan, "Gasoline Price Inflation."

merely increase the problem of rural isolation by further limiting the mobility of the rural poor.

The Weight Tax

Weight tax revenues are much smaller than fuel tax revenues, and were about 0.30 percent of the personal income of the state in 1973. In fiscal 1974, 61.3 percent of the weight tax was paid by private automobiles as opposed to commercial vehicles. If it is assumed that the weight of automobiles for each income class is uniform, it is possible to estimate the incidence of this tax on annual income. The assumption is reasonable, since many lower-income people buy used cars. In recent years, the dominance of the larger model cars, with their greater durability, made these models available as used cars.

The incidence of the weight tax is shown by the percentage that the average weight tax paid by each income class is of the mean income of that class as calculated in the following table.

Table 4 is based on the ownership pattern for vehicles in 1971. As with the fuel tax, Table 4 reflects the effect of lower vehicle ownership among lower-income groups. Nationally, 42 percent of families with annual incomes below \$5,000 owned no car and were not directly affected by the weight tax. The weight tax on private automobiles is still regressive even when the average includes non-vehicle owners.

Table VI-4.--Incidence of Weight Tax.

Mean Income of Class	Percent of Income for Income Class-- All Families	Percent of Income for Income Class-- Auto Owners
\$ 3,500	.39	.68
6,250	.38	.43
8,750	.32	.34
12,500	.24	.25
18,000	.18	.19

Sources: Lewis Mandell, George Katona, James N. Morgan, and Jay Schmiedeskamp, Survey of Consumers, 1971-1972 (Ann Arbor, Mich.: Institute for Social Research, 1973), pp. 31-41; and U.S. Department of Commerce, Census of Housing--Detailed Housing Characteristics, Michigan (Washington, D.C.: Government Printing Office, 1972), p. 141.

Commercial vehicles paid 38.7 percent of the weight tax revenue in fiscal 1974. Commercial vehicles pay about as much weight tax as fuel tax, approximately \$56 million. Past analysis has assumed that the weight tax is a forward-shifted excise tax.¹ Under this assumption, the tax has a regressive incidence similar to a general sales tax. This assumption seems plausible for much the same reasons as were listed for the fuel tax. If the incidence of the commercial portion of the weight tax is similar to a general sales tax, this would increase the regressive impact of the weight tax.

In summary, the incidence of both the weight tax and the fuel tax tends to decline as income rises despite

¹Richard A. Musgrave and Darwin W. Daicoff, "Who Pays the Michigan Taxes?" Michigan Tax Study, Staff Papers (Lansing, Michigan, 1958), pp. 131-83.

the greater consumption of highway services. In addition, low-income people cannot always avoid the tax by switching from automobile use. In this regard it should be remembered that current user taxes at the state level are a small percentage of total automobile costs, and their removal would solve few of the transportation problems of the poor.

Summary of Chapters IV, V, and VI

These three chapters constitute step three of the dissertation as these steps were identified in Chapter I. The primary purpose of this third step was to examine the current user taxes and to determine whether they had any decisive advantage over general taxation, particularly income taxation, for highway finance. These chapters examined growth, stability, effects on use of the highway system and incidence of the taxes. The general finding is that user taxes have no clear superiority over income taxes in highway finance that would warrant the extensiveness of their use in the states of the United States.

The primary advantages of the user taxes are as follows:

1. User taxes provide a source of revenue that can be earmarked for highways. The earmarked taxes provide a moderately reliable source of funds for which the highway authorities do not need to compete.

2. They provide a mild conservation effect in the use of gasoline and motor fuel.
3. They provide limited assistance to railroads by having trucks bear a portion of highway right-of-way costs.
4. In the case of the gasoline tax, a tax is levied which taxes the user in approximate proportion to his use of the highway.

The advantages of income taxation are as follows:

1. Since the tax is far less likely to be earmarked, the legislative and budget authorities may respond more quickly to changing conditions.
2. The income tax encourages the use of uncongested highways when compared with user taxes. This uncongested portion of the highway system constitutes the bulk of the system in mileage and vehicle use.
3. Income taxation allows the substitution of a progressive or proportional tax for a regressive tax.
4. Since motor vehicle ownership and use increase with rising incomes,¹ a progressive or proportional

¹The tables in this chapter have shown implicitly that automobile ownership and use rise with income. Further evidence can be derived from a special survey by the Census Bureau in 1971 and is shown in the following table:

income tax increases with vehicle use. Because of the previously mentioned variations in driving habits within income classes, an income tax does not bear as close a relation to vehicle use as does a motor fuel tax.

The user taxes offer a number of advantages, as does the income tax. The survey of the last three chapters shows nothing in the operation of either type of tax that would strongly recommend its use in highway finance over the other tax. Use of either type of tax, or a combination of both, depends on desired policy goals.

The next chapter begins the analysis of steps four and five. These steps compare the geographic redistribution of resources among counties caused by meeting a uniform set of cost standards from revenues raised using a motor fuel

Household Ownership of Cars

Money Income	One or More Cars (Percent)	Two or More Cars (Percent)
Under \$3,000	43.6	5.6
\$3,000 to \$4,999	70.2	11.3
\$5,000 to \$7,499	85.2	22.4
\$7,500 to \$9,999	91.3	32.9
\$10,000 to \$14,999	94.9	46.3
\$15,000 and over	96.6	62.7

Source: U.S. Department of Commerce, Bureau of the Census, Consumer Buying Indicators (Washington, D.C.: Government Printing Office, May, 1972), P-65, No. 40, p. 8.

This table illustrates clearly the increase in vehicle ownership with higher income.

tax or an income tax. Several issues will be analyzed. The first is the difference in geographic redistribution that is brought about by the choice of tax base. The second is the comparison of the geographic distribution of vehicle use as reflected by the motor fuel tax, and taxable income as reflected by a proportional income tax. A third is the location of highway costs in relation to two different tax bases.

CHAPTER VII

LOCATION OF COSTS AND RESOURCES

Introduction and Definitions

This chapter contains steps four and five of the analysis. These steps deal with the geographic distribution of highway costs and comparison of these costs with the resources necessary to meet them.

In order to proceed with the analysis involved in the rest of this dissertation, several terms must be defined. These definitions will be used throughout the balance of the study.

Costs of meeting the uniform standards refer to the costs of constructing and maintaining a highway system built to meet a given set of engineering standards. The engineering standards reflect differences in the volume and use of the highways. The standards were developed by the American Association of Highway Officials in conjunction with the federal government. These were then modified by the Michigan Department of State Highways in conjunction with city and county officials to apply specifically to Michigan. In general, they represent the best available

engineering practice for handling a given volume of motor vehicle traffic.

The costs of meeting the uniform standards used in this study were developed for the 1970 Michigan Highway Needs Study. Costs of the standard system are identical to needs as used in that study. The terminology, "costs of meeting the uniform standards," is used because it is more descriptive and is less restricted to use by highway engineers than the term "needs."

Legal systems refer to a system of highways classified so as to be eligible for certain funds as provided by state laws. The classification is based upon the unit of government responsible for the highway, the amount the highway is used and the function of the highway. The term "function" is vague, but refers primarily to the purpose of the highway. In general, highways that provide longer trips across political jurisdictions tend to be given funding by a higher level of government. There are five legal systems in Michigan. They are as follows:

1. State trunklines are the responsibility of the state and are funded from state and federal sources. In fiscal 1974, federal aid made up 34 percent of the support for this system, a somewhat smaller share than in several previous years. They are, in general, the most heavily traveled highways with the longest trip distances. The trunkline system

contains, among other highways, the interstate system and almost all of the limited access highways.

2. County primary roads are under control of the county road commissions. Most of the funding is from state sources, with local and federal sources combined providing about 12 percent of the funds.
3. County local roads are also the responsibility of the county road commission. However, these highways are generally less heavily traveled and the trips are generally from local residences to larger highways. This system is ineligible for most federal highway programs, with the funding coming about 65 percent from state sources and 35 percent from local sources.
4. City major streets are provided by the cities and villages. Major streets are the more heavily traveled streets in a community. Their financial support is about 66 percent state, 25 percent local, and 9 percent federal.
5. City local streets are provided by cities and villages. They tend to be less heavily traveled than major streets. The bulk of the mileage in this classification serves the primary purpose of residential access. Financial support is about 54 percent state, 41 percent local, and 5 percent federal.

The tables and analysis in this study will use these legal classifications because this will facilitate comparisons with the current practice in distributing highway funds. In addition, the legal systems basically represent transportation systems with different goals. The state trunkline system links the cities of the state together. On the other hand, the county local system is designed mainly to provide access for vehicles from rural residences to larger highways. It is much larger in mileage but carries far fewer vehicles than the state trunkline system.

The county and city highways are each divided into two systems so that a higher percentage of state funds will be spent on highways which serve more traffic or which serve traffic flowing across local governmental unit boundaries.

The criteria of trip volume, trip distance and trip purpose were used in establishing the legal systems in Michigan.¹ These criteria help channel greater amounts of funds to those highways with the greatest benefits as measured by use. These criteria are also used in highway planning.² Higher standards are generally used for each

¹Charles M. Ziegler, Highway Classification in Michigan (Lansing: Planning and Traffic Division, 1953), pp. 1-19.

²Kurt W. Bauer, "A Functional Approach to the Jurisdictional Classification of Highway Systems," Traffic Quarterly, Vol. 23, No. 4 (October, 1969), 485-503.

higher functional classification based upon the above criteria in calculating the costs of a standard system. More functional classifications are used in the 1970 Needs Study than there are legal systems because the Needs Study is not constrained by administrative feasibility of separate accounting for each system.

Resource Distribution and Costs of the Standard System

An equation was developed in Chapter II that related costs in political units to the resources necessary to pay the costs. This equation was:

$$E_i = \alpha N_i - \gamma V_i$$

The specific use made of the equation in this chapter may be clarified by defining its elements as each will be used hereafter:

E_i represents the net transfer of aid to county or city i . This result may be positive or negative, and is the subsidy or deficit for each local unit. Subsidies are positive since costs exceed revenues raised from the local tax base. Deficits are negative subsidies and result when the revenues raised from the local tax base exceed the costs.

α reflects the percentage of the local costs of meeting the uniform standards that society desires to finance. It indicates the proportion of the uniform standards that will be met. In this chapter α is set equal

to one to reflect the costs of building the system to engineering standards. The next chapter contains a calculation of the constraint of these factors to reflect current financing patterns as determined by financing in the various states of the United States.

N_i represents the annual costs of meeting the standard system in each county or city on each legal system. This cost measure provides a means of comparing costs in each county or city because of the application of common construction standards and maintenance cost elements.

V_i refers to the presence of a tax base in each county. The two tax bases used for comparison are the individual income tax and motor fuel. When the income tax base is used, the equation represents the intercounty redistribution of income brought about by meeting the costs of the uniform standards statewide. The motor fuel tax base compares the distribution of the costs of meeting the uniform standards statewide as compared to current highway use.

The income tax base and the motor fuel tax base provide a comparison of a major form of general-purpose taxation with the major user tax.

The choice of the tax base is central to the meaning of the equation. The income tax base reflects the location of taxable resources relative to the location of highway costs. Then the equation gives a measure of the inter-unit redistribution of income needed to meet the highway costs.

The motor fuel tax base reflects the county-of-use of the vehicle and therefore reflects a redistribution according to use of meeting highway costs. The two methods provide a comparison of an ability-to-pay tax with a tax based upon the benefit principle.

γ represents the tax rate that must be applied to the tax base to meet the costs of building and maintaining the highways. The study examines the effect of meeting highway costs on the geographic distribution of resources and, in this chapter, examines the effects of fully financing the costs of meeting the uniform standards, as shown when γ is set equal to one. In this situation, the statewide tax rate necessary to meet the costs equals the sum of the costs for all counties statewide divided by the statewide tax base.¹ This method of calculating the tax rate is used for both the flat rate individual income tax and the motor fuel tax.

The equation is used to compare the geographic distribution of resources that results from using the motor fuel tax as compared with a flat rate income tax. This is a comparison of a benefit-based tax with an ability-to-pay

¹This can be expressed symbolically as

$$\gamma = \frac{\sum_{i=1}^{i=n} N_i}{\sum_{i=1}^{i=n} V_i} \quad \text{with } \alpha = 1 \text{ and } i \text{ standing for each county.}$$

tax. The equation is applied so as to show how much of a subsidy or loss each part of the state is receiving relative to other parts of the state if the costs of meeting the uniform standards are funded.

The Motor Fuel Tax Base

The application of the equation to the motor fuel tax base is examined first. The equation, as applied to each local unit, contains the costs of meeting the uniform standards on one legal system in one city or county minus the product of the fuel consumed on the legal system in that political unit multiplied by the statewide tax rate. The equation is applied separately to each legal system because the legal systems are divided by geographical and functional criteria. The state trunkline system ties together the major business and recreation centers of the state, while the local systems provide access to individual homes and businesses. Under a user tax approach, the more heavily traveled system helps pay for the less heavily traveled system.

The motor fuel consumed on the system is the best available measure of use. As Table 1 in Chapter III showed, the fuel tax and weight taxes have a similar geographic pattern for vehicle use. In addition, fuel tax data are more detailed as to the system upon which the fuel was actually used. The data on fuel use are developed from the unpublished data on highway travel used for the 1970 Needs

Study.¹ The use it reflects is the travel pattern that existed in 1969-1970. The vehicle miles in the data base are converted to gallons by multiplying by 13.65 miles per gallon, the average motor fuel consumption on Michigan highways in 1970. Motor fuel consumption, V_i , is the tax base used for the user charge on each system in each political unit.

The next term in the equation is the tax rate, γ . This rate is calculated by dividing the total cost to be met annually in building and maintaining highways by the total gallons consumed on all the highways in the state. This is represented in symbols:

$$\frac{\sum N_i}{\sum V_i}$$

The annual costs of meeting the uniform standards are calculated by taking 1/20th of the twenty-year costs calculated in the 1970 Needs Study.² This amount includes construction and maintenance costs plus the costs of administering both programs. The dollar costs are in 1970 dollars with no adjustment made for inflation in later years. Since inflation is a national problem and occurs in

¹Michigan Department of State Highways, Transportation Planning Division, unpublished traffic count data.

²Wilbur Smith and Associates, Michigan Highway Needs Summary, 1970-1990 (Lansing, 1972), Appendix C, pp. 1-21.

all parts of the state, inflation is unlikely to influence relative costs substantially among geographic areas of the state. Adjustment is made for differences in the urban and rural costs of construction and maintenance.¹ The annual costs of building and maintaining the standard system in each unit on each system are represented by N_i . The equation for the benefit based tax thus is:

$$E_i = N_i - \frac{\sum N_i}{\sum V_i} V_i$$

E_i equals the subsidy or deficit received by each highway system in each city and county. Under the theory of benefit taxation, it is held that those benefited should pay the tax. The fuel tax measures the use of the facilities and is thus an approximation to benefits received.

The Income Tax

When the above equation is applied to the income tax base, it shows the redistribution of resources required to meet the costs of the standard system by income taxation. The equation yields the net amount of subsidy that must be transferred into or out of a given city or county to meet the costs of the uniform standards.

¹Cost data in the 1970 Needs Study for urban and rural areas differ for two reasons. In recognition of the heavier traffic volume of urban highways, higher engineering standards were allowed for the high-volume, generally urban, highways. Secondly, the cost factors applied to rural and urban highways reflected differences in costs by using a rural average and an urban average for selected cost items.

The costs of meeting the uniform standards N_i are calculated in the same way and are the same as those used for the motor fuel tax. However, the tax base is entirely different. Taxable income is the same as that used in Table 2 of Chapter III. It is closely related to Michigan's current definition of taxable income. It exempts pensions, social security, one-half of capital gains, veterans' benefits and imputed items from the income definition. In the case where the income of a county had to be divided among cities and the county, the taxable income was divided in the same proportion as census income is divided among the cities of a county.¹ The census income is the best available income source for units smaller than a county. V_i used in the equation when applied to the income tax therefore represents the amount of taxable income in the city or county in 1970.

The tax rate, represented by γ in the equation and applied to the taxable income in each unit, is calculated by taking the costs of meeting the standard system and dividing by the total taxable income. In order to retain comparability on each legal system, separate tax rates are calculated for the state trunkline system, the major city streets and the primary county roads combined, and the city and county local roads combined. This is done in order to

¹U.S. Department of the Treasury, Final Data Elements, Entitlement Periods, 1, 2 and 3 (Washington, D.C.: Government Printing Office, 1973), pp. 133-49.

show the amount of income tax required to support each system. In any given county or city, the trunkline system serves the heaviest traffic with the longest trip distances, while the local streets carry the lightest traffic on the shortest trips, often feeding into the larger highways.

There are three separate tax rates for the three different functional classes of roads. The county and city systems that serve roughly the same functions are combined because this illustrates the shift of resources on a state-wide basis rather than merely among cities or among unincorporated portions of counties. The three tax rates are as follows:

<u>System</u>	<u>Tax Rate as a Percent</u>
State trunkline	1.835
County primary and city major	1.673
County and city local	1.645

If the three tax rates are totalled, and this total is multiplied by the total income tax base, the result equals the total cost of meeting the standard system for one year.

When the equation $E_i = N_i - \gamma V_i$ is applied to an income tax base, as described in the preceding paragraphs, the subsidy E_i measures the difference between the annual costs of building and maintaining the standard system for that legal system in a single city or county minus the income tax revenue raised in that city or county. These revenues are estimated by multiplying the amount of taxable income in the city or county by the tax rate necessary to

raise enough money to meet annual costs on that class of highways. Just as with the motor fuel tax, the income tax analysis shows the difference between costs and tax base within the community. Since the tax base is now income, we have a measure comparing each community's primary taxable resource to its costs for highway building and maintenance.

In comparing the benefit-based fuel tax with a general purpose income tax, the fuel tax automatically results in a subsidy among legal systems. This occurs because the tax is levied without differentiation as to which legal system the fuel is used upon. The cost per mile of travel on the less heavily traveled legal systems is much greater because they carry little traffic in proportion to their mileage. For this reason, meeting the total costs of the standard system results in large subsidies to the less heavily traveled roads. This can be shown by calculating the difference between the costs of building and maintaining the standard system and the amount of money raised on each legal system by motor fuel taxation. The results of this calculation are as follows:

<u>System</u>	<u>Subsidy to Each System (in Millions)</u>
State trunkline	-\$150.9
County primary	-10.4
City major	-148.9
County local	238.0
City local	72.2

The large subsidies required to meet costs on the local roads are one of the reasons that the current formula in use in Michigan for aiding highways supplies less money to local roads. In keeping with the benefit principle, more money is devoted to the more heavily traveled systems, since more motorists will benefit from such expenditures.

Measurement of the Subsidies

This section sets forth the results of applying $E_i = \alpha N_i - \gamma V_i$ to each legal system of highways. The tables that follow show the subsidies or deficits that a county or city would pay or receive from a statewide tax levied to pay fully the costs of meeting the uniform standards. A negative subsidy, i.e., when a county or city pays in more than it receives, will be referred to as a deficit. Tables are developed for both the fuel tax and the income tax. Subsidy amounts are also expressed in per capita amounts to facilitate comparison among governmental units of different sizes. An additional reason for using per capita amounts is that this reflects the subsidy being paid per capita to meet these costs.

Table 1 shows the subsidies on the state trunkline system. In 1970 this system contained 9,221 miles of highway, just over 8 percent of all highways in the state¹ but carried 45.6 percent of the vehicle miles of travel. The

¹Michigan Department of State Highways, Nineteenth Annual Progress Report (Lansing, 1971), p. 16.

Table VII-1.--Subsidies* on the State Trunklines by County.

County	(1) Subsidies Under Motor Fuel Tax (in 1,000s)	(2) Per Capita Subsidies Under Motor Fuel Tax	(3) Subsidies Under Income Tax (in 1,000s)	(4) Per Capita Subsidies Under Income Tax
Alcona	\$1,299.3	\$182.66	\$2,160.8	\$303.78
Alger	921.9	107.60	2,031.1	237.06
Allegan	-4,686.6	-70.40	-231.1	-3.47
Alpena	483.8	15.76	1,159.3	37.75
Antrim	1,068.0	84.68	1,988.0	157.63
Arenac	626.2	56.16	2,870.9	257.50
Baraga	-75.2	-9.66	901.5	115.74
Barry	-405.7	-10.63	346.7	9.08
Bay	-3,027.4	-25.80	2,371.6	20.21
Benzie	812.3	94.53	1,717.3	199.85
Berrien	-6,386.3	-38.97	1,080.3	6.59
Branch	-581.5	-15.34	1,032.8	27.25
Calhoun	-9,690.5	-68.26	-3,040.5	-21.42
Cass	-619.3	-14.30	1,743.8	40.26
Charlevoix	301.7	18.24	909.0	54.95
Cheboygan	-1,829.9	-110.41	976.6	58.93
Chippewa	710.8	21.93	1,899.5	58.60
Clare	-2,063.6	-123.61	1,383.8	82.89
Clinton	299.6	6.18	4,438.6	91.53
Crawford	-1,705.4	-263.09	556.5	85.86
Delta	4,450.4	123.88	6,219.9	173.14
Dickinson	346.5	14.59	1,203.6	50.67
Eaton	-1,627.3	-23.62	3,264.2	47.38
Emmet	1,114.3	60.79	2,301.7	125.56
Genesee	894.3	2.01	1,339.3	3.01
Gladwin	-693.0	-51.44	374.0	27.76
Gogebic	3,310.3	160.10	4,361.3	210.94
Grand Traverse	2,266.4	57.85	1,942.0	49.57
Gratiot	-1,017.5	-25.92	1,613.6	41.12
Hillsdale	2,508.4	67.48	3,811.0	102.53
Houghton	-403.1	-11.63	1,302.5	37.59
Huron	-346.8	-10.17	1,035.1	30.37
Ingham	-4,188.3	-16.04	-2,156.1	-5.40
Ionia	-2,257.2	-49.23	788.0	17.19
Iosco	162.7	6.53	1,532.7	54.32
Iron	2,322.9	168.17	3,361.7	243.37
Isabella	-2,757.3	-61.83	-404.8	-9.08
Jackson	-6,827.1	-47.72	-928.9	-6.48
Kalamazoo	1,295.7	6.43	3,453.1	17.13
Kalkaska	190.2	36.07	1,088.4	206.44
Kent	-11,668.1	-28.39	-5,163.3	-12.56
Keweenaw	655.2	289.41	1,030.0	454.94
Lake	-37.3	-6.58	853.0	150.68

Table VII-1.--Continued.

County	(1) Subsidies Under Motor Fuel Tax (in 1,000s)	(2) Per Capita Subsidies Under Motor Fuel Tax	(3) Subsidies Under Income Tax (in 1,000s)	(4) Per Capita Subsidies Under Income Tax
Lapeer	\$ 168.6	\$ 3.22	\$2,917.5	\$ 55.77
Leelanau	396.3	36.45	1,253.0	115.25
Lenawee	-1,527.8	-18.72	1,286.7	15.77
Livingston	-6,909.8	-117.18	682.3	11.57
Luce	376.6	55.47	949.9	139.92
Mackinac	197.9	20.48	2,790.7	288.89
Macomb	-5,731.7	-9.17	-14,940.2	-23.89
Manistee	524.4	26.10	1,749.9	87.08
Marquette	1,580.0	24.43	2,831.9	43.78
Mason	468.4	20.71	1,620.7	71.68
Mecosta	598.3	21.37	2,324.2	83.03
Menominee	3,668.1	149.19	5,090.7	207.05
Midland	-2,873.0	-45.05	-1,635.0	-25.63
Missaukee	270.8	38.01	946.9	132.87
Monroe	-7,902.7	-66.70	1,830.9	15.45
Montcalm	-1,432.4	-36.12	1,349.2	34.02
Montmorency	271.3	51.70	763.7	145.54
Muskegon	-3,967.7	-25.20	-1,575.8	-10.01
Newaygo	-676.9	-24.18	1,224.5	43.75
Oakland	3,606.2	3.97	-16,339.5	-18.00
Oceana	-77.9	-4.33	1,298.2	72.19
Ogemaw	315.2	26.48	1,510.7	126.91
Ontonagon	932.9	88.45	2,107.7	199.81
Osceola	-369.4	-24.90	1,912.1	128.86
Oscoda	-113.8	-24.07	578.8	122.48
Otsego	-1,054.1	-101.14	261.0	25.05
Ottawa	-2,220.7	-17.32	-481.2	-3.75
Presque Isle	221.1	17.22	1,153.2	89.84
Roscommon	-1,580.6	-159.79	1,423.0	143.85
Saginaw	-2,453.3	-11.16	2,354.9	10.72
St. Clair	1,493.5	12.43	3,896.1	32.42
St. Joseph	156.5	3.30	2,889.2	60.96
Sanilac	800.7	22.95	2,743.2	78.62
Schoolcraft	1,689.4	205.37	3,245.0	394.48
Shiawassee	-3,391.2	-53.86	-1,009.5	-16.01
Tuscola	-1,724.3	-35.48	68.0	1.40

Table VII-1.--Continued.

County	(1) Subsidies Under Motor Fuel Tax (in 1,000s)	(2) Per Capita Subsidies Under Motor Fuel Tax	(3) Subsidies Under Income Tax (in 1,000s)	(4) Per Capita Subsidies Under Income Tax
VanBuren	\$-5,187.7	\$ -92.35	\$ -13.3	\$ -0.24
Washtenaw	-12,969.4	-55.40	4,972.2	21.24
Wayne	-69,486.0	-26.06	-74,569.3	-27.96
Wexford	-156.0	-7.91	2,147.1	108.90

*Negative subsidies ($-E_i$) are deficits.

Sources: Cost data adapted from Michigan Highway Needs Summary, 1970-1990, Appendix C-1; data on vehicle miles of travel, unpublished data from the Transportation Planning division, Michigan Department of State Highways; income data from Survey of Current Business--Local Area Personal Income, May 1974, as modified in Chapter III; county population from Bureau of the Census, Number of Inhabitants--Michigan (U.S.G.P.O., 1971).

subsidies are calculated for each county without differentiating between cities and unincorporated areas because the urban extensions are rather short and serve generally the same function within the cities as they do outside the cities. This function is the movement of traffic on long distance trips. A county unit is also appropriate because this system is state administered, resulting in no separate control by each city or county outside urban areas.

The equation for calculating the subsidies and deficits under the motor fuel tax is $E_i = N_i - 0.40569 V_i$ with V_i being the motor fuel tax base expressed in gallons of fuel consumed on the state trunklines in each county. N_i represents the costs of meeting the standards on the trunkline system in each county. The tax rate ($\gamma = 0.40569$) is calculated by dividing the total annual costs of meeting the uniform standards by the total motor fuel consumption on Michigan highways. The subsidy, E_i in each county, is shown in Column 1 of Table 1. The table shows that the largest deficits are paid by urban counties with heavy traffic concentrations, especially Wayne County, and by those rural counties with established freeway systems. Generally, subsidies are paid to the local systems in both city and county and to the counties with lightly traveled trunklines or trunklines that have not kept up with rapid traffic expansion in a county.

The rural deficits stem from large volumes of vehicles using the trunklines in that county to travel

through the county. This result is emphasized by looking at the per capita deficit (Column 2 of Table 1) in some small-population counties such as Crawford. Urban deficits stem from heavy use of trunklines in densely populated areas.

In the case of the income tax, the equation for calculating subsidies ($+E_i$) and deficits ($-E_i$) on the state trunklines is $E_i = N_i - 0.018354 V_i$. The tax rate ($\gamma = 0.018354$) is calculated by dividing the annual costs of meeting the uniform standards on the trunkline system by the statewide income tax base. The tax base V_i is the total taxable income located in each county. N_i is again the cost on the state trunkline system in each county. Application of the equation gives Column 3 of Table 1. Since the trunkline system does not subsidize local roads under the income tax, the deficits are generally smaller, while the subsidies are larger. Exceptions are the three most populous counties in the state. These counties (Wayne, Oakland, and Macomb) have larger deficits because they have large populations with incomes well above the median income for counties in the state. Many rural counties receive large subsidies because of the relatively large system that is supported compared to their population and income. Although rural trunklines are less costly because their standards are lower (since they carry less traffic), the length of these highways is often great. As was shown earlier, many rural freeways earn sufficient user revenues

to more than support themselves because of their use. This indicates the presence of vehicles not owned by the resident population. Some urban counties also receive subsidies because of extensive or inadequate trunklines. Overall, the more urban counties help support the trunklines in the less heavily populated counties with the use of the income tax.

County Roads

The county primary and county local roads are the portions of the highway system that are under control of the counties. These highways serve the unincorporated portions of the counties plus a few extensions into incorporated cities and villages. The county primary system had 25,280 miles of highway in 1970 and the county local system had 62,443 miles. Combined, these highways contained 76.4 percent of all of Michigan's highways but carried only 30.2 percent of the total traffic. The county highway systems are mainly rural and suburban. Only Wayne, Oakland, and Macomb Counties have considerable mileage of county primary highways located in their incorporated areas.

Table 2 shows the subsidies or deficits on county primary roads (Column 1), county local roads (Column 2), the total subsidies or deficits on the county primary and county local roads (Column 3), and the per capita amount of the total subsidy or deficit (Column 4). Table 2 is based upon the calculations for motor fuel taxes. The equation

Table VII-2.--Subsidies on County Roads under the Motor Fuel Tax.

County	(1) Subsidies On County Primary Roads (in 1,000s)	(2) Subsidies on County Local Roads (in 1,000s)	(3) Total Subsidy on County Roads (in 1,000s)	(4) Total Per Capita Subsidy on County Roads
Alcona	\$ 738.8	\$1,859.7	\$2,598.5	\$419.04
Alger	1,073.7	711.3	1,785.0	384.27
Allegan	1,269.6	4,107.4	5,377.0	117.42
Alpena	1,383.1	2,277.7	3,660.8	216.58
Antrim	-350.3	1,384.7	1,034.4	127.58
Arenac	151.8	1,703.1	1,854.9	227.65
Baraga	585.6	927.5	1,513.1	365.93
Barry	550.2	2,260.1	2,810.3	103.06
Bay	386.6	3,656.1	4,042.7	68.05
Benzie	-322.1	734.7	412.6	86.82
Berrien	-1,411.6	5,903.4	4,491.8	43.65
Branch	-176.7	1,695.2	1,518.5	66.87
Calhoun	1,327.4	4,233.2	5,560.6	73.18
Cass	-1,312.1	1,587.6	275.5	8.62
Charlevoix	542.9	1,515.4	2,058.3	268.54
Cheboygan	451.4	1,782.5	2,233.9	218.22
Chippewa	1,065.7	2,994.4	4,060.1	241.93
Clare	239.7	1,893.8	2,133.5	180.51
Clinton	-809.6	1,114.4	304.8	8.80
Crawford	589.9	1,456.7	2,046.6	471.67
Delta	693.4	1,634.6	2,328.0	155.37
Dickinson	827.7	1,296.6	2,124.3	315.08
Eaton	1,088.5	3,107.3	4,195.8	100.03
Emmet	557.7	1,985.7	2,543.4	277.49
Genesee	-7,059.8	6,648.8	-411.0	-1.96
Gladwin	904.1	2,016.8	2,920.9	279.62
Gogebic	1,520.1	1,357.9	2,878.0	449.48
Grand Traverse	-191.6	1,001.3	809.7	40.04
Gratiot	1,917.2	3,057.4	4,974.6	242.45
Hillsdale	1,851.9	3,331.2	5,183.1	227.95
Houghton	2,119.9	2,911.3	5,031.1	287.07
Huron	311.9	3,303.7	3,615.6	171.73
Ingham	-284.0	4,141.1	3,857.1	54.79
Ionia	1,339.3	2,554.6	3,893.9	156.98
Iosco	-230.7	1,362.9	1,132.2	55.48
Iron	1,446.8	1,406.5	2,853.3	517.75
Isabella	-1,376.9	1,720.0	343.1	15.44
Jackson	2,229.5	5,731.1	7,960.6	86.08
Kalamazoo	-274.3	3,634.6	3,360.3	45.87
Kalkaska	-1,036.3	2,043.6	1,007.3	258.48
Kent	-422.1	4,260.5	3,838.4	42.97
Keweenaw	364.1	132.7	496.8	245.19
Lake	-405.5	1,414.8	1,009.3	213.43

Table VII-2.--Continued.

County	(1) Subsidies On County Primary Roads (in 1,000s)	(2) Subsidies on County Local Roads (in 1,000s)	(3) Total Subsidy on County Roads (in 1,000s)	(4) Total Per Capita Subsidy on County Roads
Lapeer	\$1,382.3	\$3,419.8	\$4,802.1	\$124.98
Leelanau	-926.8	905.9	-20.9	-2.23
Lenawee	546.6	3,270.5	3,817.1	91.77
Livingston	532.1	3,159.0	3,691.1	76.28
Luce	682.1	539.9	1,222.0	274.30
Mackinac	984.2	1,689.2	2,673.4	427.67
Macomb	-7,706.5	9,269.2	1,562.7	12.08
Manistee	248.0	2,164.2	2,412.2	229.08
Marquette	940.8	3,003.3	3,944.1	134.95
Mason	563.6	2,712.1	3,275.7	279.33
Mecosta	550.5	2,522.6	3,073.1	211.77
Menominee	1,734.9	2,352.4	4,087.3	337.42
Midland	-268.6	1,809.2	1,540.6	57.63
Missaukee	303.2	1,563.5	1,866.7	316.28
Monroe	522.9	4,862.8	5,385.7	62.98
Montcalm	1,466.9	3,084.0	4,550.9	179.06
Montmorency	772.9	1,811.9	2,584.8	529.57
Muskegon	-1,157.9	3,551.4	2,393.5	42.63
Newaygo	220.6	3,094.5	3,315.1	158.03
Oakland	2,170.0	15,834.5	18,004.5	55.36
Oceana	772.9	2,429.5	3,202.4	279.81
Ogemaw	-206.1	1,705.3	1,499.2	163.76
Ontonagon	1,495.4	1,587.6	3,083.0	379.87
Osceola	-215.6	1,017.3	801.7	87.14
Oscoda	-124.6	1,147.6	1,023.0	216.51
Otsego	-12.7	1,495.8	1,483.1	215.31
Ottawa	-687.2	4,013.4	3,326.2	42.87
Presque Isle	-70.9	1,955.9	1,885.0	278.84
Roscommon	158.3	3,543.5	3,701.8	407.60
Saginaw	1,386.2	7,583.2	8,969.4	77.49
St. Clair	1,088.0	5,189.0	6,277.0	102.23
St. Joseph	563.1	2,008.2	2,571.3	109.34
Sanilac	659.9	5,299.7	5,959.6	248.08
Schoolcraft	1,029.1	596.7	1,625.8	416.66
Shiawassee	1,484.4	2,787.2	4,271.6	128.77
Tuscola	1,044.9	4,779.5	5,824.4	169.16

Table VII-2.--Continued.

County	(1) Subsidies on County Primary Roads (in 1,000s)	(2) Subsidies on County Local Roads (in 1,000s)	(3) Total Subsidy on County Roads (in 1,000s)	(4) Total Per Capita Subsidy on County Roads
VanBuren	\$ -33.2	\$2,450.9	\$2,417.7	\$ 69.08
Washtenaw	-2,389.1	5,704.2	3,315.1	37.05
Wayne	-33,406.0	6,611.2	-26,794.8	-150.95
Wexford	573.1	1,953.6	2,526.7	321.13

Sources: Cost data adapted from Michigan Highway Needs Summary, 1970-1990, Appendices C-2 and C-3; data on vehicle miles of travel, unpublished data from the Transportation Planning Division, Michigan Department of State Highways; county population in unincorporated areas from Michigan Department of State Highways, Twenty-second Annual Progress Report, pp. 140-41.

is $E_i = N_i - 0.40569 V_i$. The costs N_i are for the county primary system and the county local system separately in each county. The tax rate ($\gamma = 0.40569$) is the same as that used for the state trunkline system and the city systems. The tax base V_i is the gallons of motor fuel consumed on each county primary and county local system separately.

The deficits on primary roads in Table 2 occur in high density urban counties and in those rural counties aided by resort traffic or relatively small costs on the primary roads. By far the largest deficit is in Wayne County, where the system contains many high-traffic urban streets, including some in the city of Detroit. Surpluses are generally moderate on the primary system and occur in both urban and rural counties.

On local county roads all counties have surpluses. This occurs because of the massive subsidy this system receives from the more heavily used systems. The local system contains about 54 percent of all highway miles but carries only 6.5 percent of the traffic.

When both primary and local county roads are combined and the fuel tax base is used, only a few counties have deficits. This occurs because of the large subsidy that county local roads receive. This subsidy occurs despite the county local roads having the lowest standards of any system. Only Wayne County has a large deficit, and this is the result of the primary system being much larger than the local system. The bulk of the local roads has

been transferred to city administration in Wayne County, whereas many primary roads in cities are county administered.

Table 3 shows the subsidies or deficits on primary roads and local roads under the income tax base in the unincorporated portions of the counties. The format of Table 3 is similar to that of Table 2.

The equation $E_i = N_i - \gamma V_i$ is used to calculate the subsidies or deficits on the county primary road system under the income tax. The equation uses the following information: N_i = costs of meeting the uniform standards in each county on the county primary system; V_i = the taxable income in the unincorporated portions of each county; γ = the quotient of the combined costs of the county primary roads and the city major streets divided by the tax base: the total taxable income. Combining the city major street and the county local road systems to calculate the income tax rate is justified on two grounds: (1) county primary roads and city major streets serve essentially the same functions, and (2) both systems would be financed by a uniform tax in both rural and urban areas. γ is calculated as 0.016726.

In the calculations for the subsidies or deficits on the county local road system, the equation uses the following information: N_i = the costs of meeting the uniform standards in each county on the county local system; V_i = the taxable income in the unincorporated portion of each county; γ = the quotient of the combined cost of county

Table VII-3.--Subsidies on County Roads under the Income Tax.

County	(1) Subsidies on County Primary Roads (in 1,000s)	(2) Subsidies on County Local Roads (in 1,000s)	(3) Total Subsidy on County Roads (in 1,000s)	(4) Total Per Capita Subsidy on County Roads
Alcona	\$1,320.3	\$1,766.1	\$3,086.4	\$497.73
Alger	1,384.5	713.2	2,097.7	451.60
Allegan	2,589.7	3,286.6	5,876.3	128.32
Alpena	1,724.1	2,184.4	3,908.5	231.23
Antrim	1,306.8	1,495.6	2,802.4	345.63
Arenac	698.9	1,663.7	2,362.6	289.96
Baraga	738.0	923.1	1,661.1	401.72
Barry	1,967.9	1,796.7	3,764.6	138.06
Bay	1,184.5	2,768.1	3,952.6	66.54
Benzie	760.1	849.4	1,609.5	338.70
Berrien	1,873.3	2,758.4	4,631.7	45.01
Branch	1,434.4	996.0	2,430.4	107.3
Calhoun	3,032.3	1,640.0	4,672.3	61.49
Cass	-588.8	1,204.0	615.2	19.26
Charlevoix	1,129.3	1,395.5	2,524.8	329.39
Cheboygan	943.8	1,778.4	2,722.2	265.92
Chippewa	2,376.0	2,885.5	5,261.5	313.52
Clare	1,040.7	2,112.3	3,153.0	266.77
Clinton	1,700.9	307.6	2,008.5	57.98
Crawford	965.9	1,552.7	2,518.6	580.46
Delta	2,087.0	1,460.8	3,547.8	236.79
Dickinson	1,428.2	1,228.5	2,656.7	394.05
Eaton	1,350.8	1,571.1	2,921.9	69.66
Emmet	917.7	2,032.5	2,950.2	321.86
Genesee	1,811.1	-814.1	997.0	4.74
Gladwin	1,055.7	2,649.7	3,705.4	354.72
Gogebic	1,996.5	1,525.4	3,521.9	550.04
Grand Traverse	501.0	622.5	1,123.5	55.56
Gratiot	2,534.1	2,684.3	5,218.4	254.33
Hillsdale	3,102.7	3,634.4	6,737.1	296.29
Houghton	1,962.0	2,526.2	4,488.2	256.09
Huron	806.8	3,874.0	4,680.8	222.32
Ingham	2,509.6	1,625.8	4,135.4	2.94
Ionia	2,322.6	2,089.7	4,412.3	177.87
Iosco	66.2	716.6	782.8	38.36
Iron	1,947.4	1,422.1	3,369.5	611.41
Isabella	508.8	1,799.7	2,308.5	103.92
Jackson	3,498.3	2,834.1	6,332.4	68.49
Kalamazoo	5,584.8	1,547.1	7,131.9	97.35
Kalkaska	44.9	2,109.0	2,153.9	552.71
Kent	2,116.7	2,408.9	4,525.6	50.67
Keweenaw	626.2	130.7	756.9	373.57
Lake	796.5	1,679.7	2,476.2	523.61

Table VII-3.--Continued.

County	Subsidies On County Primary Roads (in 1,000s)	Subsidies on County Local Roads (in 1,000s)	Total Subsidy on County Roads (in 1,000s)	Total Per Capita Subsidy on County Roads
Lapeer	\$2,145.8	\$2,783.3	\$4,929.1	\$128.29
Leelanau	114.8	1,407.9	15,22.7	162.90
Lenawee	2,391.8	2,830.3	5,222.1	125.55
Livingston	1,194.3	1,742.2	2,936.5	60.69
Luce	853.7	516.0	1,369.7	307.45
Mackinac	1,642.5	1,860.0	3,502.5	560.30
Macomb	6,183.9	4,548.4	10,732.3	82.98
Manistee	1,076.1	2,221.5	3,297.6	313.17
Marquette	1,560.7	2,244.9	3,805.6	130.21
Mason	1,005.2	2,952.5	3,957.7	337.49
Mecosta	1,217.3	2,879.7	4,097.0	282.34
Menominee	2,612.0	2,288.8	4,900.8	404.59
Midland	1,471.3	1,416.1	2,887.4	108.00
Missaukee	816.5	1,594.4	2,410.9	408.49
Monroe	2,215.4	2,168.0	4,383.4	51.26
Montcalm	1,299.7	2,576.7	3,876.4	152.52
Montmorency	989.4	1,820.7	2,810.1	575.72
Muskegon	2,027.5	2,570.9	4,598.4	81.91
Newaygo	954.6	3,109.2	4,063.8	193.72
Oakland	16,483.0	21,329.7	37,812.7	116.26
Oceana	1,604.9	2,464.9	4,069.8	355.60
Ogemaw	1,057.8	1,978.6	3,036.4	331.67
Ontonagon	1,730.9	1,535.0	3,265.9	402.41
Osceola	596.5	1,675.3	2,271.8	246.93
Oscoda	904.7	1,355.3	2,260.0	478.21
Otsego	891.0	1,439.9	2,330.9	338.40
Ottawa	424.2	2,850.2	3,274.4	42.20
Presque Isle	1,187.5	2,246.7	3,434.2	508.01
Roscommon	1,477.5	3,811.4	5,288.9	582.35
Saginaw	1,430.9	3,895.5	5,326.4	46.01
St. Clair	3,657.1	4,676.5	8,333.6	135.72
St. Joseph	1,451.5	1,969.1	3,420.6	145.46
Sanilac	1,558.7	5,413.8	6,972.5	290.24
Schoolcraft	1,415.9	554.5	1,970.4	504.98
Shiawassee	1,782.7	2,091.5	3,874.2	116.79
Tuscola	2,686.0	4,810.6	7,496.6	217.72

Table VII-3.--Continued.

County	Subsidies on County Primary Roads (in 1,000s)	Subsidies on County Local Roads (in 1,000s)	Total Subsidy on County Roads (in 1,000s)	Total Per Capita Subsidy on County Roads
VanBuren	\$1,576.5	\$2,364.5	\$3,941.0	\$112.61
Washtenaw	2,888.9	1,846.9	4,735.8	53.07
Wayne	10,882.9	960.5	11,843.4	66.72
Wexford	809.9	1,983.4	2,793.3	355.02

Sources: Cost data adapted from Michigan Highway Needs Summary, 1970 1990, Appendices C-2 and C-3; income data from Survey of Current Business--Local Area Personal Income, May, 1974, as modified in Chapter III; Department of Treasury, Final Data Elements, Entitlement Periods 1, 2, & 3 (U.S.G.P.O., 1973); populations of unincorporated areas from Michigan Department of State Highways, Twenty-second Annual Progress Report, pp. 140-41.

local roads and city streets divided by the taxable income. γ is calculated to be 0.016452.

The results of the calculations in Column 1 of Tables 2 and 3 of county primary subsidies or deficits show that subsidies predominate and their total is much larger under the income tax than under the motor fuel tax. In fact, the subsidy to the county primary system is \$200.2 million as compared with a deficit of \$10.4 million under the motor fuel tax. This is the result of the greater geographic concentration of income and income tax collections in cities and villages than the concentration of motor vehicle usage and motor fuel tax collections. The largely rural and suburban areas served by the county system have more miles of highway (therefore higher construction and maintenance costs) relative to income than do cities and villages.

Column 2 of Table 3 shows that county local roads also receive large subsidies under the income tax. These subsidies are usually larger on the county local system than on the county primary system in rural counties. This occurs because rural counties with lightly traveled local systems spend little on these roads while maintaining the primary roads. In the more urban counties, costs of expanding the county primary system to serve increased rural and suburban development frequently result in greater costs and subsidies on the primary road system. Table 3 illustrates the large subsidies received by the county

local road system. These subsidies have a net value of \$190.2 million as compared to \$238.0 million for this system under the motor fuel tax. However, the origin of the subsidy is completely different from that under the fuel tax. The income tax subsidy comes from the cities and villages. When the subsidies in Columns 1 and 2 of Table 3 are added for both the county primary system and the county local system, the subsidies are greater than the subsidies under the motor fuel tax in most counties. The subsidies, as shown in Table 3, tend to be larger in total but smaller on a per capita basis in the more urban counties, even though city and village populations were not included in calculating the per capita amounts.

City Streets

The city streets are divided into city major streets and city local streets. City major streets consisted of 4,992 miles in 1970, or 4.35 percent of total highway mileage. They serve similar functions to county primary roads but are located in cities and villages. The city local streets had 12,855 miles in 1970, or 11.20 percent of all Michigan highways. These streets serve a function similar to county local roads. The city- and village-controlled highway systems are smaller and therefore less costly than the county systems, even though the city and village systems generally are built to higher standards because of heavier use. The city-controlled

highway systems carried 29.2 percent of all traffic in 1970.

Michigan has 531 cities and villages. Of this number, many are quite small and do not operate a highway system that can be characterized as urban. For example, 191 of the cities and villages had populations of less than 1,000 in 1970. In order to concentrate on largely urban highway systems, and to hold the tables for cities to manageable size, a sample was chosen. The sample consists of all cities and villages in existence and having a population of over 20,000 in 1970. In addition, the largest city or village in a county was included if it had at least 1,000 people. This sample provides coverage of all large urban areas and many smaller ones. It guarantees representation to core cities, suburbs, and rural market centers. Only eight of the 83 counties do not have a city or village with a population of at least 1,000; thus good geographic representation is guaranteed. The sample covers 77.1 percent of all the costs on the city and village major system and 78.4 percent on the city local system.

Because many cities did not participate in the 1970 Needs Study, estimates had to be made on costs and road use for 26 cities. These estimates were constructed from data for cities with characteristics similar to the sample city, supplemented with cost data gathered by the Michigan Department of State Highways since the 1970 Needs Study.

Tables 4 and 5 show a comparison of the costs of maintaining the standard system in the sample of 113 Michigan cities with a fuel tax and an income tax respectively.

Table 4 is based on the equation $E_i = N_i - 0.40569 V_i$. The V_i s represent the amount of motor fuel consumed on city major streets or city local streets in each city of the sample. The N_i s represent the costs of meeting the standard system on either the major or local city street system in each city. The tax rate is, again, the rate necessary to meet the highway costs on all systems. The E_i s represent the subsidies or deficits on each city's major streets (Column 1) and local streets (Column 2).

The results of applying the equation above are shown in Table 4. Subsidies on the major system are confined to the smaller cities, largely under 10,000 population. These cities also tend to be isolated from other cities so that their traffic patterns are not influenced by a large metropolitan area. Even some of the cities in this group, such as Alma, Charlevoix, and Clare, plus all of the large cities, have deficits. Detroit has the largest deficit because of its heavily traveled system, which is also the largest of any of the cities. Overall, the cities have a deficit on this system, with the bulk of the deficit in the larger cities.

Cities have a few deficits on the city local system with a fuel tax, as shown in Table 4. These deficits tend

Table VII-4.--Subsidies on City Streets under the Motor Fuel Tax.

City or Village	(1) Subsidies on City Major Streets (in 1,000s)	(2) Subsidies on City Local Streets (in 1,000s)	(3) Total Subsidies on City Streets (in 1,000s)	(4) Total Per Capita Subsidy on City Streets
Adrian	\$ -219.9	\$ 447.4	\$ 227.5	\$ 11.16
Allegan	-119.1	99.7	-19.4	-4.30
Allen Park	-581.6	57.0	-524.6	-12.87
Alma	-139.0	197.8	58.8	6.01
Alpena	-189.9	443.3	253.3	18.35
Ann Arbor	-2,890.2	73.2	-2,817.0	-28.23
Bad Axe	-20.4	41.5	21.1	7.04
Battle Creek	-336.7	288.4	-78.3	-2.01
Bay City	-560.0	888.7	328.7	6.65
Benton Harbor	-472.4	202.7	-269.7	-16.36
Berkley	-600.1	-51.2	-651.3	-28.80
Big Rapids	-162.1	173.0	10.9	0.91
Birmingham	-952.5	431.3	-521.2	-19.92
Cadillac	41.4	340.9	382.3	38.27
Caro	34.1	63.3	29.2	7.88
Charlevoix	-43.2	85.0	41.8	11.89
Charlotte	99.1	307.7	406.8	49.34
Cheboygan	24.9	327.7	352.6	63.50
Clare	-31.6	39.1	7.5	2.84
Coldwater	-104.3	88.7	-15.6	-1.71
Dearborn	-3,087.0	-300.9	-3,387.9	-32.51
Dearborn Hgts.	-1,095.5	471.7	-623.8	-7.79
Detroit	-47,481.9	12,207.5	-35,274.4	-23.34
Dowagiac	-50.0	161.4	111.4	16.92
East Detroit	-1,673.8	-342.5	-2,016.3	-43.91
East Lansing	-379.4	-13.0	-392.4	-8.25
East Tawas	63.5	228.0	291.5	122.89
Escanaba	-202.4	212.0	9.6	0.62
Ferndale	-800.6	364.2	-436.4	-14.15
Flint	-5,389.2	1,642.8	-3,746.4	-19.38
Frankfort	-32.0	31.6	-0.4	-0.24
Fremont	-62.1	4.2	-57.9	-16.71
Garden City	88.8	1,123.3	1,212.1	28.95
Gaylord	13.0	138.4	151.4	50.27
Gladwin	-29.9	71.1	41.2	19.89
Grand Rapids	-6,382.5	1,019.3	-5,363.2	-27.13
Grayling	-26.7	36.4	9.7	4.53
Greenville	-79.5	224.4	144.9	19.34
Grosse Pt. Woods	-160.3	-204.1	-364.4	-16.66
Hamtramck	-1,142.3	-28.4	-1,170.7	-42.97
Harper Woods	107.8	281.6	389.4	19.29
Hart	-16.8	75.0	58.2	27.22

Table VII-4.--Continued.

City or Village	(1) Subsidies on City Major Streets (in 1,000s)	(2) Subsidies on City Local Streets (in 1,000s)	(3) Total Subsidies on City Streets (in 1,000s)	(4) Total Per Capita Subsidy on City Streets
Hastings	\$ -248.7	\$ 47.1	\$ -201.6	\$-31.01
Hazel Park	-500.8	296.0	-204.8	-8.61
Highland Park	-1,606.7	-136.7	-1,743.4	-49.19
Hillsdale	197.1	275.0	472.1	61.09
Holland	-510.5	894.7	384.2	16.71
Houghton	36.7	132.0	168.7	27.81
Howell	18.2	201.7	219.9	42.09
Inkster	-233.5	-63.6	-297.1	-7.70
Ionia	33.3	144.8	178.1	27.99
Iron Mountain	84.2	563.9	648.1	74.48
Iron River	23.2	121.5	144.7	53.91
Ironwood	146.1	451.2	597.3	68.57
Jackson	-1,403.0	61.1	-1,341.9	-29.50
Kalamzoo	-2,412.0	884.3	-1,527.7	-17.86
Kalkaska	10.6	129.6	140.2	95.05
Kentwood	-563.8	643.0	79.2	3.90
L'Anse	-3.6	72.9	69.3	27.30
Lansing	-1,662.1	2,425.0	762.9	5.80
Lapeer	-21.5	222.1	200.6	31.99
Lincoln Park	-1,036.5	-635.0	-1,671.5	-31.54
Livonia	-761.5	1,046.5	285.0	2.59
Ludington	104.2	688.9	793.1	87.92
Madison Heights	-280.6	750.4	469.8	13.20
Mancelona	6.0	85.8	91.8	74.35
Manistee	34.4	275.9	310.3	40.18
Manistique	6.1	156.0	162.1	37.49
Marquette	-1,175.0	-50.9	-1,225.9	-55.81
Menominee	47.6	302.8	350.4	32.60
Midland	-1,838.0	611.8	-1,226.2	-34.86
Monroe	-51.0	317.5	266.5	11.15
Mount Clemens	-385.1	-24.9	-410.0	-20.02
Mount Pleasant	-413.7	47.0	-366.7	-17.88
Munising	85.7	110.7	196.4	53.41
Muskegon	-522.7	594.8	72.1	1.62
Newberry	66.5	106.2	172.7	73.99
Norton Shores	-188.2	600.4	412.2	18.51
Oak Park	-870.7	250.6	-620.1	-16.87
Ontonagon	-31.5	66.5	35.0	14.39
Owosso	-242.2	357.2	115.0	6.69
Petoskey	8.7	268.7	277.4	43.74
Pontiac	-2,262.0	1,539.7	-722.3	-8.47
Portage	-28.3	906.2	877.9	26.14

Table VII-4.--Continued.

City or Village	(1) Subsidies on City Major Streets (in 1,000s)	(2) Subsidies on City Local Streets (in 1,000s)	(3) Total Subsidies on City Streets (in 1,000s)	(4) Total Per Capita Subsidy on City Streets
Port Huron	\$ -783.7	\$ 466.8	\$ -316.9	\$ -8.85
Reed City	-10.3	42.7	32.4	14.18
Rogers City	13.2	191.4	204.6	47.86
Romulus	-691.5	235.8	-455.7	-19.92
Roseville	-647.7	608.9	-38.8	-0.64
Royal Oak	-2,489.9	-123.1	-2,613.0	-30.56
Saginaw	-804.7	1,284.7	480.0	5.23
St. Clair Shores	-789.4	1,380.7	591.3	6.71
St. Ignace	17.5	156.8	174.3	60.27
St. Johns	-121.1	187.3	66.2	9.93
Sandusky	-20.5	33.1	12.6	6.08
Sault Ste. Marie	-143.3	977.3	834.0	55.10
Southfield	-1,091.4	1,658.2	566.8	8.18
Southgate	-123.1	-55.8	-178.9	-5.28
South Haven	25.5	-17.0	8.5	1.31
Standish	-11.0	26.4	15.4	13.02
Sterling Heights	-214.6	455.1	240.5	3.92
Sturgis	-80.8	114.4	33.6	3.61
Taylor	-360.7	1,898.7	1,538.0	21.96
Traverse City	-1,074.1	187.8	-886.3	-49.11
Trenton	-185.9	78.2	-107.7	-4.46
Troy	235.1	1,120.5	1,355.6	34.39
Warren	-7,498.9	682.8	-6,816.1	-38.02
Wayne	-276.4	63.2	-213.2	-10.13
Went Branch	27.6	19.1	46.7	24.45
Westland	-503.2	863.8	360.6	4.16
Wyandotte	-337.1	429.3	92.2	2.25
Wyoming	-2,046.5	586.8	-1,459.7	-25.81
Ypsilanti	-537.3	3.2	-534.1	-18.8

Sources: Cost data adapted from Michigan Highway Needs Summary 1970-1990, Appendices C-4 and C-5; data on vehicle miles of travel, unpublished data from the Transportation Planning Division, Michigan Department of State Highways; population data from Bureau of the Census, Number of Inhabitants--Michigan (U.S.G.P.O., 1971), pp. 21-34.

to occur in the older suburbs of Detroit. These cities tend to be more compact than newer suburbs and to have their street systems completed. Most cities receive subsidies on the city local system. On balance, this system receives a large subsidy, although considerably smaller than that given to the county local roads by an amount of \$165.8 million.

When the subsidies and deficits on both systems are combined, 45 of the 113 cities in the sample have deficits. This includes the city of Detroit, several other core cities, some of the suburbs and several small cities. Cities with subsidies tend to have rural settings which hold down the general level of traffic, or to be newer suburbs with high street costs.

Table 5 shows the subsidies and deficits resulting from financing the costs of meeting the standard system with the income tax base. The equations are the same as those used on the county primary and county local systems except that N_i refers to the costs on city major streets and city local streets. V_i refers to the income tax base within the city.

In Table 5 the vast majority of cities have deficits on both the city major system and the city local system. Those few cities with subsidies tend to have rather high costs on their highway systems with relatively low taxable incomes. The high costs stem partly from neglect and partly from system size relative to income.

Table VII-5.--Subsidies on City Streets under the Income Tax.

City or Village	(1) Subsidies on City Major Streets (in 1,000s)	(2) Subsidies on City Local Streets (in 1,000s)	(3) Total Subsidies on City Streets (in 1,000s)	(4) Total Per Capita Subsidy on City Streets
Adrian	\$ -421.7	\$ -267.0	\$ -688.7	\$-33.79
Allegan	-84.4	-21.0	-105.4	-23.34
Allen Park	-2,554.4	-2,223.0	-4,777.4	-117.25
Alma	-217.8	-106.3	-324.1	-33.11
Alpena	-96.6	23.8	-72.8	-5.27
Ann Arbor	-4,080.5	-5,260.8	-9,341.3	-93.60
Bad Axe	-104.0	-81.0	-185.0	-61.70
Battle Creek	1,094.6	-753.9	340.7	8.75
Bay City	21.0	-614.1	-593.1	-11.99
Benton Harbor	180.6	-158.8	21.8	1.32
Berkley	-1,014.1	-1,100.7	-2,114.8	-93.50
Big Rapids	-196.6	34.3	-162.3	-13.53
Birmingham	-1,835.1	-1,801.2	-3,636.3	-138.95
Cadillac	-98.7	175.6	76.9	7.70
Caro	-150.2	-101.5	-251.7	-68.01
Charlevoix	-101.5	1.0	-100.5	-28.57
Charlotte	-276.7	-37.6	-314.3	-38.12
Cheboygan	-34.9	226.8	191.9	34.57
Clare	-82.0	-8.6	-90.6	-34.34
Coldwater	-127.0	-224.6	-351.6	-38.64
Dearborn	-6,019.8	-6,678.7	-12,698.5	-121.87
Dearborn Heights	-4,435.3	-2,683.3	-7,118.6	-88.91
Detroit	-54,675.5	-54,689.0	-109,364.5	-72.36
Dowagiac	-245.7	-103.6	-349.3	-53.07
East Detroit	-2,447.2	-2,584.5	-5,031.7	-109.58
East Lansing	-1,636.2	-2,079.2	-3,715.4	-78.15
East Tawas	-28.5	131.1	102.6	43.25
Escanaba	-103.2	-176.8	-280.0	-18.19
Ferndale	-1,184.0	-922.5	-2,106.5	-68.28
Flint	-4,914.2	-6,900.6	-11,814.8	-61.12
Frankfort	-46.8	-10.6	-57.4	-34.56
Fremont	-140.6	-109.2	-249.5	-72.01
Garden City	-1,821.1	-775.6	-2,596.7	-62.03
Gaylord	-31.4	61.7	30.3	10.06
Gladwin	-59.5	29.6	-29.9	-14.44
Grand Rapids	-5,071.9	-6,214.3	-11,286.2	-57.10
Grayling	-54.6	-1.9	-56.5	-26.35
Greenville	-211.5	-40.0	-251.5	-33.56
Grosse Pt. Woods	-2,072.6	-2,035.6	-4,108.2	-187.78
Hamtramck	-1,169.3	-1,120.1	-2,289.4	-84.03
Harper Woods	-1,263.8	-881.0	-2,144.8	-106.25
Hart	-29.9	22.8	-7.1	-3.32

Table VII-5.--Continued.

City or Village	(1) Subsidies on City Major Streets (in 1,000s)	(2) Subsidies on City Local Streets (in 1,000s)	(3) Total Subsidies on City Streets (in 1,000s)	(4) Total Per Capita Subsidy on City Streets
Hastings	\$ -217.5	\$ -178.2	\$ -395.7	\$-60.87
Hazel Park	-951.7	-893.1	-1,844.8	-77.56
Highland Park	-1,540.5	-1,675.9	-3,216.4	-90.75
Hillsdale	-65.1	-73.5	-138.6	-17.94
Holland	-401.0	-325.5	-726.5	-31.60
Houghton	-94.9	-33.8	-128.7	-21.20
Howell	-154.8	-56.6	-211.4	-40.48
Inkster	-1,766.0	-1,403.7	-3,169.7	-82.13
Ionia	-160.3	-127.9	-288.2	-45.31
Iron Mountain	-110.8	255.6	144.8	16.64
Iron River	82.6	83.2	165.8	61.79
Ironwood	183.4	263.4	446.8	51.29
Jackson	-828.6	-1,270.0	-2,098.6	-46.14
Kalamazoo	-349.0	-2,451.5	-2,800.5	-32.73
Kalkaska	26.0	110.9	136.9	92.77
Kentwood	-561.2	-215.8	-777.0	-38.26
L'Anse	-34.3	9.9	-24.4	-9.61
Lansing	-2,040.0	-3,415.8	-5,455.8	-41.47
Lapeer	-111.5	3.6	-107.9	-17.20
Lincoln Park	-3,011.6	-2,953.6	-5,965.2	-112.57
Livonia	-6,178.6	-4,683.2	-10,861.8	-98.65
Ludington	-289.0	283.4	-5.6	-0.62
Madison Heights	-838.2	-1,040.9	-1,879.1	-52.79
Mancelona	-7.7	64.5	56.8	46.04
Manistee	-42.0	86.9	44.9	5.81
Manistique	-49.9	94.7	44.8	10.35
Marquette	-254.9	-525.0	-779.9	-35.51
Menominee	-130.6	-43.1	-173.7	-16.17
Midland	-1,373.1	-1,202.9	-2,576.0	-73.23
Monroe	-675.5	-717.2	-1,392.7	-58.29
Mount Clemens	-1,222.9	-837.5	-2,060.4	-100.63
Mount Pleasant	-629.5	-610.2	-1,239.7	-60.46
Munising	-2.5	14.3	11.8	3.19
Muskegon	342.5	-888.6	-546.1	-12.24
Newberry	-34.0	10.0	-24.0	-10.28
Norton Shores	395.2	-355.5	39.7	1.78
Oak Park	-1,827.5	-1,976.3	-3,803.8	-103.47
Ontonagon	-62.2	-3.2	-65.4	-26.87
Owosso	-617.7	-495.7	-1,113.4	-64.81
Petoskey	-175.2	22.4	-152.8	-24.08
Pontiac	-268.7	-1,456.6	-1,725.3	-20.23
Portage	-1,517.3	-293.8	-1,811.1	-53.92

Table VII-5.--Continued.

City or Village	(1) Subsidies on City Major Streets (in 1,000s)	(2) Subsidies on City Local Streets (in 1,000s)	(3) Total Subsidies on City Streets (in 1,000s)	(4) Total Per Capita Subsidy on City Streets
Port Huron	\$ -680.7	\$ -859.0	\$ -1,539.7	\$-43.02
Reed City	-46.4	-17.7	-64.1	-28.04
Rogers City	-84.6	78.8	-5.8	-1.36
Romulus	-1,128.2	-394.2	-1,522.4	-66.54
Roseville	-2,805.6	-2,183.3	-4,988.9	-82.42
Royal Oak	-8,802.9	-9,563.5	-18,366.4	-214.81
Saginaw	-480.0	-2,359.8	-2,839.8	-30.92
St. Clair Shores	-4,967.0	-3,557.3	-8,524.3	-96.76
St. Ignace	9.8	109.3	119.1	41.18
St. Johns	-274.4	-101.5	-375.9	-56.34
Sandusky	-66.7	-19.7	-86.4	-41.72
Sault Ste. Marie	154.8	351.7	506.5	33.46
Southfield	-5,676.3	-4,329.0	-10,005.3	-144.41
Southgate	-7.7	280.5	272.8	8.04
South Haven	-8.2	-13.8	-22.0	-3.40
Standish	-20.4	-6.8	-27.2	-22.97
Sterling Heights	-1,797.6	-2,733.5	-4,531.1	-73.84
Sturgis	-319.1	-256.0	-575.1	-61.87
Taylor	-2,672.7	-780.8	-3,453.5	-49.32
Traverse City	-693.8	-276.1	-969.9	-53.74
Trenton	-1,519.1	-1,265.5	-2,784.6	-115.41
Troy	-2,088.7	-1,361.8	-3,450.5	-87.53
Warren	-8,456.3	-8,251.2	-16,707.5	-93.20
Wayne	-983.2	-942.9	-1,926.1	-91.48
West Branch	10.3	-19.3	-9.0	-4.71
Westland	-4,169.7	-3,574.8	-7,744.5	-89.27
Wyandotte	-1,787.8	-1,486.4	-3,274.2	-79.74
Wyoming	-1,256.8	-1,614.7	-2,871.5	-50.77
Ypsilanti	-602.9	-906.4	-1,509.3	-51.10

Sources: Cost data adapted from Michigan Highway Needs Summary, 1970-1990, Appendices C-4 and C-5; income data from Survey of Current Business-Local Area Personal Income, May, 1974, as modified in Chapter III; Department of Treasury, Final Data Elements, Entitlement Periods 1, 2, and 3 (U.S.G.P.O., 1973); population data from Bureau of the Census, Number of Inhabitants--Michigan (U.S.G.P.O., 1971), pp. 21-34.

Far more cities have overall deficits, and the deficits are generally larger when total per capita deficits for the income tax are compared with the fuel tax. The total subsidy from city to county systems, computed as the items in Table 5, is \$153.4 million on the major system and \$190.2 million on the local system. This occurs because the county systems are much larger and have fewer people living in the areas they serve.

Conclusion

This chapter has compared the distribution of resources resulting from using a fuel tax or an income tax to finance the costs of meeting the standard system. The results are that either method of finance involves considerable subsidization of one part of a highway system by the rest of the system. In addition, there is subsidization among the highway systems. Under the fuel tax the subsidy goes from the heavily traveled systems to those with less traffic. The state trunkline system, particularly in urban areas and heavily traveled freeway sections, and the bulk of the city major system plus the portions of the county primary system in a few urban and resort counties, pay to support the less heavily traveled systems. The balance of the highways in the state is subsidized. Under the income tax, the subsidies are more directly from the cities to the counties. This occurs because the rural road mileage is

so much greater that cost savings from lower standards are more than offset.

The comparisons developed in this chapter are based upon the total cost of meeting the uniform standards of the 1970 Needs Study. These costs are assumed to be financed by the state, using either the fuel tax or the income tax. In this way total annual costs of building and maintaining highways are compared with the location of taxable resources of both the benefit-based fuel tax and the income tax. The chapter shows the location of resources for highway building and maintenance relative to the costs.

Finally, it should be noted that the expenditure necessary to meet the standards is much higher than is usually spent on highways. The costs are high because of the use of high construction standards and the desire to provide an all-weather highway system throughout the state. In addition, the local road systems that received such heavy subsidies are usually partially financed locally. The next chapter will deal with constraining the costs to fit into current expenditures for highways and to allow for local finance.

CHAPTER VIII

FACTORS DETERMINING HIGHWAY EXPENDITURES AND CONSTRAINT OF THE COSTS OF THE STANDARD SYSTEM

Introduction

Chapter VII showed the distribution of the costs of the standard system relative to motor fuel use and income. The costs involved were considerably higher than the actual payments for highways in the year the costs were calculated. Standards on which the costs were calculated were designed to provide a high quality of service in both urban and rural areas in terms of the standards for the system, and to provide options for local citizens and road builders in designing highways. The result was an annual cost of building and maintaining highways in excess of the amount of revenues available for highway building and maintenance. Such costs would require a fuel tax of \$0.4057 per gallon of motor fuel while 1973 highway expenditures equalled a motor fuel tax of only \$0.1866.¹ Total 1970 highway

¹The cost per gallon is calculated by taking the total costs of meeting the uniform standards and dividing by the 1970 taxed motor fuel consumption. The 1973 expenditures per gallon are calculated by dividing the

expenditures were only 43 percent of the annual costs of meeting the uniform standards.

This chapter deals with constraining the costs of meeting the uniform standards to levels that are more likely to be financed by the citizenry. It constitutes step six as described in Chapter I of this study.

An overall constraint for the whole state is calculated because the study continues to assume statewide collection of a tax to fund highways, with distribution to various political jurisdictions. The constraint can then be used to reduce the costs for each jurisdiction and for each legal system by the proportion that the constraint reduces statewide costs. This can be shown by changing the equation used in the previous section. The equation is

$$E_i = \alpha N_i - \gamma V_i$$

In the previous chapter the constraint α was set equal to one. In this chapter a lower value will be developed. The constraint will equal the ratio of the state and federal taxes devoted to highway purposes divided by the total cost of building the highway system. Results of applying the equation with the constraint on each system are that the state supplies the same proportion of costs for each system in each county or city.

estimated expenditures for 1973 by the gallons of taxed motor fuel consumption for that year.

Economic meaning of the constraint is that each local highway authority must choose the highest priority projects and delete those of lower priority. The costs of meeting the uniform standards are developed by applying a cost factor to each construction or maintenance component (paving, base, shoulders, etc.) sufficient to meet the uniform standards on each project. By reducing or deleting individual projects, the total costs of meeting the uniform standards in a jurisdiction on a given highway system can be reduced to meet the constraint. This method of applying the constraint allows each local unit to apply its funds so as to maximize benefits over costs in the unit. The unit can choose the projects with the highest benefit-cost ratios and, in that way, maximize the returns from state investment.¹ Since the cost standards are designed with

¹Costs of the project to nearby land users and the economy in general, as well as user benefits, must be considered in constructing cost-benefit analyses. Double counting of a cost or benefit must be avoided. Currently, any analyses involving state trunklines would be conducted by the Michigan Department of State Highways and Transportation under general legislative supervision. Both federal and state laws in recent years have encouraged consideration of environmental and neighborhood impacts. The Highway Department has also been given responsibility for other modes of transportation. This may help to broaden the perspective of transportation analysis.

In cities and villages the council would have decision-making powers for city streets, with the department of public works providing staff. Sometimes a traffic commission gathers further input. For counties, a County Road Commission, usually appointed by the county board of commissioners, has primary supervisory responsibility for county road planning, management and construction. The elected county board of commissioners and elected township boards become involved when money in addition to earmarked user taxes is needed for a project. The present system of

expected use taken into account, they reflect the number of users benefited. The design standards provide benefits in reduced vehicle wear, travel time and accident rates. The cost factors also reflect differing costs in urban and rural areas. By meeting the same proportion of costs, each political unit can provide the same proportion of highway projects on that legal system in each unit. If there is only one funding source and if deficiencies in highway service are proportional to costs, this results in uniform services as defined by the uniform cost standards.

Local Roads and Streets

As Chapter VII shows, local roads and streets receive large subsidies from higher-level systems while they carry only light traffic. In addition, these systems tend to be used for the shortest trip-lengths. These roads and streets are used for local trips almost exclusively. Because of these limited spill-over effects, local roads depend in part on local financing.

In this study a 50 percent local share for costs of construction on local roads is assumed. This figure is used for two reasons. The first is that local spending on roads and streets is approximately equal to 50 percent of total spending by the state and its local governments on local roads and streets. This percentage did not vary

highway management provides considerable room for input into analysis. However, increased input and analysis with a broader view is still needed.

markedly from year to year between 1969 and 1973. This appears to reflect the amount of local support that citizens will provide, given alternative uses for the funds.

Secondly, since the local roads and streets (legal systems three and five) carry small amounts of traffic for short distances, few motorists benefit from improvements and those benefits that result are largely local in impact. It is for these reasons that a portion of local road improvement is left to local resources. The state share is aimed at providing money for the most essential construction projects and the maintenance necessary for minimum usability. For example, current Michigan highway law requires 50 percent matching on legal systems three and five for construction other than bridges.¹ Bridge construction requires local matching of only 25 percent.

A question might be raised as to whether the 50 percent matching on construction has not been the cause of the approximately 50 percent local contribution. In actual fact, maintenance makes up much of the local expenditures on these lightly traveled systems, since weather conditions are the major influence on maintenance costs. Some local money is spent on legal systems two (the county primary system) and four (city major streets), although such expenditures allow transfers to legal systems three and

¹John T. Rice (Ed.), Michigan Statutes Annotated, Sections 9.1097(12) and 9.1097(13).

five on a dollar-for-dollar basis. This provision for transfer is frequently not used. Cities tend to spend more local funds than the matching requires, suggesting that the provision has little influence on them. While some counties have difficulty meeting matching provisions, failure to match does not mean a loss of state aid. The aid expenditure is simply redirected to maintenance. Overall, the state-local matching requirements have very limited effect on total expenditures on the local systems.

In the remainder of this study, the construction costs on systems three (county local roads) and five (city local streets) will be reduced by 50 percent. This is done for the following reasons:

1. The reduced costs are used to measure the effect on state highway finance of setting payments to the least traveled highways of the state equal to reduced costs. A reason for reduced state aid is that the spillover effects on these highways are far less than on more heavily traveled systems.
2. Reduction of the local road and street construction costs will provide a basis for evaluating the state highway aid formula. The current state formula contains a legal provision that 50 percent of local road and street construction costs are to be met by local funds.

3. Current local government financing of local streets and roads is approximately 50 percent of the total support of these roads.

Comparison of Michigan Highway Expenditures with Other States

There are a number of influences on expenditure levels for highways that can be measured. In this part of the study, these influences are examined graphically and statistically. The purpose of the exercise is to compare expenditures on highways in Michigan with expenditures in other states. This provides somewhat more information than the previous practice of comparing total highway expenditures of neighboring states without any adjustment for different characteristics.

Graphical Analysis

The possible effects of some of these factors may be illustrated graphically with the help of a few assumptions. The first is that a community indifference curve can be defined for each state which determines the desired combination of a public good and all other public and private goods, with the latter being valued in dollars. Secondly, it is assumed that the choices are consistent so that the community indifference curves have the normal shape.

In Diagram 1, G represents all other goods both private and public valued in money terms, while H represents highway services. I is the community indifference curve

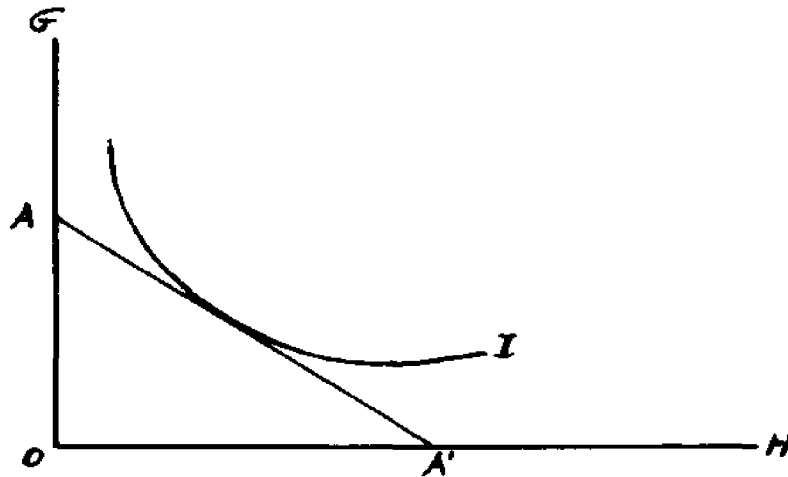


Diagram 1. Community Indifference Curve and Income Constraint.

for the state. This community indifference curve would be set by the legislature and would be a true indifference curve only to the extent that the legislature represented the desires of the citizens. AA' represents the income constraint. This type of analysis is similar to that already used in some public finance analyses of inter-governmental grants.¹

Using the above framework, it is possible to show the effects of matching grants for highways from a higher level of government. This is a form of grant used in many highway programs, although the matching required is frequently small.

¹For examples, see A. D. Scott, "The Evaluation of Federal Grants," Economica, Vol. 19, No. 76 (November, 1952), 377-94; and James A. Wilde, "The Expenditure Effects of Grant-in-Aid Programs," National Tax Journal, Vol. 21, No. 3 (September, 1968), 340-48.

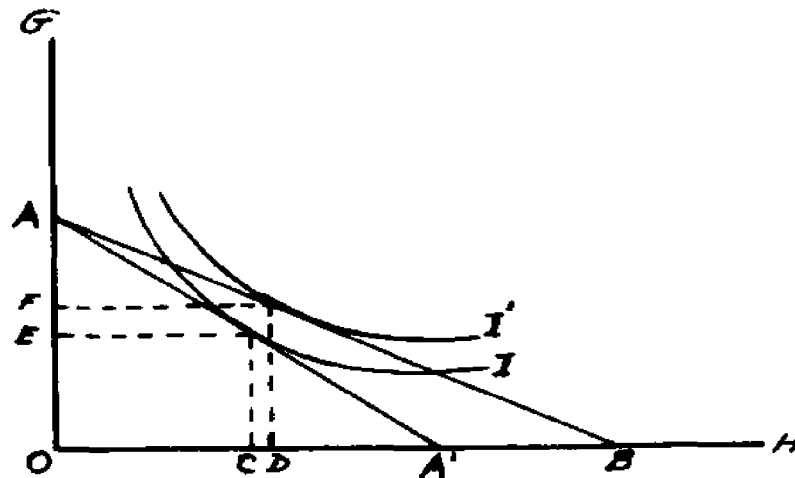


Diagram 2. Effect of Specific Matching Grant.

The grant is shown as shifting the income restraint from AA' to AB in Diagram 2. This can be seen to increase highway expenditures by the amount of CD while increasing other expenditures by the amount of EF . In most cases, specific federal grants for highways will have some stimulative effect on expenditures. This is especially true for matching grants when the funds are raised by taxes which do not discourage use of the function aided by the grants.

Highway grants tend to be stimulative of highway expenditures, in part because of grant formulae which attempt to give the largest surpluses to the states with the highest marginal propensity to consume highway services. This comes from the design of several federal highway programs to aid areas where highway services are difficult to provide. In addition, added state-level expenditures may be necessary to modify state supported highways to meet shifting traffic patterns caused by federal aid. For

example, freeway development often leads to the expansion of connecting roads because of a shifting or increase of traffic.

The use of local highway money to supplement state and federal funds will have a weak positive effect on highway expenditures. This arises from the fact that local funds are often used to purchase higher quality services than the state would provide. The effect of local expenditures is weak because state authorities may tend to withdraw from areas where the local government is doing well. Also, local highway expenditures are a small percentage of total highway expenditures.

Diagram 3 shows the effect that local finance has on highway expenditures. The budget constraint is rotated (AA' to BB') because of the ability to purchase more types of highway services. This comes about through the use of payment devices to purchase road services that otherwise could not be purchased because neither the state nor the individual could recognize the demand. Use of special assessments for street paving on local streets is an example.

Differentials in construction and maintenance costs among states are another cause of variation in interstate highway expenditures. If two states desire roughly similar amounts of highway services but have different cost levels, the state with the higher cost levels will tend to have higher expenditures for highways. This can be shown graphically in Diagram 4.

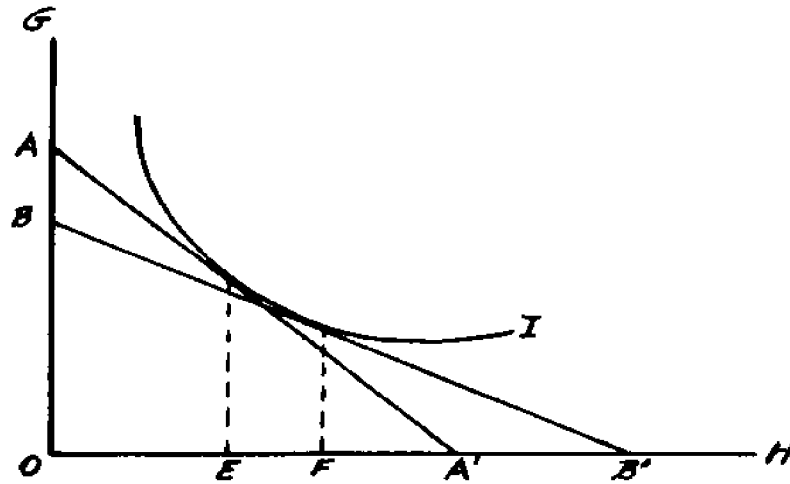


Diagram 3. Influence of Local Finance

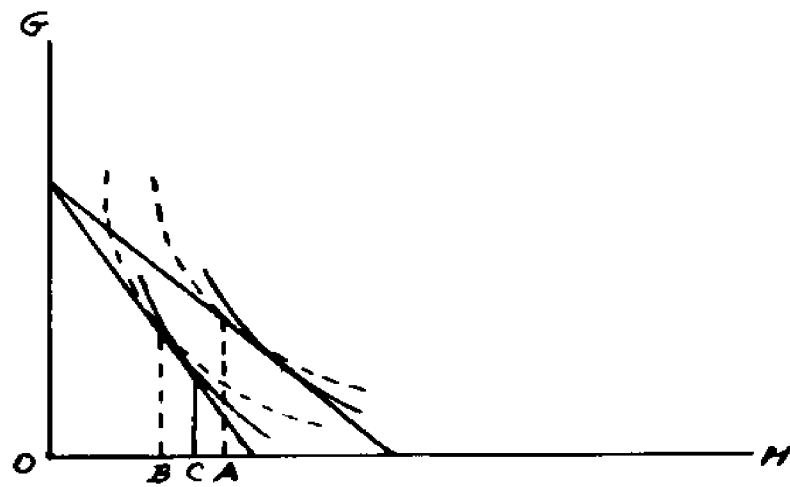


Diagram 4. Effect of Cost Differences on Highway Services.

If the higher costs result in higher prices, the expected shift would be to reduce the quantity of highway services consumed from OA to OB. However, if the second state has a somewhat different community indifference curve (the solid curves in Diagram 4), the state would still provide OC in highway services and spend considerably more in dollars on highways. In addition, the dollar amount spent on highway services may rise even though the level of service is lower in some cases. Cost increases exceed the service reductions believed tolerable by the legislature.

The above results would occur because the state with the higher valuation of highway services is pressured by its citizens to maintain a level of service reasonably similar to neighboring states. This pressure would come from those elements in the state that use the highways, ranging from trucking firms that are familiar with standards in neighboring states to private citizens. Also involved are industries such as tourism, which compete with neighboring states and depend on highways. Agriculture and other transportation-dependent industries also encourage efforts to improve roads.¹ These factors are sufficient to prevent service levels from falling enough to offset all cost differences. In the case that the high-cost state

¹Some of the expenditures on highways to serve agriculture and other industries may be viewed as investment undertaken with the hope of increasing income as opposed to meeting consumption requirements.

also has higher incomes, highway standards are more likely to be maintained because the maintenance of high standards involves less sacrifice of other goods.

Statistical Analysis

The previous subsection used community indifference curves to show the probable effects of certain characteristics of highway finance on the overall level of highway spending in a state. This subsection shows a simple method to compare statistically these characteristics among states. This is done to determine whether expenditure levels in Michigan are unusually high or low compared to other states. This procedure, in turn, is needed to calculate an expenditure level to which the costs in the 1970 Needs Study can be constrained.

Many studies have been carried out with the purpose of explaining expenditure variations among states. One of the earliest was by Solomon Fabricant in 1942.¹ Later studies included those of Seymour Sacks and Robert Harris,²

¹Solomon Fabricant, Trend of Government Activity in the United States Since 1900 (National Bureau of Economic Research, 1952), pp. 121-31.

²Seymour Sacks and Robert Harris, "The Determination of State and Local Government Expenditures and Intergovernmental Flows of Funds," National Tax Journal, Vol. 17, No. 1 (March, 1964), 75-86.

Ann Horowitz¹ and Dennis Zimmerman.² While statistical techniques differ, all of these studies attempted to estimate the effects of various measures or proxies for costs, income, intergovernmental aid and preferences on expenditures by state and local governments. Only a few studies concentrated specifically on highways, with most choosing variables best suited to general government expenditures.

This study seeks to measure the influence of federal government aid, local government expenditures, income, growth in highway use and cost differences on total highway expenditures in each state. An equation is developed which attempts to take into consideration those variables that influence the design of a state highway program and the level of highway expenditures.

The quantity of highways provided depends, in part, on the costs of providing the service. It was suggested in the previous subsection that higher costs will be reflected in lower levels of service and in higher expenditures for highway services. The cost of attaining similar levels of

¹Ann R. Horowitz, "A Simultaneous-Equation Approach to the Problem of Explaining Interstate Differences in State and Local Government Expenditures," Southern Economic Journal, Vol. 34, No. 4 (April, 1968), 459-76.

²Dennis Zimmerman, "On the Relationship between Public Goods Theory and Expenditure Determinant Studies," National Tax Journal, Vol. 28, No. 2 (June, 1975), 227-39.

service varies widely among the states because of topography, population distribution, wage differentials and changes in highway use patterns.

Federal aid has the advantage of increasing the ability to purchase increased amounts of the aided commodity. Previous studies of grants generally have found positive influences on expenditures.¹ Also included in the equation are data on local expenditures for highways, since these provide additional unique highway services. Income is included in the equation as a representation of the income constraint and the overall ability to finance public services.

The expenditure equation may be written as follows:

$$Ex = f(F, L, Y, C, G, P) \quad \text{where}$$

Ex = the quantity of highway services purchased

F = federal aid to highways

L = local aid to highways

Y = income

C = costs of building and maintaining highways

G = growth in highway use

P = use pattern of the highway system

¹Examples are: David L. Smith, "The Response of State and Local Governments to Federal Grants," National Tax Journal, Vol. 21, No. 3 (September, 1968), 349-59; and Thomas O'Brien, "Grants-in-Aid: Some Further Answers," National Tax Journal, Vol. 24, No. 1 (March, 1971), 65-79.

In actually estimating the equation the following data were used:

Ex equals the annual expenditures for the maintenance and construction of highways in 1972 per thousand vehicle miles. This form of the dependent variable is chosen because it relates the expenditure directly to those benefited, rather than to a more general measure, such as population. In this way it provides a somewhat better measure of quality of service than simple per capita expenditure. The data for both the vehicle miles and expenditures were obtained from Federal Highway Administration, Highway Statistics.¹

F equals per capita federal aid in the same year as the expenditure data. The federal aid data are available from Highway Statistics² and population data from the 1970 Census of Population.³

L is the per capita local receipts for highways in each state for 1972.⁴ For most states, the bulk of these

¹U.S. Department of Transportation, Federal Highway Administration, Highway Statistics 1973 (Washington, D.C.: Government Printing Office, 1975), pp. 53 and 98.

²Ibid., p. 97.

³U.S. Department of Commerce, Bureau of the Census, General Population Characteristics, United States Summary (Washington, D.C.: Government Printing Office, 1972), p. 294.

⁴U.S. Department of Transportation, Highway Statistics, 1973, pp. 161 and 165.

revenues is raised by property taxes, other local general revenues and special assessments.

Y is per capita income for the year 1972, as calculated by the Department of Commerce definition.¹ The income variable is included in the equation because it provides a representation of the income constraint and the overall ability of the state to support services.

C is the per capita future costs of maintaining and constructing the highway system for the years 1970 to 1990 in hundreds of dollars. It is the only reasonably comparable cost information available for the 50 states and is compiled as a part of the 1972 National Needs Study.² As with the state 1970 Needs Study, uniform cost factors were applied to highways with the same general type and amount of use. The same data base was used in both studies in Michigan. A major reason for the choice of 1972 expenditures for use in the equation rather than those of 1970 is to give some time for the information gathered in the 1972 National Needs Study (which was begun in 1969) to influence decision making.

G is another cost variable. However, this variable seeks to measure the effect of growth in the recent past on highway expenditures. It is the percentage increase in

¹U.S. Department of Commerce, Survey of Current Business, Vol. 54, No. 4 (April, 1974), p. 17.

²U.S. House of Representatives, Part II of the 1972 National Highway Needs Study (Washington, D.C.: Government Printing Office, 1972), pp. IV-1 to IV-93.

motor fuel consumption in each state between 1960¹ and 1970.² A higher-than-average increase would mean rapid expansion of motor vehicle use and increased pressure to expand highway facilities.

P is the percentage of workers who drove to work in 1970.³ This variable is a measure of the traffic pattern, since the highest percentage of automobile-driving commuters is found in states which have primarily medium sized cities designed to accommodate the automobile. The variable indicates a population which can meet transportation needs through highways at a reasonable cost.

The expenditure equation outlined above is calculated by ordinary least squares estimation. The sample covers all 50 states. The results are as follows, showing the regression coefficients and the ratios of the regression coefficients to their standard errors:

$$EX = 0.1560F + 0.1175L + 0.002905Y + 0.1482C + 0.1156G - 0.2404P$$

(4.15)	(2.14)	(3.24)	(4.56)	(3.07)	(3.87)
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¹U.S. Department of Commerce, Bureau of Public Roads, Highway Statistics, 1960 (Washington, D.C.: Government Printing Office, 1961), p. 3.

²U.S. Department of Transportation, Federal Highway Administration, Highway Statistics, 1970 (Washington, D.C.: Government Printing Office, 1970), p. 5.

³U.S. Department of Commerce, Bureau of the Census, Census of Population, 1970, General Social and Economic Characteristics (Washington, D.C.: Government Printing Office, 1972), p. 486.

All coefficients except that of L are significant at the 1 percent level; that for L is significant at the 5 percent level. The R^2 is equal to 0.9017.

This equation provides a number of interesting items of information. Most expenditure studies in the past have attempted to use cost proxies, usually density and/or rural populations in their equations. This equation is the first to use an overall comparison of costs among the states. This provides a far better estimate of relative costs in each state than the earlier proxies and makes them unnecessary in the equation. This finding supports the hypothesis suggested by the findings of Ohls and Wales¹ to the effect that a true measure of costs would be more accurate than the use of density as an expenditure determinant.

The primary purpose of this section of the chapter is to test whether Michigan spends more or less for highways than other states when consideration is given to differences in measurable economic, demographic and travel characteristics. The equation used in this chapter contains economic variables for income, costs of constructing highways, federal aid and local support. Growth in motor vehicle use and automobile commuter patterns also are included. The equation shows that actual highway

¹James C. Ohls and Terence J. Wales, "Supply and Demand for State and Local Services," Review of Economics and Statistics (November, 1972), pp. 424-30.

expenditures in 1972 per thousand vehicle miles in Michigan were slightly lower than would be expected from the equation. The estimated expenditures were \$13.55 per thousand vehicle miles while actual expenditures were \$11.11 as calculated from information in Highway Statistics. With a standard error of estimate of 4.13 and just over 90 percent of the difference in expenditures explained by the equation, the result suggests that Michigan did not spend more on highways than other states in the year of the study.

The above results indicate that the location of the automobile industry and its suppliers in this state has no special influence on the state's highway program at this time. The equation gives no information as to the importance of highway interests except that either highway interest groups or city preferences generally are such that those states faced with higher costs seem to attempt to maintain levels of highway service by increasing expenditures to meet those costs.

An interesting side note is that states that do not earmark their receipts for highway expenditures do not have clearly lower expenditures while those with rigid earmarking do not have clearly higher expenditures than predicted. This suggests that earmarking did not have a

clear positive effect on expenditures. These preliminary findings are similar to those of Enns.¹

Michigan's highway expenditures in 1972 appear to have been slightly lower than the variables chosen for the equation predict. Since the cost figures calculated in the equation reflect data similar to the 1970 Needs Study, the higher figure will be used to calculate the constraint on meeting the costs of building the uniform system. This amount merely reflects the expenditures that would be made by Michigan if the state had responded as predicted by the characteristics in the equation. Either figure is reasonably defensible because the estimated expenditure and the amount actually spent are nearly equal, the difference being less than the standard error. Another reason for the choice of the higher figure is that an effort, later successful in 1973, was being made to increase highway spending and highway taxes in Michigan.

¹John Hermann Enns, Jr., "The Impact of Federal Grants-in-Aid on State Highway Expenditures and Revenues: An Econometric Study" (unpublished Ph.D. dissertation, University of California, Los Angeles, 1973).

CHAPTER IX

ACTUAL FINANCES AVAILABLE AND THE CURRENT DISTRIBUTION FORMULA

Introduction

This chapter concludes the study with an examination of two topics. The first of these is the calculation of a constraint based upon the information included in the previous chapter. This can then be used to illustrate the amount of the costs of meeting the standard system that are likely to be met. This topic concludes the sixth step of the analysis, viz., the calculation of the constrained costs.

The second topic, which constitutes the seventh and final step of the analysis, is an examination of the effect of distributing the motor vehicle highway fund payments to local government. Three alternatives are compared: the costs of building and maintaining the standard system, the current allocation formula used by the state and the allocation of the highway money according to use of the system. The primary reason for this comparison is to determine if the current allocation formula is meeting the

costs of the highway system. The current use allocation is included to show where the highway money is actually generated and therefore shows the gainers and losers from the other two distribution formulae. A strict application of the benefit principle of taxation would require spending highway money in the areas that the money was raised.

Actual Expenditures

It was shown in Chapter VIII that highway expenditures in Michigan were slightly below what would have been expected, given Michigan's income and cost characteristics. In addition, Michigan's expenditures per thousand vehicle miles, not corrected for different characteristics, were about 70 percent lower than the mean for all states. Early in 1973, the state raised its gasoline taxes by two cents, with one and one-half cents devoted to state and local highway construction and maintenance. This increase had been sought, in part, based upon the results of the 1970 Needs Study. The increase raised available receipts for expenditure on highways, but it was not sufficient to bring them up to the level predicted in the equation of Chapter VIII. That equation estimated Michigan highway expenditures as compared to those of all other states adjusted for income and cost differences. The receipts available for expenditure are much closer to the estimated value than the size of the standard error. Much of the difference can be accounted for by fluctuations of federal aid,

therefore the 8.5 cent gasoline tax and the current weight tax rates are used as the level of state financing likely to be provided by the state.

The following assumptions are made in determining the amount of money available to meet the costs. One assumption is that levels of federal aid to highways will remain near the recent annual apportionments of about \$190 million. This means that there would be no massive shift of spending away from highways and that any decrease in spending on the interstate system would be largely offset by increases in other highway aid. The second assumption is that highway use in Michigan will rise from 50.9 million vehicle miles to 92.2 million vehicle miles between 1970 and 1990.¹ This is the growth projection used in the 1970 Needs Study, and the projection appears to be holding up fairly accurately in the first four years.² In estimating the motor fuel tax, a 20 percent improvement in fuel economy was assumed. Also assumed was a 2 percent annual growth in weight tax receipts. While this growth rate is historically low for weight taxes, the Michigan population

¹Wilbur Smith and Associates, Michigan Highway Fiscal Analysis, 1970-1990 (December, 1972), pp. 119-26.

²Michigan Department of State Highways, Financial Planning and Budget Section, Computation of Vehicle Miles Traveled on Michigan Highways, Roads and Streets, 1970, 1971, 1972, and 1973.

will grow more slowly¹ and the average automobile weight is declining. Given the above assumptions, an average of \$748.8 million in dollars of constant purchasing power is computed to be raised yearly between 1970 and 1990.

Table 1 compares the average annual costs for each legal system with the amount that can be financed by state and federal sources under the assumptions in the preceding paragraph. The costs are also adjusted so as to reflect the current practice of not financing one-half of construction costs on local roads and streets. Both limitations on costs are included in Table 1.

Table IX-1.--Effect of Constraint Based on Projected Annual Revenue.

System	Average Annual Costs (in Thousands)	Costs Constrained (in Thousands)	Percent of Costs Met
State trunkline	\$538,907	\$302,312	56.10
County primary	348,698	195,610	56.10
City major	142,417	79,888	56.10
County local	336,273	120,050	35.70
City local	146,797	50,939	34.70

Source: Calculations based on Wilbur Smith and Associates, Michigan Highway Needs Summary, 1970-1990, pp. C-1 to C-21.

Table 1 shows that approximately 56 percent of the costs of building and maintaining the state trunklines, county primary and city major systems could be met if

¹Michigan, Economic Report of the Governor (Lansing, Michigan, March, 1975), pp. 164-69.

available state and federal highway revenues were distributed in proportion to costs. This number provides an estimate of the average costs that can be met each year and a basis for calculating the constraint. County local roads and city local streets receive lower percentages because one-half of local road and street construction costs are supposed to be met locally. The slightly lower percentage of costs met on the city local streets is caused by the generally lower standards used for county roads. Some county roads receive primarily maintenance services because they do not have paved surface and therefore need only maintenance.

The amount of money used in calculating the constraint changes if the projection of the number of vehicle miles driven changes. A reduction in vehicle miles driven would allow cost reductions in the highway system, since fewer vehicles would have to be served. Therefore, any highway building program must be reviewed in the light of possible changes in use of the highways during the 20-year program.

A second reason for review of expenditures is inflation. The effect of inflation on user tax collections was analyzed in Chapter IV. During periods of rapid inflation, the amount available in actual purchasing power to meet highway construction and maintenance can deteriorate rapidly, given the lag in changing these earmarked taxes. This further constrains the ability to meet highway costs.

For example, the 1973 increase in the gasoline tax had its purchasing power in construction cut by 17 percent because of rapid inflation, as is shown by Tables 1 and 2 of Chapter IV.

Effect of Constraints on Cost Distributions
Among Units

In Chapter VII the unconstrained costs were compared to resources. Both motor fuel taxes and taxable personal income were compared with the unconstrained costs. This provided a comparison of the location of taxable resources with the location of costs of meeting the uniform standards.

The constraints described in the previous section of this chapter have two effects on the distribution described in Chapter VII. The first is a lower level of funding and therefore smaller gains or losses in each county and city. A second result of the constraint is caused by the decision to include only one-half of local road and street costs in the portion of costs to be met by state finance. This reduces the subsidies that are paid by the state trunkline system and city major system to the local systems under the motor fuel tax, since the overall tax rate is lowered.

Since the constraint varies with the growth in motor vehicle use, it is calculated as equal to \$636,752,000, based upon 1970 traffic levels and federal aid estimates. This amount reflects the 8.5 cent gasoline tax rate and is a close approximation to the amount predicted by the

equation in Chapter VIII. The 1970 estimate, based on current law, was used instead of the 20-year revenue projection developed in the previous section because of the complexity and uncertainty of the required projections. Unlike the calculations in Chapter VIII, locally-raised funds were not included in the constraint since the local share of the costs of meeting the standard system has been deducted. These costs were removed since they are not met through centrally collected taxes. These costs total 50 percent of construction costs on city local streets and county local roads.

Applying the amount in the previous paragraph to the financing of each legal system, and distributing the money in proportion to the costs on each system, provides the results in Table 2. This table shows the annual cost of meeting the uniform standards as constrained by estimated available federal and state revenues. The percentages in Table 2 represent the proportion of costs met from federal and state sources.

The lower percentages on local roads result, again, from leaving some construction to be met locally. The percentage difference between the city local streets and the county local roads arises because maintenance costs are a higher percentage of costs on the county system with its somewhat lower construction standards. The percentages of costs that are met by the constrained costs constitute the

Table IX-2.--Cost Constraints Calculated on 1970 Vehicle Mile Data.

System	Amount (in Thousands)	Percent of Total Costs Met
State trunkline	\$257,075	47.70
County primary	166,339	47.70
City major	67,934	47.70
County local	102,086	30.36
City local	43,317	29.51

Source: Wilbur Smith and Associates, Michigan Highway Needs Summary, 1970-1990.

constraint (α) for each legal system in the equation $E_i = \alpha N_i - \gamma V_i$.

The equations for the motor fuel tax and the income tax change in two ways from Chapter VII. One of the changes is the α , the constraint, which is no longer equal to one. Second, as a result of the reduced costs, lower tax rates (γ) are necessary to finance the constrained costs. The effect of the constraints on the equations for the motor fuel tax are as follows:

<u>System</u>	<u>Constrained</u>	<u>Unconstrained</u>
State trunkline	$E_i = 0.4770N_i - 0.1707V_i$	$E_i = N_i - 1.40569V_i$
County primary	$E_i = 0.4770N_i - 0.1707V_i$	"
City major	$E_i = 0.4770N_i - 0.1707V_i$	"
County local	$E_i = 0.3036N_i - 0.1707V_i$	"
City local	$E_i = 0.2951N_i - 0.1707V_i$	"

As in Chapter VII, N_i equals the costs of meeting the uniform standards in each legal system in each city and county, and V_i represents the motor fuel consumption on each legal system in each city and county. E_i equals the gain or loss on each legal system for each city and county. The constraint for county local roads and for city local streets is adjusted to show the average effect of including only one-half of construction costs in the cost of local highway systems to be met from centrally collected state and federal funds.

The effect of the constraint and the reduction in local road costs under fuel tax financing is to reduce the size of the subsidies on each legal system. Table 3 illustrates the intersystem subsidies. The subsidies are calculated for both the constrained and unconstrained costs on each legal system.

Table IX-3.--Comparative Subsidies With and Without Constraint.

System	Constrained Subsidy (in Millions)	Unconstrained Subsidy (in Millions)
State trunkline	\$-33.2	\$-150.9
County primary	15.2	-10.4
City major	-54.7	-148.9
County local	60.7	238.0
City local	11.9	72.2

Sources: Calculations based upon cost data from Wilbur Smith and Associates, Michigan Highway Needs Summary, 1970-1990, pp. C-1 to C-21; and vehicle mile data from Michigan Department of State Highways, Transportation Planning Division.

As in Chapter VII, a negative subsidy means that a particular system is helping to support another system. The local systems receive reduced subsidies because of the constraint of overall reduced funding and because of the reduced costs being financed on these systems. With the reduced costs on local highway systems, the county primary system now receives a small subsidy instead of a deficit. The effect on individual counties and cities is similar in that the constraint reduces the subsidies and deficits without changing the basic pattern of their distribution. Because of the reduced subsidy to local roads and streets, some small deficits will be turned into small subsidies.

In the case of the income tax, no cross system subsidies arise from the financing of highways except a general subsidy between rural and urban jurisdictions, because the income tax is levied at a uniform rate on income regardless of where it is located. For this reason it is best to view urban and rural systems as combined. The subsidies flow among communities for systems that are of approximately equal importance. Using the equation $E_i = \alpha N_i - \gamma V_i$, it is possible to show the change in the equation that will reduce the subsidies under the income tax. Comparison of the equations for the income tax used in Chapter VII and the constrained equations is as follows:

<u>System</u>	<u>Constrained Equation</u>	<u>Unconstrained Equation</u>
State trunkline	$E_i = 0.4770N_i - 0.008755V_i$	$E_i = N_i - 0.01835V_i$
County primary	$E_i = 0.4770N_i - 0.007979V_i$	$E_i = N_i - 0.01673V_i$
City major	$E_i = 0.4770N_i - 0.007979V_i$	$E_i = N_i - 0.01673V_i$
County local	$E_i = 0.30358N_i - 0.004952V_i$	$E_i = N_i - 0.01645V_i$
City local	$E_i = 0.29508N_i - 0.004952V_i$	$E_i = N_i - 0.01645V_i$

In the above equations, α and γ are as shown and N_i equals the cost of meeting the uniform standards. As in Chapter VII, V_i represents the income tax base and E_i is the net gain or loss in financing the system by income taxes. The constraints reflect the level of financing available for trunklines, county primary roads and city major streets. The constraints for county local roads and city local streets also include the average effect of reducing the construction costs by 50 percent since one-half of local construction costs are assumed to be borne by the local government.

For state trunklines, county primary roads, and city major streets income tax financing, the effect of the constraint is to reduce the subsidy or deficit by 52.3 percent. This is apparent from the fact that the tax rate γ is the statewide cost of meeting the uniform standards on the systems providing that level of service, either trunklines or county primary roads and city major streets, divided by the statewide income tax base. In this case the reduction in tax rate is proportional to the constraint on

the costs, therefore the constraint causes a proportional reduction in the subsidy or deficit. In the case of the county local roads and city local streets, the reduction is not quite proportional because of the slight difference (less than 1 percent) in the constraints for county local roads and city local streets caused by the lower proportion of construction costs in the counties.

In order to illustrate the detailed effects of the constraints on the subsidies among counties, the constrained costs of meeting the standard system with either the motor fuel tax or the income tax are compared. The state trunkline system data are used for this comparison because they are most clearly presented in tabular form and because they illustrate the effects in each county.

As Table 4 shows, the size of the subsidies and deficits (negative subsidies) are reduced for every county. In the case of the fuel tax, a few small deficits are changed to subsidies, as in Baraga County. This occurs because traffic on the heavily traveled trunkline system now pays a smaller subsidy to county local roads and city local streets. This subsidy is reduced because only one-half of the local county and city road costs is included in the state-financed portion of the costs. Under income tax financing, both subsidies and deficits are reduced proportionally to the constraint. The general distribution of subsidies and deficits, although smaller, is not substantially changed from the results of Chapter VII.

Table IX-4.--Comparison of Constrained and Unconstrained Subsidies on State Trunklines (in Thousands of Dollars).

County	(1) Constrained Subsidies Under Motor Fuel Tax	(2) Unconstrained Subsidies Under Motor Fuel Tax	(3) Constrained Subsidies Under Income Tax	(4) Unconstrained Subsidies Under Income Tax
Alcona	\$ 681.4	\$ 1,299.3	\$ 1,030.7	\$ 2,160.8
Alger	516.1	921.9	968.8	2,031.1
Allegan	-1,815.5	-4,686.6	-110.2	-231.1
Alpena	345.5	483.8	553.0	1,159.3
Antrim	589.9	1,068.0	948.3	1,988.0
Arenac	453.8	626.2	1,369.4	2,870.9
Baraga	35.5	-75.2	430.0	901.5
Barry	-49.5	-405.7	165.4	346.7
Bay	-798.8	-3,027.4	1,131.3	2,371.6
Benzie	459.3	812.3	819.2	1,717.3
Berrien	-2,090.2	-6,386.3	515.3	1,080.3
Branch	-85.3	-581.5	492.6	1,032.8
Calhoun	-3,807.2	-9,690.5	-1,450.3	-3,040.5
Cass	-33.9	-619.3	831.8	1,743.8
Charlevoix	1,536.9	301.7	433.6	909.0
Cheboygan	-679.1	-1,829.9	465.8	976.6
Chippewa	486.2	710.8	906.1	1,899.5
Clare	-761.2	-2,063.6	660.1	1,383.8
Clinton	525.2	299.6	2,117.2	4,438.6
Crawford	-674.2	-1,705.4	265.5	556.5
Delta	2,298.5	4,450.4	2,966.9	6,219.9
Dickinson	273.6	346.5	574.1	1,203.6
Eaton	-265.9	-1,627.3	1,557.0	3,264.2
Emmet	649.6	1,114.3	1,097.9	2,301.7
Genesee	2,069.3	894.3	638.8	1,339.3
Gladwin	854.2	-693.0	178.4	374.0
Gogebic	1,679.2	3,310.3	2,080.3	4,361.3
Grand Traverse	1,171.1	2,266.4	926.3	1,942.0
Gratiot	-229.8	-1,017.5	769.7	1,613.6
Hillsdale	1,372.7	2,508.4	1,817.9	3,811.0
Houghton	-31.9	-403.1	621.3	1,302.5
Huron	0.5	-346.8	493.7	1,035.1
Ingham	-998.5	-4,188.3	-1,028.4	-2,156.1
Ionia	-782.5	-2,257.2	375.9	788.0
Iosco	216.6	162.7	645.2	1,532.7
Iron	1,191.7	2,322.9	1,603.5	3,361.7
Isabella	-1,078.2	-2,757.3	-193.1	-404.8
Jackson	-2,457.7	-6,827.1	-443.1	-928.9
Kalamazoo	1,384.3	1,295.7	1,647.1	3,453.1
Kalkaska	151.8	190.2	519.2	1,088.4
Kent	-3,900.4	-11,668.1	-2,462.9	-5,163.3
Keweenaw	337.9	655.2	491.3	1,030.0

Table IX-4.--Continued.

County	(1) Constrained Subsidies Under Motor Fuel Tax	(2) Unconstrained Subsidies Under Motor Fuel Tax	(3) Constrained Subsidies Under Income Tax	(4) Unconstrained Subsidies Under Income Tax
Lake	\$ 41.9	\$ -37.3	\$ 406.9	\$ 853.0
Lapeer	380.3	168.6	1,391.6	2,917.5
Leelanau	262.8	396.3	597.7	1,253.0
Lenawee	-323.4	-1,527.8	613.7	1,286.7
Livingston	-2,667.8	-6,909.8	325.5	682.3
Luce	227.8	376.6	453.1	949.9
Mackinac	260.2	197.9	1,331.2	2,790.7
Macomb	-929.2	-5,731.7	-7,126.5	14,940.2
Manistee	364.1	524.4	834.7	1,749.9
Marquette	1,000.6	1,580.0	1,350.8	2,831.9
Mason	352.7	468.4	773.1	1,620.7
Mecosta	437.7	598.3	1,108.6	2,324.2
Menominee	1,882.6	3,668.1	2,428.3	5,090.7
Midland	-1,081.1	-2,873.0	-779.9	-1,635.0
Missaukee	182.9	270.8	451.6	946.9
Monroe	-2,843.2	-7,902.7	873.4	1,830.9
Montcalm	-428.3	-1,432.4	643.6	1,349.2
Montmorency	167.6	271.3	364.3	763.7
Muskegon	-1,340.1	-3,967.7	751.7	-1,575.8
Newaygo	-147.5	-676.9	584.1	1,224.5
Oakland	4,811.0	3,606.2	-7,793.9	-16,339.5
Oceana	79.9	-77.9	619.2	1,298.2
Ogemaw	239.6	315.2	720.6	1,510.7
Ontonagon	538.8	932.9	1,005.4	2,107.7
Osceola	-17.0	-369.4	912.1	1,912.1
Oscoda	-8.7	-113.8	276.1	578.8
Otsego	-403.7	-1,054.1	124.5	261.0
Ottawa	-589.1	-2,220.7	-229.5	-481.2
Presque Isle	184.0	221.1	550.1	1,153.2
Roscommon	-564.1	-1,580.6	678.8	1,423.0
Saginaw	-157.3	-2,453.3	1,123.3	2,354.9
St. Clair	1,223.1	1,493.5	1,858.4	3,896.1
St. Joseph	369.1	156.5	1,378.1	2,889.2
Sanilac	581.3	800.7	1,308.5	2,743.2
Schoolcraft	907.7	1,698.4	1,547.8	3,245.0
Shiawassee	-1,274.6	-3,391.2	-481.5	-1,009.5
Tuscola	-585.4	-1,724.3	32.4	68.0

Table IX-4.--Continued.

County	(1)	(2)	(3)	(4)
	Constrained Subsidies Under Motor Fuel Tax	Unconstrained Subsidies Under Motor Fuel Tax	Constrained Subsidies Under Income Tax	Unconstrained Subsidies Under Income Tax
VanBuren	\$-2,041.4	\$-5,187.7	\$ 6,349.8	\$ -13.3
Washtenaw	-4,880.0	-12,969.4	2,371.7	4,972.2
Wayne	-23,835.6	-69,486.0	-35,569.6	-74,569.3
Wexford	99.1	-156.0	1,024.0	2,147.1

Sources: Cost data adapted from Michigan Highway Needs Summary, 1970-1990, Appendix C-1; data on vehicle miles of travel, unpublished data from the Transportation Planning Division, Michigan Department of State Highways; income data from Survey of Current Business-Local Area Personal Income, May 1974, as modified in Chapter III; county population from Bureau of the Census, Number of Inhabitants--Michigan (U.S.G.P.O., 1971).

The Motor Vehicle Highway Fund Formula

The final step in the dissertation is a comparison of the present system of distributing money by the current state formula with the costs used as a basis for distribution of highway funds in this study. The money spent on the state trunkline system is distributed through individual construction contracts and by direct expenditure or local contracts for maintenance. The trunkline distribution uses the formula only to decide the proportion of state-level highway taxes that will be devoted to highway use. This amount is currently 44.5 percent. The remaining 55.5 percent of state-level highway money is devoted to counties and cities for the construction and maintenance of roads and streets under their responsibility. These distributions are made by a formula written into the state law. The formula uses proxies for highway costs which are used to distribute money to each county, city or village for each legal system under that unit's control.

The greater part of the money distributed by the Motor Vehicle Highway Fund is devoted to the legal systems (state trunkline, county primary road and city major street) which receive heavier use. The county primary system receives approximately 75 percent of the 35.7 percent of the total Motor Vehicle Highway Fund devoted to county roads. City major streets also receive about 75 percent of the 19.8 percent of the Fund devoted to city streets. County local roads and city local streets each

receive approximately 25 percent of the total funds to both cities and counties.

The results of distributing highway fund money based upon the current formula are compared with the results of distributing highway construction and maintenance money on the basis of costs of the uniform standards. The costs exclude the 50 percent of construction costs on local roads that are met locally. The percentage distribution of money among systems based upon the present formula is shown compared to the distribution to meet the costs of the uniform standards and lastly, to the percentage of total fuel use on each system. The results are as follows:

Table 5 shows that the formula favors the more heavily traveled highway systems over the less heavily traveled highways. State trunklines and city major streets are especially favored. City major streets form a relatively low-cost system because they are compact and have rather low mileage. The trunkline system is given heavy support because it contains the highways with the heaviest traffic and the longest trip distances. The Michigan Department of State Highways also uses the argument that money must be available for matching federal funds and for building necessary connector roads on the trunkline system. Because most federal aid is paid on the trunkline system and matching is usually required,¹ this

¹The federal apportionments and the estimated percentages devoted to Michigan state trunklines for the years

Table IX-5.--Shares of State Highway Revenues by Legal System.^a

System	Present Formula (Percent)	Costs of Uniform System (Percent)	Motor Fuel Consumption (Percent)
State trunkline	44.50	40.37	45.59
County primary	26.52 ^b	26.12	23.73
City major	14.85	10.67	19.25
County local	8.83 ^b	16.03	6.50
City local	4.95	6.80	4.93

^aColumns may not total 100 percent because of rounding.

^bA small sum of money (1 percent of the county share) was not included in these percentages since its distribution depends upon snowfall in the counties of the state. This program normally benefits counties in the northern Lower Peninsula and the Upper Peninsula.

Sources: Calculations based upon Michigan Department of State Highways, Twenty-third Annual Progress Report, p. 9; 1970 Needs Study--Technical Report; and Michigan Department of State Highways, unpublished data.

argument has carried considerable weight. It has also resulted in the state trunklines having a considerably higher percentage of their costs financed, since the federal aid is substantial. Federal aid to state trunklines derives from the intent of the federal government to

1973, 1974, and 1975 are as follows: in 1973, \$172,917,896, of which 86 percent was for trunklines; in 1974, \$132,777,157, of which 76 percent was for trunklines; and in 1975, \$211,876,881, of which 77 percent must be used for trunklines. Matching requirements for federal aid are presently 90 percent federal and 10 percent state or local on the interstate system. The interstate system was 12.24 percent of the mileage of the Michigan trunkline system in 1973.

complete the interstate system and to support a nationwide network of roads connecting them.

Although changes in the federal highway laws in 1973 allow increased federal aid to urban highway systems other than trunklines, these systems remain primarily dependent upon state and local finance as outlined in Chapter VII. The formula provides more than 80 percent of the user revenues available on county primary roads and major city streets. Formula money on local roads represents nearly all non-local revenue.

The current formula is compared to distributing the money in proportion to costs of meeting the uniform standards by distributing \$100 million in the highway fund to the cities and counties that receive money under the formula portion of the Motor Vehicle Highway Fund. The reason for distributing \$100 million is that this number can be divided into any amount actually distributed to highways to develop a number which, when multiplied by the number in the table, will give a good estimate of the amount actually distributed in any year. The tables presented in this section can therefore be used to distribute any sum of money by the existing formula and by amounts of cost. This is useful because the size of the formula amount changes continually due to changes in automobile use or tax rates. Inflation, too, changes the value of the dollars distributed through the current formula.

In order to compare the distribution of highway funds by the current formula and by costs with the distribution of taxable resources, the \$100 million also will be distributed based upon motor fuel consumption and income. This allows a comparison of the distribution brought about by the use of a formula with what would result from simply returning the money to the places from which it was collected. The distribution of funds according to motor fuel consumption also gives an indication of the distribution of traffic around the state.

County Primary Roads

The current formula used for the distribution of Motor Vehicle Highway Funds is actually a combination of four formulae, one for each of four legal systems. The analysis begins with the county primary system. The current county primary formula distributes 66.75 percent of county money by three factors. These factors and their weights are as follows:

Weight tax collections in the county	75%
One eighty-third to each county	15%
County primary road mileage	10%

This amount distributed by the three factors is supplemented by about 7.5 percent of county money distributed in proportion to county urban road mileage.

The above formula payments to county primary roads equal 26.52 percent of the total Motor Vehicle Highway Fund. This amount distributed by formula represents all

state payments to the county primary system except for a small amount devoted to snow removal and a \$10,000 payment for hiring a professional engineer. These payments were not included in the formula because they are not dependent on a formula for distribution but represent small specialized programs.

The distribution according to costs of meeting the uniform standards is made by giving each county the same share of the funds available for county primary roads as the costs on county primary roads in that county are to the total costs on that highway system. The proportion of total Motor Vehicle Highway Fund money devoted to the county primary roads is the proportion of costs on that highway system compared to the total costs on all highway systems that are to be met from state funds. Local road and street construction costs have been reduced by 50 percent since one-half of these costs are to be met by locally-raised funds. County primary roads represented about 26.12 percent of the costs of meeting the uniform standards.

In order to compare the distribution of funds on county primary roads with the distribution of taxable resources, the tax rate necessary to raise \$100 million in 1970 is multiplied by the amount of fuel consumed on county primary roads in each county in that year. This tax rate is equal to \$0.026812 per gallon. Also calculated is the distribution of the portion of \$100 million that is devoted to the county primary and city major systems across the

taxable income in each city and county. This shows the distribution of a flat-rate income tax to finance the current formula. The rate is 0.14088 percent.

Table 6 shows the results of the calculations described in the preceding four paragraphs. Examining column (1) and column (2) in Table 6, we see that the use of costs instead of the current formula to distribute highway money has no strong bias in favor of either urban or rural counties. Shifting from the current formula to distribution by costs tends to aid counties that are near urban centers but lack large population centers within the county. Allegan, Clinton, and Tuscola Counties are examples of such counties. The county is credited with vehicle registrations of citizens living in cities in that county. Other counties that would gain under a cost-based system are those with rapid growth in township areas or with heavy resort traffic. Examples of such counties include Barry, Oakland, and Roscommon. The proportion of current formula funds devoted to county primary roads approximates the proportion of costs on this highway system, but funds to individual counties vary so widely that the money frequently does not reach the counties with the largest costs. More than half of the counties (44) have a greater than 20 percent spread between current formulae payments and the same amount of money distributed by costs of meeting the uniform standards.

Table IX-6.--Revenues Distributed on County Primary Roads (in Thousands of Dollars).

County	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenue
Alcona	\$ 80.8	\$ 112.8	\$ 50.7	\$ 15.7
Alger	77.6	112.3	28.1	9.7
Allegan	240.6	341.3	217.2	165.6
Alpena	139.6	176.8	64.6	53.6
Antrim	91.6	120.2	129.2	25.1
Arenac	84.8	72.6	54.0	22.8
Baraga	71.3	65.6	19.2	11.6
Barry	144.0	232.5	168.7	95.6
Bay	384.5	296.4	236.0	233.5
Benzie	79.0	70.7	83.7	15.5
Berrien	520.8	546.7	575.6	456.9
Branch	187.4	173.9	165.1	74.7
Calhoun	443.9	530.2	380.0	340.6
Cass	168.1	71.9	150.2	130.5
Charlevoix	97.8	105.5	57.2	23.5
Cheboygan	105.0	95.6	54.5	28.0
Chippewa	142.2	224.2	127.3	51.9
Clare	105.1	101.2	73.4	26.1
Clinton	181.7	256.2	279.5	144.8
Crawford	75.1	81.6	33.0	10.4
Delta	181.3	191.1	122.8	39.1
Dickinson	130.6	126.7	57.1	22.2
Eaton	231.2	286.3	180.6	208.1
Emmet	112.9	98.8	50.3	33.8
Genesee	1,171.1	794.4	1,167.4	1,045.7
Gladwin	95.1	104.9	32.8	29.0
Gogebic	106.0	164.8	44.9	17.1
Grand Traverse	192.6	105.6	105.8	76.6
Gratiot	190.1	164.8	97.6	72.4
Hillsdale	165.8	305.6	147.2	82.2
Houghton	130.4	184.0	22.2	41.7
Huron	161.1	123.3	88.2	70.7
Ingham	639.8	489.2	450.3	338.6
Ionia	172.3	247.6	129.9	82.7
Iosco	131.4	75.0	81.4	78.7
Iron	97.1	158.3	44.1	14.0
Isabella	169.7	101.6	180.6	71.3
Jackson	477.7	637.5	415.1	422.1
Kalamazoo	565.6	714.1	648.1	332.5
Kalkaska	87.3	128.6	79.9	10.7
Kent	1,207.4	494.7	464.3	377.9
Keweenaw	56.6	51.6	21.4	5.2
Lake	78.0	69.0	87.7	10.5

Table IX-6.--Continued.

County	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenue
Lapeer	\$ 193.0	\$ 286.4	\$ 161.3	\$ 141.3
Leelanau	82.8	35.0	92.1	29.7
Lenawee	291.5	324.2	249.9	163.1
Livingston	213.8	288.9	219.7	224.2
Luce	71.3	74.8	20.9	12.2
Mackinac	85.8	138.7	57.3	17.6
Macomb	1,567.8	1,385.7	1,731.8	3,170.2
Manistee	119.3	108.9	79.7	31.8
Marquette	196.0	207.5	120.9	101.8
Mason	113.3	111.7	61.3	41.0
Mecosta	117.8	125.6	74.4	38.7
Menominee	151.2	223.6	82.6	31.4
Midland	205.5	195.6	190.3	95.9
Missaukee	80.1	76.3	47.3	17.0
Monroe	412.9	490.3	398.0	364.7
Montcalm	164.8	169.6	52.7	81.2
Montmorency	75.1	86.0	24.8	13.4
Muskegon	435.1	315.4	354.8	183.9
Nawaygo	139.2	131.6	101.5	67.5
Oakland	2,477.3	3,584.5	3,018.8	5,749.9
Oceana	108.0	149.1	80.5	32.5
Ogemaw	103.3	98.8	100.8	22.0
Ontonagon	84.1	154.6	37.6	28.1
Osceola	100.3	67.0	73.3	25.1
Oscoda	73.2	75.8	75.1	9.0
Otsego	95.6	87.1	77.7	22.9
Ottawa	461.7	279.1	291.7	276.1
Presque Isle	87.8	103.1	95.6	15.9
Roscommon	88.2	133.8	107.5	25.9
Saginaw	616.0	599.1	436.9	553.0
St. Clair	392.6	505.0	373.6	259.8
St. Joseph	194.2	191.0	131.3	92.5
Sanilac	165.2	189.7	123.8	82.0
Schoolcraft	81.8	113.4	32.1	8.3
Shiawassee	210.8	264.4	135.1	147.1
Tuscola	187.9	310.1	204.5	122.4

Table IX-6.--Continued.

County	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenue
VanBuren	\$ 197.1	\$ 221.5	\$ 197.6	\$ 116.3
Washtenaw	570.8	601.9	688.9	433.4
Wayne	5,420.6	3,842.2	5,597.4	13,096.6
Wexford	111.2	78.5	32.8	21.8

Sources: Present distribution calculated from Michigan Department of State Highways, Local Government division, Interdepartmental Memoranda on fourth quarter 1974 payments to local government; cost data adapted from Michigan Highway Needs Summary, 1970-1990, Appendix C-2; data on vehicle miles of travel, unpublished data from the Transportation Planning Division, Michigan Department of State Highways; income data from Survey of Current Business-Local Area Personal Income (May, 1974), as modified in Chapter III.

Column (3) in Table 6 shows the amount of motor fuel tax raised in each county on the county primary system with a tax rate that would have raised \$100 million in 1970. Eighteen counties pay in more than they receive under the current formula or under the allocation by costs. In both cases they were a mixture of urban and rural counties. Under the current formula, Wayne, Oakland, and Macomb Counties all lose relative to fuel tax collections. These counties have county systems with more high traffic volume roads because they control many roads in incorporated areas, unlike other counties where the county primary system is located outside incorporated areas.

The income tax yields less money than is allocated under the current formula or the allocation by costs. Even in Wayne, Oakland, and Macomb Counties, income tax collections appear larger, mainly because of tax collections from income in incorporated areas. Such income is included for only these three counties, since a considerable portion of the county primary road system is in incorporated areas. Consistent with the findings of Chapter VII, income concentrates in cities more than travel patterns or highway costs. It is apparent that cities generally subsidize counties under either motor fuel or income taxes. Subsidy refers to costs on a highway system in one jurisdiction exceeding highway revenues derived from the tax base in that jurisdiction, given a statewide tax rate.

City Major Streets

City major streets receive 14.85 percent of funds distributed through the Motor Vehicle Highway Fund. This is 75 percent of the 19.8 percent of all state-level funds devoted to cities for highway purposes. The share of each city is calculated in the current formula with 60 percent on the basis of population and with 40 percent on the basis of equivalent major street mileage.¹ This formula allocates state aid to city major streets.

Alternatively, the money can be directed to city streets on the basis of costs of meeting the uniform standards. This results in the cities receiving a somewhat lower percentage of the Motor Vehicle Highway Fund than is devoted to the city major streets by the current formula. This percentage of total highway costs is 10.67 percent.

In Table 7, money is distributed among the sample cities by both the present formula (Column 1) and by the costs of meeting the uniform standards (Column 2). In each case, the Motor Vehicle Highway Fund is again assumed to contain \$100 million with the cities receiving their share based on the current formula or on the proportion of costs on the city major streets. The sample of cities is the same as that used in Chapter VII and contains all cities

¹Equivalent major mileage equals the sum of twice the state trunkline mileage in cities over 30,000 population plus major street mileage in each city multiplied by a factor ranging from one to two, rising with population, and with Detroit having a factor of 2.4.

Table IX-7.--Revenues Distributed on City Major Streets (in Thousands of Dollars).

Cities or Villages	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenues
Adrian	\$ 48.6	\$ 41.5	\$ 51.1	\$ 82.2
Allegan	13.5	9.0	15.8	17.2
Allen Park	88.1	22.2	58.1	240.2
Alma	22.1	17.3	24.5	37.8
Alpena	34.2	38.3	46.3	51.2
Ann Arbor	253.3	179.5	349.3	545.5
Bad Axe	7.9	3.9	4.8	13.2
Battle Creek	120.8	221.3	219.4	156.6
Bay City	133.5	176.3	192.5	196.4
Benton Harbor	39.9	59.9	84.0	52.1
Berkley	43.6	29.5	65.7	118.6
Big Rapids	25.0	14.5	23.5	32.9
Birmingham	55.0	64.4	119.5	226.7
Cadillac	26.0	22.0	16.6	33.0
Caro	9.7	4.1	5.9	17.2
Charlevoix	10.5	3.4	5.8	12.5
Charlotte	17.2	11.7	3.8	36.5
Cheboygan	15.2	12.9	9.7	17.4
Clare	6.3	1.4	3.3	8.4
Coldwater	25.2	22.6	26.8	36.1
Dearborn	275.5	121.3	311.1	643.4
Dearborn Heights	162.5	60.9	126.1	442.0
Detroit	3,799.1	1,968.3	4,874.5	6,818.3
Dowagiac	16.5	5.1	7.8	26.4
East Detroit	90.4	27.0	134.4	236.4
East Lansing	102.8	67.3	84.5	213.5
East Tawas	7.1	7.6	2.5	10.9
Escanaba	39.7	36.7	45.8	50.0
Ferndale	67.0	57.3	103.5	164.2
Flint	522.5	458.5	760.7	929.4
Frankfort	4.8	1.7	3.6	5.9
Fremont	9.5	2.2	6.1	14.3
Garden City	84.8	32.4	22.7	189.8
Gaylord	8.1	6.7	5.1	10.2
Gladwin	6.2	2.6	4.3	8.0
Grand Rapids	584.7	357.2	737.0	828.8
Grayling	5.2	1.3	2.9	6.0
Greenville	18.6	11.2	1.5	30.4
Grosse Pt. Woods	42.7	11.6	20.8	187.6
Hamtramck	52.6	20.7	93.8	121.8
Harper Woods	38.0	15.7	6.7	124.1
Hart	6.2	3.5	4.2	6.5
Hastings	18.0	7.9	23.4	27.2

Table IX-7.--Continued.

Cities or Villages	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenues
Hazel Park	\$ 46.7	\$ 26.4	\$ 56.4	\$ 109.8
Highland Park	75.3	18.2	122.2	150.2
Hillsdale	22.2	24.7	8.7	33.2
Holland	67.1	69.9	95.4	112.4
Houghton	12.7	8.4	5.0	17.5
Howell	14.7	12.4	9.7	26.9
Inkster	74.2	15.1	28.7	165.7
Ionia	14.1	11.9	8.3	26.8
Iron Mountain	25.4	21.0	13.0	32.9
Iron River	10.4	12.0	9.1	6.6
Ironwood	25.7	35.2	21.4	24.2
Jackson	129.2	115.4	194.5	199.6
Kalamazoo	242.4	294.1	418.9	360.1
Kalkaska	5.0	5.5	4.1	4.0
Kentwood	51.3	36.5	69.4	88.2
L'Anse	6.7	4.3	4.0	7.7
Lansing	376.4	381.5	446.4	600.8
Lapeer	16.5	15.1	14.7	26.4
Lincoln Park	118.9	16.1	82.7	271.8
Livonia	237.8	83.7	124.2	614.6
Ludington	21.0	13.2	4.7	39.1
Madison Heights	79.9	108.2	114.0	192.3
Mancelona	3.4	3.1	2.4	4.1
Manistee	21.1	17.8	13.4	23.6
Manistique	9.9	6.4	5.2	11.4
Marquette	49.6	57.6	128.4	86.2
Menominee	29.0	22.2	16.4	35.9
Midland	120.3	72.0	184.9	196.5
Monroe	53.5	51.6	48.9	114.9
Mount Clemens	41.4	22.3	45.1	103.0
Mount Pleasant	44.3	10.6	36.7	64.9
Munising	10.2	8.2	1.6	9.5
Muskegon	138.1	169.0	183.6	161.1
Newberry	6.6	6.0	0.9	9.6
Norton Shores	62.8	115.5	114.4	96.6
Oak Park	70.6	79.4	127.6	243.2
Ontonagon	7.1	4.1	5.7	9.8
Owosso	40.2	29.6	42.2	85.3
Petoskey	15.6	10.6	8.8	26.7
Pontiac	215.2	283.6	399.7	341.9
Portage	96.0	22.0	21.2	152.5
Port Huron	104.2	84.0	125.9	151.7
Reed City	6.3	3.4	3.7	7.7
Rogers City	10.0	6.9	5.2	14.8

Table IX-7.--Continued.

City or Villages	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenues
Romulus	\$ 44.0	\$ 5.0	\$ 50.1	\$ 100.6
Roseville	137.2	37.8	76.1	278.8
Royal Oak	204.2	140.6	288.3	899.5
Saginaw	270.4	323.7	338.8	468.1
St. Clair Shores	173.4	44.2	91.2	8.3
St. Ignace	8.7	8.2	6.0	30.6
St. Johns	16.2	6.7	13.9	404.4
Sandusky	5.2	1.8	2.9	7.6
Sault Ste. Marie	41.3	61.5	63.7	56.1
Southfield	195.2	91.2	152.6	580.6
Southgate	64.7	14.7	21.1	17.2
South Haven	18.2	21.0	16.8	24.3
Standish	3.7	2.5	2.9	4.5
Sterling Heights	144.2	151.3	147.6	321.5
Sturgis	24.0	14.1	17.8	42.7
Taylor	149.6	81.4	95.7	316.7
Traverse City	44.1	8.7	78.7	68.2
Trenton	43.2	6.3	17.9	135.1
Troy	104.0	78.5	53.7	264.1
Warren	379.5	188.5	661.9	924.2
Wayne	42.6	18.0	32.1	103.0
West Branch	4.8	1.2	3.2	5.6
Westland	167.3	56.4	83.0	414.6
Wyandotte	86.9	42.4	59.6	198.2
Wyoming	157.7	107.6	230.2	226.9
Ypsilanti	58.5	57.5	86.2	115.4

Sources: Current distribution calculated from the Michigan Department of State Highways and Transportation, Twenty-third Annual Progress Report, pp. 208-23; cost data adapted from Michigan Highway Needs Summary, 1970-1990, Appendix C-5; data on vehicle miles of travel, unpublished data from the Transportation Planning Division, Michigan Department of State Highways; income data from Survey of Current Business-Local Area Personal Income (May, 1974), as modified in Chapter III; U.S. Department of Treasury, Final Data Elements, Entitlement Periods 1, 2 and 3 (U.S.G.P.O., 1973).

with a 1970 population of over 20,000 plus the largest city or village in each county if its population exceeded 1,000.

Also included in Table 7 (Column 3) is the amount of motor fuel tax that would be collected in each city in the sample if \$100 million were collected statewide by the tax. The required tax rate is \$0.02681 per gallon. Column 4 in Table 7 shows the income tax collections required to meet the current formula payments on city major streets and county primary roads. The required tax rate equals 0.1409 percent. The information on motor fuel tax and income tax is presented to show the distribution of highway use and taxable resources relative to the distribution of highway revenues by both the current formula and costs.

Distributing highway monies in proportion to costs results in a total amount for city major streets of only 71.85 percent of the amount which is distributed by the present formula. As a result, more cities lose than gain under a distribution according to costs. The heaviest losses appear to be concentrated in suburban cities and in some of the smaller communities. Most older non-suburban cities have very small losses or actual gains under a shift to distribution by costs. Wayne County cities are the largest losers because a portion of their major street system has remained within the county primary system. This is true in Detroit and is more pronounced in many of the suburbs. Pressure from the cities with relatively small major street systems has resulted in allowing a 25 percent

transfer to local streets by resolution of the city council. The losses that occur in many smaller cities are the result of lower standards and the resulting reduced costs caused by smaller traffic volumes on their city streets.

The distribution of money in proportion to motor fuel consumption shows that the larger cities generally receive less from the formula than the amount of tax earned on their city major streets. Smaller cities generally receive more than was earned on their city major streets. This is especially true for sample cities under 10,000 population. In the case of the income tax, most cities, large and small, pay more than they receive under either the current formula or the costs for city major streets. The only exceptions are some of the low-income cities.

The current formula for distributing funds from the Motor Vehicle Highway Fund does not appear to be designed to meet the costs of major streets. It tends to give large sums to cities with small systems while neglecting others with considerable capital improvement requirements.

County Local Roads

The current Motor Vehicle Highway Fund formula gives county local roads 8.83 percent of the total funds distributed by the formula. As with the county primary road system, small amounts shared with the primary roads for snow removal and engineering are not included in this study. The county local system receives 22.25 percent of

the 35.7 percent allocated to county roads distributed to each county by formula, with 35 percent on the basis of 1970 population outside of cities and villages and 65 percent on the basis of local road mileage. Another 2.5 percent of county road money is distributed to county local roads on the basis of urban local road mileage.

Only one-half of the construction costs of meeting the uniform standards is included in calculating the percentage of the Motor Vehicle Fund that should be allocated to county local roads to meet costs. This is because of the provision in the current law that requires that one-half of construction costs be met by funding other than by the Motor Vehicle Highway Fund. Even with this provision, 16.03 percent of all costs are on the county local road system.

Table 8 shows the results of distributing the county local share of \$100 million in proportion to the current formula (Column 1) and according to the costs of meeting the uniform standards (Column 2). The table also shows the amount of money raised on the county local road system of each county by a statewide motor fuel tax sufficient to raise \$100 million in 1970. The tax rate is \$0.02681 per gallon. Column 4 in Table 8 shows the distribution of a flat rate income tax sufficient to raise the percentage of \$100 million allocated by the current formula to city local streets and county local roads. The tax rate is 0.04692 percent.

Table IX-8.--Revenues Distributed on County Local Roads (in Thousands of Dollars).

County	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenue
Alcona	\$ 52.1	\$ 97.3	\$ 5.9	\$ 5.2
Alger	30.4	39.3	7.6	3.2
Allegan	154.3	263.2	79.5	55.1
Alpena	57.8	133.2	35.2	17.8
Antrim	63.7	92.4	26.7	8.4
Arenac	46.8	90.6	32.0	7.6
Baraga	34.7	51.9	8.7	3.9
Barry	87.2	146.1	43.2	31.8
Bay	133.6	256.4	121.5	77.8
Benzie	41.0	53.3	19.5	5.1
Berrien	217.7	378.2	144.8	152.2
Branch	76.7	92.1	11.5	24.9
Calhoun	185.0	263.9	91.5	113.4
Cass	95.7	135.2	75.3	43.4
Charlevoix	52.7	86.2	10.2	7.8
Cheboygan	84.4	104.5	21.4	9.3
Chippewa	90.9	171.4	32.9	17.3
Clare	73.9	119.4	34.6	8.7
Clinton	103.3	103.6	58.4	48.2
Crawford	49.7	82.6	14.4	3.5
Delta	60.5	94.3	18.7	13.0
Dickinson	40.2	70.9	12.6	7.4
Eaton	116.2	193.8	59.1	69.3
Emmet	61.0	116.5	29.1	11.2
Genesee	370.0	524.0	313.9	348.3
Gladwin	60.6	141.7	64.2	9.6
Gogebic	35.8	82.5	24.3	5.7
Grand Traverse	77.9	75.7	34.1	25.5
Gratiot	88.8	177.4	31.2	24.1
Hillsdale	93.0	211.9	83.5	27.4
Houghton	67.6	144.8	6.7	13.9
Huron	126.6	228.9	92.2	23.5
Ingham	152.0	258.4	95.1	112.8
Ionia	85.6	146.4	33.1	27.5
Iosco	80.3	80.8	18.1	26.2
Iron	35.5	76.0	11.8	4.7
Isabella	90.8	129.6	60.3	23.8
Jackson	211.2	357.1	134.3	140.6
Kalamazoo	156.3	256.4	118.7	110.7
Kalkaska	55.4	113.0	12.6	3.6
Kent	213.4	319.2	169.3	125.8
Keweenaw	7.7	9.1	3.9	1.7
Lake	66.0	90.2	25.6	3.5

Table IX-8.--Continued.

County	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenue
Lapeer	\$ 116.7	\$ 220.3	\$ 67.0	\$ 47.1
Leelanau	47.6	84.5	56.1	9.9
Lenawee	131.3	226.2	96.8	54.3
Livingston	114.8	210.2	79.4	74.7
Luce	24.1	33.2	7.8	4.1
Mackinac	40.3	101.2	24.9	5.9
Macomb	253.0	532.0	180.9	212.7
Manistee	76.6	129.0	28.3	10.6
Marquette	113.8	162.8	28.4	33.9
Mason	75.6	167.3	47.5	13.6
Mecosta	85.3	169.0	53.5	12.9
Menominee	75.4	130.0	20.1	10.5
Midland	76.4	119.1	48.1	32.0
Missaukee	58.7	92.9	15.2	5.7
Monroe	173.8	305.1	103.3	121.4
Montcalm	119.7	176.8	29.1	27.0
Montmorency	44.9	94.6	10.9	4.5
Muskegon	131.6	226.1	77.1	61.2
Newaygo	120.5	194.4	53.1	22.5
Oakland	619.4	1,878.2	1,671.0	564.4
Oceana	85.4	140.9	27.4	16.8
Ogemaw	55.0	108.9	35.0	7.3
Ontonagon	37.1	89.1	18.2	9.4
Osceola	66.6	98.5	62.8	8.4
Oscoda	50.0	72.0	20.7	3.0
Otsego	55.4	88.0	14.0	7.6
Ottawa	198.2	289.0	137.8	92.6
Presque Isle	56.3	119.3	31.4	5.3
Roscommon	64.6	190.7	37.7	8.6
Saginaw	265.0	492.8	183.1	184.2
St. Clair	164.3	367.7	166.6	86.5
St. Joseph	80.7	148.0	68.8	30.8
Sanilac	143.6	309.6	70.9	27.3
Schoolcraft	21.0	32.4	3.6	2.8
Shiawassee	99.7	179.8	67.5	49.0
Tuscola	137.5	306.1	96.5	40.8

Table IX-8.--Continued.

County	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenue
VanBuren	\$ 110.4	\$ 181.0	\$ 84.0	\$ 38.7
Washtenaw	194.8	314.4	79.6	144.4
Wayne	282.4	477.1	247.7	268.1
Wexford	75.9	114.2	18.8	7.3

Sources: Present distribution calculated from Michigan Department of State Highways, Local Government Division, Interdepartmental Memoranda on fourth quarter 1974 payments to local government; cost data adapted from Michigan Needs Summary, 1970-1990, Appendix C-3; data on vehicle miles of travel, unpublished data from the Transportation Planning Division, Michigan Department of State Highways; income data from Survey of Current Business-Local Area Personal Income (May, 1974), as modified in Chapter III.

Since the percentage of \$100 million devoted to county local roads under distribution by costs in meeting the uniform standards is almost twice that of the current formula, most counties would gain substantially from the shift to allocation on the basis of costs. The gains are greatest for counties with above-average growth over recent years and for counties which have failed to maintain their local road system. The smallest gains occur in counties with small local road systems, primarily counties with their populations concentrated in cities and villages with rural areas requiring few roads. Alger, Benzie, and Schoolcraft Counties are examples.

The receipts from the motor fuel tax and the income tax both show that even urban counties gain under both the current formula and the distribution according to the costs of meeting uniform standards. Only in Oakland and St. Clair Counties, where a large local system carries many vehicles, does the current formula provide less money than was earned by the fuel tax. These results indicate that in almost all counties the county local system would be subsidized under either the motor fuel tax or the income tax whether the current formula or the costs are used to distribute funds.

City Local Streets

The city local street formula allocates 4.95 percent of the total Motor Vehicle Highway Fund to city local

streets. Each city receives its share of local street funds based 60 percent on population of the city or village and 40 percent on local street mileage in each city or village. Local streets are allocated 25 percent of all state funds for cities and villages. In comparison, allocating Motor Vehicle Highway Funds by the costs of meeting the uniform standards results in 6.80 percent of total Motor Vehicle Highway Fund money allocated to city streets.

Table 9 shows the results of distributing the city local street share of \$100 million of Motor Vehicle Highway Fund money by the current formula (Column 1) and by costs of meeting the uniform standards (Column 2). As with the county local roads, the costs of meeting the uniform standards were reduced by one-half of the construction costs. Column 3 shows the amount of motor fuel tax collected in each city or village based on a statewide rate of \$100 million. The tax rate is \$0.02681 per gallon. Column 4 shows the amount of income tax necessary to meet the state share of costs on city local streets and county local roads based upon the share these highways receive from \$100 million in the Motor Vehicle Highway Fund. The tax rate, as with the county local roads, is 0.04692 percent.

Allocation by costs of meeting the uniform standards results in approximately 37 percent more money being allocated to local city streets than under the current formula. A vast majority of the cities and villages gain

Table IX-9.--Revenues Distributed on City Local Streets (in Thousands of Dollars).

Cities or Villages	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenues
Adrian	\$ 16.3	\$ 32.2	\$ 16.2	\$ 27.4
Allegan	4.7	8.4	5.4	5.7
Allen Park	31.5	27.0	34.7	80.0
Alma	9.1	15.5	9.1	12.6
Alpena	13.5	29.2	11.8	17.0
Ann Arbor	78.2	55.2	68.5	181.7
Bad Axe	3.0	3.3	2.1	4.4
Battle Creek	37.5	49.5	52.0	52.2
Bay City	44.1	78.1	52.3	65.4
Benton Harbor	13.5	20.7	16.3	17.3
Berkley	16.4	13.6	22.2	39.5
Big Rapids	9.9	19.3	16.2	10.9
Birmingham	22.2	38.8	27.4	75.5
Cadillac	10.8	25.6	14.6	11.0
Caro	4.1	4.5	2.4	5.7
Charlevoix	4.0	6.9	4.1	4.2
Charlotte	7.7	17.7	5.4	12.2
Cheboygan	7.6	20.0	6.8	5.8
Clare	3.8	4.1	3.4	2.8
Coldwater	8.7	9.7	7.1	12.0
Dearborn	81.1	46.0	75.1	214.3
Dearborn Heights	62.8	112.2	132.7	147.2
Detroit	1,043.3	1,121.2	841.2	2,270.9
Dowagiac	6.6	9.6	2.8	8.8
East Detroit	34.8	12.1	34.3	78.7
East Lansing	31.7	20.6	28.2	71.1
East Tawas	4.0	11.5	2.0	3.6
Escanaba	14.6	19.6	12.9	16.6
Ferndale	23.4	44.0	41.7	54.7
Flint	152.1	183.8	152.7	309.6
Frankfort	2.1	2.6	1.7	2.0
Fremont	4.4	2.6	3.6	4.8
Garden City	32.8	63.1	21.0	63.2
Gaylord	3.6	8.2	2.8	3.4
Gladwin	3.5	5.6	3.4	2.7
Grand Rapids	157.1	165.6	161.6	276.0
Grayling	2.6	3.1	2.1	2.0
Greenville	8.4	14.5	6.0	10.1
Grosse Pt. Woods	16.9	8.7	23.7	62.5
Hamtramck	16.6	13.6	21.9	40.6
Harper Woods	15.2	24.9	19.0	41.3
Hart	2.2	4.5	1.6	2.2
Hastings	7.7	7.2	6.1	9.1

Table IX-9.--Continued.

Cities or Villages	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenues
Hazel Park	\$ 18.3	\$ 18.6	\$ 6.2	\$ 36.6
Highland Park	21.1	4.5	14.2	50.0
Hillsdale	7.2	14.2	2.6	11.1
Holland	25.8	44.8	6.1	37.4
Houghton	4.9	7.9	2.5	5.8
Howell	5.3	12.0	3.7	9.0
Inkster	31.0	26.8	39.3	55.2
Ionia	5.6	8.4	2.7	8.9
Iron Mountain	10.5	29.5	5.1	11.1
Iron River	3.1	7.4	2.5	2.2
Ironwood	10.4	24.9	6.2	8.0
Jackson	37.7	50.8	66.1	66.5
Kalamazoo	67.7	83.7	57.5	119.9
Kalkaska	2.6	7.2	2.5	1.3
Kentwood	18.9	37.1	11.4	29.4
L'Anse	3.1	4.6	1.8	2.6
Lansing	109.4	165.5	77.6	200.1
Lapeer	6.0	14.7	5.9	8.8
Lincoln Park	38.8	11.7	56.5	90.5
Livonia	93.0	122.0	95.6	204.7
Ludington	9.9	21.2	3.4	13.0
Madison Heights	29.9	54.0	30.0	64.0
Mancelona	1.9	5.1	1.8	1.4
Manistee	8.0	16.8	5.7	7.8
Manistique	4.7	10.4	4.8	3.8
Marquette	18.4	22.6	35.2	28.7
Menominee	11.4	17.5	4.9	12.0
Midland	34.6	53.1	31.7	65.4
Monroe	18.9	28.6	20.3	38.3
Mount Clemens	16.1	18.1	25.8	34.3
Mount Pleasant	16.3	8.0	6.7	21.6
Munising	3.5	5.6	0.9	3.2
Muskegon	39.4	46.7	26.3	53.7
Newberry	2.5	5.5	1.1	3.2
Norton Shores	23.5	35.3	11.4	32.2
Oak Park	28.2	39.5	40.6	81.0
Ontonagon	3.3	5.1	3.0	3.3
Owosso	15.3	23.1	9.5	28.4
Petoskey	6.5	14.8	4.3	8.9
Pontiac	66.4	114.1	65.6	113.7
Portage	34.4	69.4	38.4	50.8
Port Huron	31.0	43.9	29.5	50.5
Reed City	2.4	3.4	2.0	2.6
Rogers City	5.0	11.5	4.0	4.9

Table IX-9.--Continued.

Cities or Villages	(1) Current Formula	(2) Costs of Uniform Standards	(3) Motor Fuel Consumption Revenues	(4) Income Tax Revenues
Romulus	\$ 23.9	\$ 36.2	\$ 36.0	\$ 33.5
Roseville	45.1	49.7	30.6	92.8
Royal Oak	65.2	47.7	70.4	299.6
Saginaw	73.9	107.3	71.3	134.7
St. Clair Shores	66.7	87.8	34.9	155.9
St. Ignace	3.8	9.4	3.3	2.8
St. Johns	7.2	12.2	4.5	10.2
Sandusky	2.8	3.1	2.4	2.5
Sault Ste. Marie	16.4	46.2	19.6	18.7
Southfield	61.9	112.7	52.4	193.4
Southgate	26.5	24.8	35.5	5.7
South Haven	6.3	12.5	19.0	8.1
Standish	1.6	2.1	1.3	1.5
Sterling Heights	55.0	50.1	37.4	107.1
Sturgis	9.4	12.0	8.5	14.2
Taylor	58.7	131.4	67.3	105.5
Traverse City	16.5	24.3	22.0	22.7
Trenton	19.2	15.6	15.4	45.0
Troy	42.3	78.7	39.8	88.0
Warren	139.2	124.9	122.9	307.8
Wayne	16.4	13.0	13.0	34.3
West Branch	2.0	2.1	1.8	1.8
Westland	65.9	60.6	26.6	138.1
Wyandotte	30.4	37.6	26.4	66.0
Wyoming	49.5	50.3	29.6	75.6
Ypsilanti	19.7	20.2	29.0	38.4

Sources: Current distribution calculated from the Michigan Department of State Highways and Transportation, Twenty-third Annual Progress Report, pp. 224-39; cost data adapted from Michigan Highway Needs Summary, 1970-1990, Appendix C-6; data on vehicle miles of travel, unpublished data from the Transportation Planning Division, Michigan Department of State Highways; income data from Survey of Current Business-Local Area Personal Income (May, 1974), as modified in Chapter III; U.S. Department of Treasury, Final Data Elements, Entitlement Periods 1, 2 and 3 (U.S.G.P.O., 1973).

from the increase in revenues to local roads. The only cities that would lose by a shift to distributing money on the basis of costs are a few older suburban cities such as Dearborn and Allen Park. In these cities the capital investment in local streets has been completed but is not yet in need of replacement. Some of the newer suburbs plus many older cities gain under the cost approach.

The current formula payment exceeds the motor fuel tax collections in just over one-half of the sample cities. Income tax collections exceed the current formula payments in almost all cases and frequently exceed the distribution in proportion to costs.

Summary and Comments

The Motor Vehicle Highway Fund does not have a rural bias in distributing revenues to counties, cities, and villages when these distributions are compared to the costs of meeting the uniform standards. If the current formula or the costs are used to distribute highway funds, higher payments relative to the motor fuel tax are made, on average, to county primary roads, county local roads, and city local streets, while lower payments result to state trunklines and city major streets. Again, there is no clear-cut urban or rural bias in either method of distribution.

Distribution of state highway funds by either the current formula or by the costs of meeting the uniform

standards does not return the money to the cities and counties in which it is collected. The motor fuel tax is not returned to the city or county of collection under either the current formula or the costs of meeting the uniform standards. In the distribution of the motor fuel tax, neither the current formula nor distribution by costs meet the requirements of the strict application of the benefit principle. More money is spent on highways in some cities and counties than is earned on their highway systems, while other cities and counties receive less, causing the benefits of the expenditures to be distributed differently from the user taxes.

The current formula does not meet the costs as recognized in the 1970 Needs Study. Even when the proportion of costs is close to the proportion of available funds, as on the county primary system, individual counties receive proportions above or below the costs of meeting the standard system. If the policy goal is to meet the costs on the highway systems in proportion to the funds available, state aid should be distributed in proportion to those costs of meeting the uniform standards that are to be met by state funds. This goal could be modified by giving extra aid to high volume highways. Two reasons may be advanced in support of additional aid: (1) a willingness to spend limited resources where they benefit the greatest number of users of the services, and (2) a desire to return the highway funds to the benefit of those who paid for

them, in keeping with the benefit principle. The more heavily traveled systems could be aided by distributing a portion of the highway money on the basis of volume of travel in the recipient unit on that system.

Objection is raised by highway department officials to any distribution directly by costs on the grounds that it penalizes those local units which have supplemented highway money with local funds. This problem could be eliminated by allowing some locally met costs, primarily those in excess of matching requirements, to be included in the costs used for the distribution of state aid. This action has the advantage of not reducing payments of state aid to cities and counties that make a strong effort to improve their highways. However, allowing an adjustment of costs for local highway expenditures reduces the uniformity of the ability to pay for highway services. This occurs because capacity to pay for highway services differs among jurisdictions. If a jurisdiction with greater capacity is allowed to count some highway costs that have already been met as costs for allocation of state aid payments, that jurisdiction will have more revenue to finance highways than other jurisdictions.

Federal aid was not included in the tables used in this section because of the uncertainty and shifting pattern of federal aid. This study also has assumed that the state has little influence on federal aid. Any distribution formula should recognize the heavy federal aid to

the interstate system and to the other portions of the state trunkline system. Federal aid also goes to the city major system and to the county primary system in considerable amounts. Any adjustments in state highway funding for federal aid should consider the diversion provisions for mass transit now included in the federal law. Financial provisions should not be designed to discourage the comparison of highway and non-highway transportation alternatives.

CHAPTER X

ASSESSMENT OF THE STUDY

This study examined the distribution of highway monies for construction and maintenance in relation to highway costs and taxable resources. It also analyzed the effects of alternative choices of taxes to finance highways.

Type of Taxation

In the choice of the type of taxation for highway purposes, a flat rate income tax and the motor fuel tax were given primary emphasis after a brief examination of property taxes, weight taxes, and congestion taxes. The motor fuel tax and the income tax were chosen because they are prototypes of the benefit-based user tax and the ability-to-pay tax respectively.

Chapters III through VI concentrate on the analysis of the alternative taxes. The primary result of the study is that there is no overriding economic or technical reason for the domination of user tax financing in highway construction and maintenance. The following advantages are provided by user taxes:

1. These taxes offer an easily earmarked and fairly reliable revenue source for which the highway authorities need not compete with other public purposes.
2. User taxes provide a mild conservation effect in the use of motor fuel. The elasticity of demand for gasoline appears to be less than -1.0, but at least -0.5.
3. A method of charging for the right-of-way in proportion to the amount of increased construction that a heavier vehicle requires on a roadway is provided. Charges to larger vehicles for highway building could help to protect financially the railroads which pay for their track and roadbed. Current user taxes in Michigan have tended to charge trucks which compete with railroads less than the costs imposed by such vehicles on road construction.
4. User taxes provide a form of taxation that increases revenues as traffic increased.

Disadvantages of user taxes are as follows:

1. Under inflation, user taxes lose much of their stability as a revenue source. Temporary constrictions of supplies of the taxed input, such as rationing or embargo of motor fuel, also decrease stability.
2. User taxes do not follow rigidly the benefit principle because the money is distributed

by proxies (population and highway mileage are examples) for highway use. Reasons for supporting highways with little current use are to provide basic government services and to support, if not lead, economic development.

3. If earmarked, the user taxes reduce budget flexibility to meet changing conditions.
4. User taxes, including motor fuel taxes, are generally regressive on income.

The income tax has advantages that are the converse of the user taxes. Among the major advantages are the following:

1. Because the income tax is seldom earmarked, income tax financing of highways would offer greater flexibility to meet changing conditions. This would afford greater consideration of programs to develop other forms of transportation and allow comparison of transportation and nontransportation programs in the budget process.
2. The flat rate income tax is mildly progressive. By changing the rates or credits of the income tax it can be made even more progressive.
3. Income taxation is generally more responsive to changes in the price level.
4. Because of the close link between automobile use and income, the income tax is correlated positively

with automobile use, although not as closely as the motor fuel tax.

5. Income taxes encourage the use of highways that are not congested. As this study shows, congestion is a problem on only a small portion of Michigan highway mileage and for a minor part of the vehicle miles driven.

Disadvantages of the income tax include its somewhat greater reaction to an economic slowdown than the fuel tax and the greater complexity of budgeting for highways without an earmarked revenue source. On balance, the choice of earmarked user taxes for highway finance does not appear to be dictated by overriding technical or economic considerations.

This study found that the property tax was primarily efficient in supporting local roads on the basis of benefits. Its use is largely restricted to highways with minimal spillover effects on other jurisdictions.

An examination of the use of congestion tolls in highway finance in Michigan showed that congestion taxation is not a viable method of financing highways at this time. Congestion tolls pose serious technical and equity problems. These taxes appear useful only in conditions of heavy congestion and the availability of an effective public transit system.

Distribution of Highway Revenues

This study also examined the distribution of the costs of building the standard system and the resources necessary to build and maintain the highway system. Motor fuel consumption and income were used as the measures of available resources. General findings are that the total costs of building the standard system, including locally met costs, are greater for rural and suburban areas than are the total costs for cities. This means that lower standards on rural roads are offset by greater distances and faster growth rates in the rural and suburban areas.

A motor fuel tax levied at a statewide rate sufficient to pay the annual costs of meeting the uniform standards shows that the lightly traveled county local road and city street systems would gain revenue. The more heavily traveled systems tend to lose. In the case of income tax financing, meeting costs with income taxation results in gains to roads in the more rural areas and the transfer of resources from higher income areas. Income is more concentrated in urban areas than is overall driving, which causes the rural areas to have a higher percentage of motor fuel consumption than of total income. In addition, much of the higher fuel consumption comes from intercity travel through rural areas by city residents.

The total costs of meeting the uniform standards are constrained to a level of costs that have been met by recent actual expenditures. This constraint means that

about 48 percent of the costs will be met by state and federal funds. The costs covered include 50 percent of local county road and city street costs since these are a local responsibility because of the essentially local nature of the service these roads provide. The constraint was developed from statistical analysis which showed that Michigan spent less than the average for all states in 1972 in relation to costs, income and highway system characteristics. The calculation showed that Michigan did not spend greater amounts on highways in proportion to its income, cost and highway characteristics because it is the home of the automobile industry. The 1973 increase in the motor fuel tax has come very close to reaching the level of expenditure predicted by the statistical analysis. For this reason, the constraint used to calculate the portion of the costs met included the 1973 increase which reflected the results of the 1970 Needs Study.

Distribution of highway funds by the current state formula does not meet the costs of the standard system on many of the highways in cities and counties. Some receive larger payments than their portion of costs while others receive smaller portions. The current formula also does not distribute highway funds on the basis of highway use. The cost data reflect use, but more compact residential and commercial land uses are less costly to provide with highway services. This occurs even when higher service

standards are applied to the highways serving higher density land uses.

It appears certain that sufficient money will not be raised to meet the cost of the uniform standards. Highway funds should be distributed primarily in proportion to costs of meeting the uniform standards if the goal is to pay the same proportion of highway costs on a specific legal system in each legal jurisdiction. The cost data provide the only statewide measure of comparable highway services. A smaller portion of state aid could be distributed on the basis of the amount of travel on each system in each county or city if greater aid is to be directed to costs on the more heavily traveled systems. Such action may be desirable because it would aid a larger number of vehicles, thereby increasing benefits to motorists. Costs of meeting the uniform standards should remain the more important factor in distributing aid because costs already recognize greater traffic flows. Both costs and travel data would have to be updated every two to four years to keep such a formula operational. Adjustments would also be required for changes in federal aid and local spending on the highway system.

Goals and Distribution

The geographic distribution of state highway aid depends on the goals decided upon for the expenditure of the funds. The current formula claims to be meeting highway

costs. The formula uses proxies for highway costs, primarily population, highway mileage and vehicle registrations. Adjustments are made among cities, counties and the state to reflect highway costs. However, these adjustments also consider the need to maintain the highway or public works department at the state, county, and city levels. Other influences include efforts to aid more heavily traveled highways and to meet federal matching requirements.

Results of the current Motor Vehicle Highway Fund formula suggest that the proxies often fail to meet highway costs. The emphasis given to the goals is not clearly defined and emerges from bargaining among representatives for cities, county road commissions, the state highway department, and the legislature.

The goal of distribution according to costs is the meeting of the same proportion of costs in each jurisdiction on each highway system. These costs are calculated from uniform standards and therefore provide an estimate of the quality of service in each jurisdiction. Distribution by costs seeks to provide the same level of service in each jurisdiction on each system. Distributing highway funds in proportion to costs generally provides more aid to highways that are less heavily traveled than would distribution by use. Distribution by costs also reaches special problem areas, especially urban fringe areas and older cities.

Distributing highway revenues by use meets the goal of improving the heavily traveled highways and benefiting the greatest number of motorists. This method of distribution is in compliance with the benefit principle of taxation. However, distributing by highway use fails to maintain the local roads and streets necessary to reach the more heavily traveled highways. This method of distribution, if strictly followed, would discourage the use of highway expenditures to improve highways in areas with light travel. Such improvements may be warranted to encourage development in new areas.

The motor fuel tax provides a measure of the use of the highways. Returning motor fuel tax collections to the system and jurisdiction upon which they were accumulated closely approximates a tax and expenditure system based upon use. This method of distribution concentrates highway funding on heavily traveled sections of the state trunkline system and on other more heavily used highways in urban and resort areas.

The distribution of income among jurisdictions suggests that state aid to highways is required if the same proportion of either highway cost or use is to be met in each jurisdiction. The income distribution by jurisdiction also shows the source of tax collections under an income tax.

Two areas of further research in the subject area of this study may be mentioned. Greater formalization of

the procedures for making choices with limited resources among highway projects would improve transportation planning. While cost-benefit analysis has been attempted on some projects and public hearings are required on major highway projects, little technical research and even less political debate has been given to establishing goals for the highway system to meet, and to deriving the criteria for cost-benefit analysis from these goals. Possible goals, sometimes conflicting, include minimizing travel time, supporting economic development, preserving existing neighborhoods and providing public services efficiently.

A second area of research involves the calculation of costs for other transportation methods and their incorporation into a larger transportation, rather than simply a highway study. This area of research remains very difficult because of the difficulty in estimating the requirements and response to alternative modes of transportation. The comparison of transportation modes has taken on new importance with the passage in 1973 of laws at both the federal and state levels that allow the diversion of user tax revenue to public transportation.

APPENDIX

**NON-HIGHWAY CHARACTERISTICS OF COUNTIES
AND SAMPLE CITIES**

APPENDIX

NON-HIGHWAY CHARACTERISTICS OF COUNTIES AND SAMPLE CITIES

This appendix is designed to provide the reader with a simple profile of selected non-highway characteristics of counties and cities. The variables are chosen so as to quickly summarize population and land use characteristics of the counties and sample cities studied in this dissertation. None of the variables used in this appendix are sufficiently accurate proxies for either highway use or highway costs to be used for the distribution of highway funds. Highway costs and use are influenced by such a wide variety of factors that no simple statistical profile could represent all influences. However, the data shown in Tables 1 and 2 of the appendix indicate characteristics that influence both use and costs of highway systems.

Table 1 provides data on population, location and land use for counties. Population figures give an indication of the number of motor vehicles in use by residents in the county. The percentage population growth relates to the requirements of providing expanded roads and

Table A-1.--Non-Highway Characteristics of Counties.

County	(1) Population of County in 1960	(2) Percent Growth 1960-70	(3) Percent Rural Population	(4) Percent of Land in Farms	(5) Location* of County
Alcona	7,113	12.9	100	12.9	N
Alger	8,568	-7.4	57.1	4.3	U
Allegan	66,575	15.3	77.4	52.2	S
Alpena	30,708	7.5	55.0	25.6	N
Antrim	12,612	21.6	100	23.0	N
Arenac	11,149	13.1	100	38.9	N
Baraga	7,789	8.9	67.4	4.3	U
Barry	38,166	20.3	83.0	55.9	S
Bay	117,339	9.6	33.2	64.6	S
Benzie	8,593	9.7	100	19.2	N
Berrien	163,875	9.3	53.6	58.2	S
Branch	37,906	8.6	76.0	81.2	S
Calhoun	141,963	2.2	40.4	63.7	S
Cass	43,312	17.3	79.4	65.6	S
Charlevoix	16,541	23.2	60.8	19.3	N
Cheboygan	16,573	13.9	66.5	11.9	N
Chippewa	32,412	-0.7	33.8	9.5	U
Clare	16,695	43.3	84.2	24.4	N
Clinton	48,492	27.7	78.7	78.4	S
Crawford	6,482	30.4	100	-	N
Delta	35,924	4.7	42.6	13.5	U
Dickinson	23,753	-0.7	28.4	8.2	U
Eaton	68,892	38.7	57.9	71.1	S
Emmet	18,331	15.3	65.4	19.3	N
Genesee	444,341	18.7	22.7	41.6	S
Gladwin	13,471	25.1	100	28.4	N
Gogebic	20,676	-15.2	31.0	1.6	U
Grand Traverse	39,175	17.0	53.9	28.3	N
Gratiot	39,246	6.0	57.6	83.4	S
Hillsdale	37,171	7.0	79.2	72.6	S
Houghton	34,652	-2.8	60.3	7.1	U
Huron	34,083	0.2	91.2	81.3	S
Ingham	261,039	23.5	14.3	64.6	S
Ionia	45,848	6.3	66.6	76.2	S
Iosco	24,905	50.9	58.2	21.4	N
Iron	13,813	-19.6	80.6	3.6	U
Isabella	44,594	26.2	54.0	57.0	S
Jackson	143,274	8.5	45.2	57.8	S
Kalamazoo	201,550	18.8	24.5	51.5	S
Kalkaska	5,272	20.3	100	6.5	N
Kent	411,044	13.2	16.7	44.0	S
Keweenaw	2,264	-6.3	100	-	U
Lake	5,661	6.1	100	8.5	N
Lapeer	52,317	24.8	88.0	58.4	S

Table A-1.--Continued.

County	(1) Population of County in 1960	(2) Percent Growth 1960-70	(3) Percent Rural Population	(4) Percent of Land in Farms	(5) Location* of County
Leelanau	10,872	16.6	100	35.3	N
Lenawee	81,609	4.9	59.7	83.8	S
Livingston	58,967	54.2	89.0	47.5	S
Luce	6,789	-13.3	100	2.1	U
Mackinac	9,660	-11.0	70.1	4.4	U
Macomb	625,309	54.1	7.8	31.5	S
Manistee	20,094	5.5	61.6	19.3	N
Marquette	64,686	15.2	34.9	2.3	U
Mason	22,612	3.1	60.1	30.6	N
Mecosta	27,992	33.0	57.2	42.0	N
Menominee	24,587	-0.4	56.3	24.4	U
Midland	63,769	23.9	45.2	30.4	S
Missaukee	7,126	5.0	100	27.1	N
Monroe	118,479	17.2	65.0	71.2	S
Montcalm	39,660	10.8	81.1	59.1	S
Montmorency	5,247	18.6	100	8.0	N
Muskegon	157,426	5.0	30.9	22.3	S
Newaygo	27,992	15.9	87.6	27.8	S
Oakland	907,871	31.5	10.0	18.4	S
Oceana	17,984	8.7	100	38.3	N
Ogemaw	11,903	23.0	100	22.7	N
Ontonagon	10,548	-0.3	100	5.8	U
Osceola	14,838	9.1	100	36.5	N
Oscoda	4,726	37.1	100	6.9	N
Otsego	10,422	38.1	71.1	13.6	N
Ottawa	128,181	29.8	51.7	49.0	S
Presque Isle	12,836	-2.1	66.7	23.0	N
Roscommon	9,892	37.4	100	2.7	N
Saginaw	219,743	15.2	30.2	66.8	S
St. Clair	120,175	12.1	54.0	46.5	S
St. Joseph	47,392	12.0	64.9	73.3	S
Sanilac	34,889	8.0	100	75.0	S
Schoolcraft	8,226	-8.1	47.4	2.0	U
Shiawassee	63,075	18.0	62.4	74.8	S
Tuscola	48,603	12.2	86.6	68.9	S

Table A-1.--Continued.

County	(1) Population of County in 1960	(2) Percent Growth 1960-70	(3) Percent Rural Population	(4) Percent of Land in Farms	(5) Location* of County
VanBuren	56,173	16.1	78.4	58.4	S
Washtenaw	234,103	35.8	21.8	57.2	S
Wayne	2,666,751	-	1.8	12.8	S
Wexford	19,717	6.8	49.3	15.9	N

*N = county located entirely north of a straight line from Bay City to Muskegon, but in the Lower Peninsula. S = county located astride or south of that straight line. U = county located in the Upper Peninsula.

Note: Crawford and Keweenaw Counties contain so few farms that Census data violate the confidentiality requirement. Wayne County had a change of less than one-tenth percent in population between 1960 and 1970.

Sources: Columns (1), (2), and (3) computed from U.S. Department of Commerce, Bureau of the Census, Number of Inhabitants--Michigan; Column (4) computed from U.S. Department of Commerce, Bureau of the Census, 1969 Census of Agriculture--Michigan County Data.

highways to maintain service levels to larger numbers of people. The percentage of rural population refers to the number of people living in small towns (under 2,500) and rural areas. It suggests the number of people who must be served by long, low travel volume roads. Land use influences traffic volume and costs. The percent of agricultural land is shown because a high percentage of agricultural land means a county with a widely dispersed rural population. This requires a large rural road system to serve the dispersed populations. A high rural population and a low percentage of agricultural land indicate a county with much forest or waste land and a rural population concentrated in small settlements. An urban-agricultural mix of population requires a more costly highway system to maintain service levels than a small settlement-nonfarm county. This is especially true on the local road system.

Table 2 shows the county in which each city in the sample is located. It also shows the population of the city, its growth in population in the 1960-1970 decade and the percentage of property valuation devoted to residential property. Population figures of the city indicate automobile use in the city, despite variations in number of vehicles owned depending on income. Growth in population in a city indicates expansion requiring new facilities and increased costs. A low percentage of residential property valuation indicates that the city attracts many shoppers and commuters because of the presence of commercial and

Table A-2.--Non-Highway Characteristics of Sample Cities.

City or Village	County	(1) Population of City in 1970	(2) Percent Population Change 1960-70	(3) Percent Residential Real Property Valuation
Adrian	Lenawee	20,283	0.2	45.6
Allegan	Allegan	4,516	-6.3	37.4
Allen Park	Wayne	40,747	8.7	66.8
Alma	Gratiot	9,790	9.0	38.6
Alpena	Alpena	13,805	-6.0	29.9
Ann Arbor	Washtenaw	99,797	48.2	46.9
Bad Axe	Huron	2,999	-	51.4
Battle Creek	Calhoun	38,931	-11.9	35.7
Bay City	Bay	49,449	-7.8	56.2
Benton Harbor	Berrien	16,481	-13.9	36.6
Berkley	Oakland	22,618	-2.8	79.1
Big Rapids	Mecosta	11,995	38.1	51.4
Birmingham	Oakland	26,170	2.5	63.0
Cadillac	Wexford	9,990	-1.2	46.6
Caro	Tuscola	3,701	4.7	54.1
Charlevoix	Charlevoix	3,519	27.9	54.3
Charlotte	Eaton	8,244	7.7	47.2
Cheboygan	Cheboygan	5,553	-5.2	41.6
Clare	Clare	2,639	8.1	44.1
Coldwater	Branch	9,099	2.5	38.6
Dearborn	Wayne	104,199	-7.0	33.8
Dearborn Hgts.	Wayne	80,069	NC	81.5
Detroit	Wayne	1,511,482	-9.5	47.7
Dowagiac	Cass	6,583	-8.7	43.2
East Detroit	Macomb	45,920	0.4	80.5
East Lansing	Ingham	47,540	57.4	64.4
East Tawas	Iosco	2,372	-3.7	70.3
Escanaba	Delta	15,391	-0.1	67.4
Ferndale	Oakland	30,850	-1.6	53.4
Flint	Genesee	193,317	-1.8	33.5
Frankfort	Benzie	1,660	-1.8	48.2
Fremont	Newaygo	3,465	2.4	32.4
Garden City	Wayne	41,864	10.1	77.8
Gaylord	Otsego	3,012	17.3	49.0
Gladwin	Gladwin	2,071	-7.0	54.8
Grand Rapids	Kent	197,649	11.5	48.2
Grayling	Crawford	2,143	6.4	31.6
Greenville	Montcalm	7,493	0.7	40.9
Grosse Pt. Woods	Wayne	21,878	17.8	87.6
Hamtramck	Wayne	27,245	-20.2	27.7
Harper Woods	Wayne	20,186	1.0	62.6
Hart	Oceana	2,139	7.5	55.4
Hastings	Barry	6,501	2.0	43.3

Table A-2.--Continued.

City or Village	County	(1) Population of City in 1970	(2) Percent Population Change 1960-70	(3) Percent Residential Real Property Valuation
Hazel Park	Oakland	23,784	-7.2	64.2
Highland Park	Wayne	35,444	-6.9	18.9
Hillsdale	Hillsdale	7,728	1.3	49.8
Holland	Ottawa	22,991	6.3	53.9
Houghton	Houghton	6,067	78.8	59.1
Howell	Livingston	5,224	7.5	46.6
Inkster	Wayne	38,595	-1.3	68.5
Ionia	Ionia	6,361	-5.8	49.7
Iron Mountain	Dickinson	8,702	-6.4	58.6
Iron River	Iron	2,684	-28.5	54.8
Ironwood	Gogebic	8,711	-15.1	50.8
Jackson	Jackson	45,484	-10.3	37.8
Kalamazoo	Kalamazoo	85,555	4.2	43.5
Kalkaska	Kalkaska	1,475	11.7	56.1
Kentwood	Kent	20,310	NC	47.9
L'Anse	Baraga	2,538	5.9	49.2
Lansing	Ingham	131,546	20.9	43.2
Lapeer	Lapeer	6,270	1.8	52.6
Lincoln Park	Wayne	52,989	-1.8	69.1
Livonia	Wayne	110,109	65.1	50.3
Ludington	Mason	9,021	-4.2	47.4
Madison Hgts.	Oakland	35,599	15.8	45.0
Mancelona	Antrim	1,235	10.0	77.6
Manistee	Manistee	7,723	-7.2	47.1
Manistique	Schoolcraft	4,324	-11.3	41.5
Marquette	Marquette	21,967	10.8	53.5
Menominee	Menominee	10,748	-4.8	51.6
Midland	Midland	35,176	25.7	32.2
Monroe	Monroe	23,894	4.0	24.8
Mount Clemans	Macomb	20,476	-2.6	44.5
Mount Pleasant	Isabella	20,504	37.8	56.7
Munising	Alger	3,677	-13.0	41.4
Muskegon	Muskegon	44,631	-4.0	34.4
Newberry	Luce	2,334	-10.6	68.0
Norton Shores	Muskegon	22,271	25.0	68.1
Oak Park	Oakland	36,762	0.4	60.1
Ontonagon	Ontonagon	2,432	3.1	43.7
Owosso	Shiawassee	17,179	1.0	69.2
Petoskey	Emmet	6,342	3.3	44.9
Pontiac	Oakland	85,279	3.7	22.3
Portage	Kalamazoo	33,590	66.4	50.1
Port Huron	St. Clair	35,794	-0.8	44.4
Reed City	Osceola	2,286	4.7	49.1

Table A-2.--Continued.

City or Village	County	(1)	(2)	(3)
		Population of City in 1970	Percent Population Change 1960-70	Percent Residential Real Property Valuation
Rogers City	Presque Isle	4,275	-9.5	41.8
Romulus	Wayne	22,879	50.2	32.1
Roseville	Macomb	60,529	20.6	64.6
Royal Oak	Oakland	85,499	6.1	62.2
Saginaw	Saginaw	91,849	-6.5	35.2
St. Clair Shores	Macomb	88,093	14.9	79.2
St. Ignace	Mackinac	2,892	-13.3	53.7
St. Johns	Clinton	6,672	18.5	56.6
Sandusky	Sanilac	2,071	0.2	49.2
Sault Ste. Marie	Chippewa	15,136	-19.2	43.4
Southfield	Oakland	69,285	119.9	38.3
Southgate	Wayne	33,909	15.3	62.1
South Haven	VanBuren	6,471	5.2	47.5
Standish	Arenac	1,184	-2.5	38.0
Sterling Hgts.	Macomb	61,365	319.7	50.0
Sturgis	St. Joseph	9,295	4.3	39.9
Taylor	Wayne	70,020	41.0	56.8
Traverse City	Grand Traverse	18,048	-2.1	47.4
Trenton	Wayne	24,127	30.8	23.5
Troy	Oakland	39,419	103.2	41.8
Warren	Macomb	179,260	100.9	43.9
Wayne	Wayne	21,054	31.3	39.9
West Branch	Ogemaw	1,912	-5.6	53.9
Westland	Wayne	86,749	NC	64.6
Wyandotte	Wayne	41,061	-5.6	48.6
Wyoming	Kent	56,560	23.4	37.7
Ypsilanti	Washtenaw	29,538	40.9	42.0

Notes: NC = new city which was not incorporated in 1960. Bad Axe had a change of population of less than one-tenth percent in the decade.

Sources: Columns (1) and (2) from U.S. Department of Commerce, Bureau of the Census, Number of Inhabitants--Michigan; and Column (3) from Michigan State Tax Commission, unpublished L-4023 forms for selected cities--1973.

industrial property. In addition, cities with little commercial and industrial valuation have greater difficulties financing road improvements because of lower valuations relative to streets.

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