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16. Abstract

With increasing concerns about the present level of highway funding, this study was initiated to investigate historical trends and to develop predictive methodologies for considering alternatives available for increasing highway revenues. Emphasis was placed on historical trends, and a data base of highway-related and socio-economic variables were prepared to document the relationship between these variables and highway-user revenues. A historical file of 37 variables was prepared for the period 1964 through 1984.

As a means of investigating future alternatives that will affect highway-user revenues, a series of nine equations or models were developed that represented historical data. Input data necessary for the models were personal income in 1972 constant dollars, the price of motor fuel, motor fuel taxation rates, and motor vehicle fuel economy.

These models provided logical and reasonable relationships, and the statistical data generally indicated high levels of correlation as represented by R-squares. An effort was made to develop models that were policy-sensitive such that future scenarios could be investigated. Using the series of nine models, forecasts of highway-user revenues were made for the years 1990 through 2005. This was an attempt to demonstrate use of the models for investigating the influence of policy-sensitive variables on revenues. Scenarios investigated were the following: 1) variations in fuel price and fuel tax, 2) increasing fuel economy, 3) variations in usage tax rate, and 4) registration fees increases. Examples showing the impact of future alternatives indicated several possible sources of increased highway-user revenues.

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Research Report
UKTRP-85-20

TRAFFIC TRENDS AND THEIR RELATIONSHIP TO HIGHWAY-USER REVENUES

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September 1985

EXECUTIVE SUMMARY

Because of increasing concerns about the present level of highway funding, a study was undertaken 1) to investigate historical trends in highway related characteristics and 2) to develop methods for predicting consequences of various alternates available for increasing highway revenues.

A historical file of 37 highway-related and socio-economic variables was prepared for the period 1964 through 1984. A series of nine equations or models was developed for use in determining future highway-user revenues resulting from various alternatives. The equations are based on the historical file and provide a means of determining the effect of socio-economic factors and fuel taxation rates on future highway-user revenues as a result of laws that may be enacted and variations of other factors.

The equations or models were developed in such a way that they would be policy-sensitive -- that is, they could be used to predict future revenues for each of numerous possible policies, laws or regulations that might foreseeably be put into effect. The equations or models may take into account for variations in the price of fuel, vehicle-miles traveled, and vehicle fuel economy.

The models were tested and proved to provide logical and reasonable results. Forecasts of highway-user revenues were made for the years 1990 through 2005. Examples indicating the impact of possible alternatives revealed several potential sources of increased highway-user revenues. As should be expected, it was shown that the impact of fuel prices and fuel taxes on potential revenues may be dramatic. For example, the impact of increasing fuel price results in decreasing revenues when compared to a constant fuel price for 1990 through 2005. Vehicle-miles traveled should increase by 1995 and vehicle fuel economies are expected to improve. Decreased fuel consumption resulting

from greater vehicle fuel economy may more than offset additional fuel consumed due to increased vehicle-miles traveled and the result would be a decrease in motor-fuel revenues by 1995 if current policy remains unchanged.

In general, the models are simple, policy sensitive, and sufficiently accurate to forecast highway-user revenues with only limited input data. Their use is recommended for determining potential effects of any proposed legislation which may impact highway-user revenues.

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We would also like to acknowledge the following employees of the Kentucky Transportation Cabinet for their guidance in the development and completion of this study: David Smith, Barry House, Bill Stutzenberger, Dudley Shryock, Bennie Wheat, Cy Layson, and Bruce Siria. A special note of appreciation is expressed to Forest Harrod for his significant efforts in the compilation of data for this study.

Of particular importance to the outcome of the study was the technical guidance and review by John Deacon with the University of Kentucky's Department of Civil Engineering.

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SUMMARY

The relationship between travel and highway-user revenues is critical when considering the need for additional funds for maintenance and rehabilitation of the highway infrastructure. Fuel price variations and decreasing fuel consumption have created questions about the levels of revenue that may be expected from the present fuel tax.

Revenues received by the Kentucky Transportation Cabinet during calendar year 1984 totaled approximately $860 million. User revenues collected from state-imposed taxes (excluding toll receipts) accounted for $423 million or approximately half of the total income. Included were $199 million in motor fuel tax receipts and $224 million in registration fees and other motor-carrier taxes. Toll receipts accounted for approximately $21 million. An additional $250 million was received from Federal agencies. Other miscellaneous sources of revenue such as bond issue reimbursements, interest income, and income from counties and cities totaled $187 million.

With increasing concerns about the present level of highway funding, this study was initiated to investigate historical trends and to develop predictive methodologies for considering alternatives available for increasing highway revenues. Emphasis was placed on historical trends, and a data base of highway-related and socio-economic variables were prepared to document the relationship between these variables and highway-user revenues. A historical file of 37 variables was prepared for the period 1964 through 1984.

Regression analysis was selected as the primary means of forecasting highway-user revenues based on past trends. Simplicity and flexibility available through computer packages permitted model development with the additional capability of providing statistical characteristics of variables included in the analysis.

As a means of investigating future alternatives that will affect highway-user revenues, a series of equations or models that represented historical trends and was capable of forecasting future trends based on historical data was developed. Input data necessary for the models were personal income in 1972 constant dollars, the price of motor fuel, motor fuel taxation rates, and motor vehicle fuel economy. Other input data were derived from output in the series of equations. Listed below are the nine sequential models recommended for use in predicting future revenues:

$$TVR = 287.86 + 0.1424\ (PCC)$$

$$TVM = 10.625\ (TVR) - 11.470\ (FPC)$$

$$TFC = 0.0795\ (TVM)$$

$$MFT = 939.72\ (TFC)\ [0.75(XG2) + 0.25\ (XGM)]$$

$$TVF = -33{,}056 + 31.706\ (TVR)$$

$$UTR = -103{,}510 + 13.147\ (PCC)$$

$$WDT = -52{,}408 + 0.0285[104.138\ (TVM)]$$

$$MSC = -1973 + 0.4979\ (PCC)$$

$$HUR = MFT + TVF + UTR + WDT + MSC$$

where;

TVR: total annual motor-vehicle registration in thousands,

PCC: total personal income based on 1972 constant dollars in millions,

TVM: total annual vehicle-miles traveled in millions,

FPC: average retail price of fuel in cents per gallon,

TFC: total annual fuel consumption in million gallons,

MFT: total annual fuel taxation in thousand dollars,

XG2: fuel taxation rate for two-axle vehicles in dollars per gallon,

XGM: fuel taxation rate for vehicles having more than two axles in dollars per gallon,

TVF: total annual vehicle registration fees in thousand dollars,
UTR: total annual usage taxation in thousand dollars,
WDT: total annual weight-distance taxation in thousand dollars,
MSC: total annual miscellaneous fees and other taxations in thousand dollars,
YR: year, and
HUR: total annual highway- user revenues in thousand dollars.

The nine models or equations are intended to be used in sequence such that total motor-vehicle registration is estimated with personal income in 1972 constant dollars as the primary input variable. Next total vehicle-miles traveled is estimated by inputing total motor-vehicle registration and the price of gasoline. This process is continued with output from one equation used as input into another until all the sources of highway-user revenues are estimated. Input required that are not a direct estimate from a previous equation are personal income, fuel price, and fuel taxation rates.

These models provided logical and reasonable relationships, and the statistical data generally indicated that variables selected as input for the equations were adequate predictors of the independent variables necessary to estimate highway-user revenues. An effort was made to develop models that were policy-sensitive such that future scenarios could be investigated. Using the series of nine models, forecasts of highway-user revenues were made for the years 1990 through 2005. This was an attempt to demonstrate use of the models for investigating the influence of policy-sensitive variables on revenues. Presented in the attached table are predictions of total highway-user revenues from six scenarios where examples of varying fuel prices and fuel taxes were included. Also presented in graphical form are total highway-user revenues for each of six scenarios. It can be seen that the impact of fuel price and fuel taxes on the forecasted revenues may be dramatic.

For example, from the attached table showing various scenarios, the impact of increasing fuel price (Scenarios 2 and 3) results in decreasing revenues when compared to a constant fuel price (Scenario 1) for 1990 through 2005.

It also was shown by means of fuel economy scenarios that significant improvements in the fuel economy of automobiles (with the fuel economy of trucks remaining constant) could result in only a slight increase in total motor-fuel revenues by 1995. Reduced fuel consumption due to increased fuel economy was slightly offset by the increased fuel consumption due to increased vehicle-miles traveled in 1995. Improvements in fuel economy of both automobiles and trucks could result in a decrease in motor-fuel revenues by 1995.

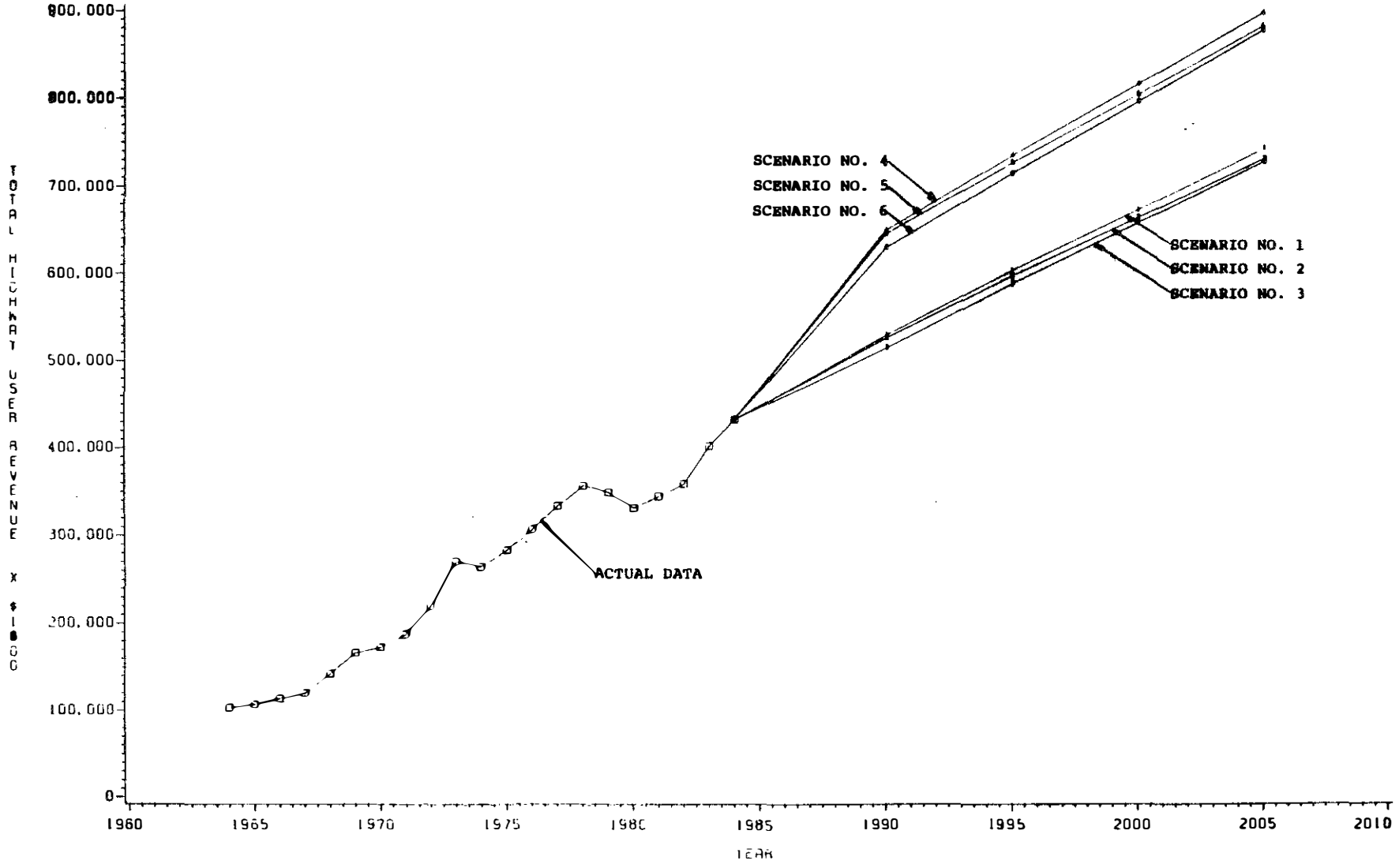
An analysis of varying usage tax rates indicated that significant increases in the usage tax revenue could be obtained with a change from the rate of 5 percent on 90 percent of the factory advertised price of automobiles to 6 percent on 100 percent of the factory advertised price. Without any change in the tax rate, the 1995 predicted revenue would be $198 million as compared to $264 million with a 6 percent tax on 100 percent of the price.

Examples showing the impact of future alternatives indicated several possible sources of increased highway-user revenues. It is apparent that more in-depth study of the relevant variables could produce additional alternatives that could show their relationship to highway-user revenues. The assumption that some future conditions will be a reflection of the past is an obvious limitation that must be considered when the models are used. In general, the recommended models appear to offer the advantages of being simple to apply, policy sensitive, and sufficiently accurate to forecast highway-user revenues with only a limited amount of input data.

CURRENT AND PREDICTED TOTAL ANNUAL HIGHWAY-USER REVENUES WITH SCENARIOS OF VARYING FUEL PRICES AND FUEL TAXES

	TOTAL HIGHWAY-USER REVENUES ($ THOUSANDS)					
	1984 ACTUAL	1984 PREDICTED	1990	1995	2000	2005
SCENARIO NO. 1 (Current Taxation Scheme) Fuel price = $1.30/gal Fuel tax = $0.10/gal for autos and $0.12/gal for trucks	431,961	454,859	530,036	603,714	673,215	744,097
SCENARIO NO. 2 Fuel price = $1.30/gal in 1984 and $0.04/gal/year increase for 1990-2005; Fuel tax = $0.10/gal for autos and $0.12/gal for trucks	431,961	454,859	526,811	597,761	664,410	732,564
SCENARIO NO. 3 Fuel price = $2.50/gal Fuel tax = $0.10/gal for autos and $0.12/gal for trucks	431,961	454,859	515,154	588,832	658,333	729,213
SCENARIO NO. 4 Fuel price = $1.30/gal Fuel tax = $0.15/gal for autos and $0.17/gal for trucks	431,961	454,859	649,681	735,425	816,306	898,796
SCENARIO NO. 5 Fuel price = $1.30/gal in 1984 and $0.04/gal/year increase for 1990-2005; Fuel tax = $0.15/gal for autos and $0.17/gal for trucks	431,961	454,859	645,343	727,415	804,459	883,277
SCENARIO NO. 6 Fuel price = $2.50/gal Fuel tax = $0.15/gal for autos and $0.17/gal for trucks	431,961	454,859	629,658	715,401	796,283	878,722

TOTAL HIGHWAY-USER REVENUES VS YEAR



INTRODUCTION

The relationship between travel and highway-user revenues is an important issue when considering increased taxation. The possibility of increased highway-user taxes is related to the need for additional funds to rehabilitate and maintain the present highway infrastructure. In addition, fuel price variations and trends in vehicle fuel economy have raised questions about the levels of revenue that may be expected from the present fuel tax. Several other factors have a significant influence on highway-user revenues. Included are vehicle-miles traveled, motor-vehicle registrations, and socio-economic variables.

Revenue received by the Kentucky Transportation Cabinet during calendar year 1984 was approximately $860 million. That portion of total receipts that could be designated as user-revenues collected from state-imposed taxes (excluding toll receipts) totaled $423 million. Included were $199 million in motor-fuel tax receipts and $224 million in registration fees and other motor-carrier taxes. Toll receipts accounted for approximately $21 million. An additional $250 million was received from Federal agencies. Other miscellaneous sources of revenue such as bond issue reimbursements, interest income, and income from counties and cities totaled $187 million.

The overall objectives of this study were 1) to compile a database of highway-related and socio-economic variables, 2) document the relationships between these variables and highway-user revenues, and 3) demonstrate the applicability of models for predicting highway-user revenues. Specific variables to be analyzed as they relate to highway-user revenues include the following:

1) fuel prices,
2) fuel taxes,
3) registration fees,
4) usage taxes,
5) vehicle fuel economy, and

6) gasohol tax exemptions.

Historical trends were developed for the period 1964-1984 and the data were used to model and forecast future highway revenues.

The literature of forecasting in relation to statewide highway volumes and user revenues showed the most commonly used method involved the following (1, 2, 3, 4, 5):

(a) projection of over-all population,

(b) projection of density of vehicle ownerships,

(c) projection of average travel per vehicle, and

(d) combination of (a), (b) and (c) to indicate future travel and highway volumes.

Some planning agencies have been involved in detailed studies that required great amounts of data collection and mathematical modeling. These studies adapted the UTPS demand modeling procedures for forecasting state or regional traffic volumes (6, 7, 8). When the state was used as the study area, it was usually divided into zones (often the breakdown is at the county level), each represented by a centroid. The centroid was assumed to be the origin and destination of all interzonal trips. Major roads and highways connecting these nodes were then presented as links. The first phase of the study using the UTPS model was to perform modeling and forecasting of socio-economic variables for each zone. In the second phase, transportation demands were forecasted from the base of first phase results. That is, trip generation and attraction for each zone were modelled and forecasted. Then, the modeling and forecasting of trip interchanges between each pair of zones were performed. At the last stage, the zonal trip interchanges were assigned to different modes and routes. With forecasted volumes for each route, the vehicle-miles traveled were determined. This method provided very detailed volume information that, when aggregated, provided state traffic volumes. This method is very expensive and time consuming, but it will not necessarily provide better total statewide traffic forecasts than the classical method.

In the current study, a modified version (use of personal income rather than population as the primary independent variable) of the commonly used method was developed and applied. The previously described method could have been applied up to the point of the energy crisis of 1974, when the growth of travel continued relatively constant and fuel prices did not increase drastically. However, the rapid increase in fuel prices and a changing economic situation required that the current modeling effort be able to reflect variation of recent trends. For these reasons, models were developed that considered personal income, fuel price, and fuel taxation rates.

HISTORICAL BACKGROUND

Issues related to highway-user revenues traditionally have been of significant importance to highway administrators and policy makers in Kentucky. The gasoline tax, first imposed in 1920, has been the most important single source of income since 1928 (9). The tax in 1920 was at the rate of $0.01 per gallon at the retail level and was changed in 1924 to a tax of $0.03 per gallon at the wholesale level. It was increased to $0.05 per gallon in 1926 and to $0.07 per gallon in 1948. Up to that time, the tax had been the same for all vehicles; however, in 1956 a surtax of $0.02 per gallon was imposed on fuel used in Kentucky by vehicles having four or more axles. In 1970, the tax was increased to $0.09 per gallon and the surtax of $0.02 per gallon remained the same.

Since 1980, the motor fuel tax rate has been 9.0 percent of the "average wholesale price" of fuel used by all vehicles. In addition, there is a 2.0 percent surtax on fuel used in Kentucky by vehicles having more than two axles. A further stipulation has been made that, if the "average wholesale price" on which the taxes are imposed decreases to less than $1.11 per gallon, then the average shall be $1.11 per gallon for taxation purposes only. In addition, the "average

wholesale price" on which the fuel tax is based cannot, for taxation purposes, increase more than 10 percent over the price at the end of the previous fiscal year.

Other forms of user revenues include registration fees, usage taxes, and several miscellaneous fees and taxes. The miscellaneous category includes such items as driver license fees and some tolls, but is not a major component of total user revenues. A more recent form of revenue is a weight-distance tax imposed at the rate of $0.0285 per mile on vehicles weighing more than 60,000 pounds.

Registration fees have increased significantly since the first motor vehicle statute in 1910 (9). At that time, all vehicle types were grouped together with rates based on horsepower only. Fees ranged from $5.00 to $20.00 dependent upon horsepower. In 1937, a registraton fee of $4.50 was established for automobiles. Trucks were classified by type of operation in 1932 when a mileage tax, in addition to the basic registration fee, was imposed on for-hire vehicles. In 1946, the registration fee for trucks was changed such that it was based on gross weight. The current registration fee schedule, which was enacted in 1968, requires automobiles and all other vehicles weighing less than 6,000 pounds to pay $11.50. Fees for other vehicles are based on registered weight according to the following categories:

Gross Weight (Pounds)	Registration Fee (Dollars)
6,000 - 10,000	24.00
10,001 - 14,000	30.00
14,001 - 18,000	50.00
18,001 - 22,000	132.00
22,001 - 26,000	160.00
26,001 - 32,000	216.00
32,001 - 38,000	300.00
38,001 - 44,000	474.00
44,001 - 55,000	544.00
55,001 - 62,000	588.00
62,001 - 73,280	750.00
73,281 - 82,000	840.00

The motor-vehicle usage tax was adopted in 1936 (9). No significant changes have taken place with regard to the tax other than an increase from the initial rate of three percent of the factory advertised price in 1967 to a present rate of five percent on 90 percent of the factory advertised price. Trucks are presently taxed at the rate of five percent on 81 percent of the factory advertised price.

In general, highway-user taxes have traditionally been a significant portion of the total income for highways. There have been fluctuations in recent years; however, user taxes accounted for 61 percent of total expenditures for highways in 1983 and 52 percent in 1984. It should also be noted that additional user taxes are returned to Kentucky in the form of federally-imposed user taxes (approximately $246 million in 1984).

Other studies concerned with highway funding in Kentucky include the previously referenced study by the University of Kentucky Bureau of Business Research in 1956 (9) and another study by the same group in 1963, which dealt with allocation of expenditures among the various classes of roads and streets (10).

Needs studies and allocation studies must consider as a part of the expenditure responsibility the source of income for highways. A more recent study was undertaken as a result of the 1973-74 "energy crisis" and the impact on future funding for Kentucky's transportation system (8). Two significant components of that study were an examination of transportation demands and forecasts and a translation of the forecasts into transportation needs. Socio-economic and transportation demand forecasts for the years 1980, 1985, and 1990 were the basis for cost and revenue estimates for Kentucky's transportation system.

A study completed in 1982 again attempted to assign cost responsibilities to the various types of vehicles (11). Cost responsibilities and user-generated revenues were determined for each vehicle class, and the incremental-cost method was used to allocate

responsibility for each component of the highway cost to the user. It was found that automobiles and pickups paid 157 percent of their share, and trucks paid 54 percent of their share. Results from that study were used to support adoption of a weight-distance tax in Kentucky.

DATA ASSIMILATION

To analyze the influence of socio-economic variables and highway-related variables as they relate to highway-user revenues, historical trends were developed for the time period 1964 through 1984. This 21-year period was selected to insure that sufficient data were available to document trends before and after the "energy crisis" of 1973-1974 and again in the late 1970's. Initially, the study period was selected to include the 20-year period from 1965-1984; however, data representing all variables were not available for 1984 and it was decided that 1964 data should be included to assure 20 years of data for all variables.

As noted, the general categorization of variables was socio-economic and highway related. Further disaggregation could be made into external (input) variables and internal (output) variables. Subgroups of external (input) variables included 1) socio-economic variables, 2) highway mileage, and 3) fuel-related variables. Subgroups of internal (output) variables included 1) vehicle registration, 2) vehicle-miles traveled, 3) fuel consumption, and 4) highway-user revenue. Within the external subgroup was a total of 14 variables and within the internal subgroup were 23 variables. A listing of the 37 variables for which historical data were available is presented in Table 1. Historical data for the 21-year study period have been tabulated and are presented in Appendix A.

The general criteria when selecting variables were to include 1) those that could logically be used as input or output variables to explain the future trends in highway-user revenues and 2) those that were readily available for the time period of analysis. The primary sources of data were from "Highway Statistics" (12) and "Statistical Abstracts" (13). In addition, data were obtained from the Kentucky Transportation Cabinet's Division of Planning (14).

FORECASTING PROCEDURE

Forecasting methodologies to obtain estimates of characteristics that may explain future trends often rely on past trends. A common procedure is to collect historical data and to fit a curve to the data as a means of extrapolating and predicting future trends. Simplicity and flexibility are available when the mathematical relationships of historical data bases are modeled by regression analysis. Considering the advantages of this method, regression analysis was selected as the primary means of forecasting highway-user revenues based on socio-economic and highway-related variables.

To develop an understanding of the statistical characteristics of the variables individually and their interrelationships with other variables, preliminary statistical analyses were performed. A simple statistical analysis of the 37 variables, performed with the Condescriptive Program of SPSS (15), served both to characterize the variables and to allow further assessment of their accuracy and adjustment if required. Among the statistics generated by the condescriptive program for each variable are its minimum, mean, maximum, standard deviation, coefficient of variation, kurtosis, and skewness. The summary of the results of the condescriptive program is shown at the bottom of the historical listings in Appendix A.

To begin to develop an understanding of the basic interrelationship among the variables, a Pearson correlation analysis (15) was performed. The resulting 37 by 37 correlation matrix revealed that, on the average, each of the 37 variables is significantly correlated with 99 percent of the other variables. All the variables were highly correlated with each other and high collinearity exists in the data base. This outcome was particularly helpful in the subsequent development of regression equations, suggesting that very few independent variables should appear in linear regression equations.

To further confirm this idea of a limited number of independent variables, factor analyses were performed. Factor analysis is a statistical procedure for exploration and detection of patterns among interrelated variables with a view toward grouping variables having similar patterns of variance. In this procedure, variables having similar patterns of variance are grouped together into statistically independent factor dimensions. Varimax rotation with minimum eigen value of one resulted in three factor dimensions explaining 95 percent of the variance of the data base. The first factor explained 87 percent of the variance. Results of factor analysis confirmed that there are high collinearity in the data base and a very few number of variables should appear in the regression equations. The varimax rotated factor matrix is presented in Appendix B. Where possible, variables most closely related to each factor have been listed first and readings less than 0.5 have been omitted for clarity. As Appendix B shows, almost all of the variables are represented by one factor and are grouped into this factor dimension. The preliminary statistical analysis was used to assess the accuracy and variability of the variables.

RESULTS

REGRESSION ANALYSIS

To develop an understanding of possible relevant regression models, six groups of multiple linear regression equations were developed. The general mathematical form of these models are

output variable = f(time) [1]

output variable = f(population) [2]

output variable = f(input variables) [3]

output variable = f(other output variables) [4]

output variable = f(input and other output variables) [5]

output variable = f(specific input and output variables) [6]

The results of this part of the regression analysis are summarized in Appendix C. Model types [1] and [2] are easy to use for prediction due to time being the only independent variable of model type [1] and availability of population forecasts for model type [2]. These models showed smaller R-squares than other models and are insensitive to policy issues. In model types [3], [4], and [5], stepwise regressions with a maximum of five independent variables were developed. As correlation analysis and factor analysis had predicted before, due to very high collinearity of variables, with a very small improvement of R square, the sign and the value of coefficients drastically fluctuated at each step of regression after the second variable had been entered into the stepwise calibrations. The equations reported in Appendix C contain no more than two independent variables. These models, which have larger R-squares than model types [1] and [2], can be used to address policy issues; however, they are difficult to use for prediction. This is because forecasted values of independent variables are not readily available as input for each equation. In model type [6], specific independent variables that appeared to be most related to dependent

variables were selected for each stepwise regression analysis. These models [6], which appeared to be intuitively more logical and reasonable than previous model types, showed large R-squares and can be used to address some of the policy issues. The evaluation of the developed models clarified the following criteria for final development and selection of regression models:

1) The number of independent variables should be very small, desirably, not exceeding two.
2) The independent variables should be easy to forecast or already have been forecasted.
3) The models should be logical and theoretically sound.
4) The models should be policy sensitive and able to address the different taxation issues at hand.
5) The models should be statistically acceptable and have reasonable predictions as compared with actual values.

After consideration of the above criteria, the final set of regression equations of model type [6] were developed. Appendix D includes the equations and their predictions for 1964 to 1984.

After evaluating the models based on the five criteria listed previously, the final recommended set of models are as follows:

$$TVR = 287.86 + 0.1424\ (PCC) \quad [7]$$

$$TVM = 10.625\ (TVR) - 11.470\ (FPC) \quad [8]$$

$$TFC = 0.0795\ (TVM) \quad [9]$$

$$MFT = 939.72\ (TFC)\ [0.75(XG2) + 0.25\ (XGM)] \quad [10]$$

$$TVF = -33{,}056 + 31.706\ (TVR) \quad [11]$$

$$UTR = -103{,}510 + 13.147\ (PCC) \quad [12]$$

$$WDT = -52{,}408 + 0.0285[104.138\ (TVM)] \quad [13]$$

$$MSC = -1973 + 0.4979\ (PCC) \quad [14]$$

$$HUR = MFT + TVF + UTR + WDT + MSC \quad [15]$$

where

TVR: total annual motor-vehicle registration in thousands,
PCC: total personal income based on 1972 constant dollars in millions,
TVM: total annual vehicle miles traveled in millions,
FPC: average retail price of fuel in cents per gallon,
TFC: total annual fuel consumption in million gallons,
MFT: total annual fuel taxation in thousand dollars,
XG2: fuel taxation rate for two-axle vehicles in dollars per gallon,
XGM: fuel taxation rate for vehicles having more than two axles in dollars per gallon,
TVF: total annual vehicle registation fees in thousand dollars,
UTR: total annual usage taxation in thousand dollars,
WDT: total annual weight-distance taxation in thousand dollars,
MSC: total annual miscellaneous fees and other taxations in thousand dollars,
YR: year, and
HUR: total annual highway-user revenues in thousand dollars.

Figure 1 shows the sequence and interrelationships of the models. The variables that external forecasts should be available for include total personal income in constant 1972 dollars, price of fuel, fuel tax rates for two-axle vehicles and vehicles having more than two axles. Once the values of these variables for any future year are available, the forecasts for all other variables may be determined.

IMPACT OF FUTURE ALTERNATIVES

To demonstrate applicability of models for predicting user-generated revenues in Kentucky, several scenarios were evaluated using the

recommended set of models. These scenarios were used as examples of future alternatives that could impact the level of user revenues. Generally, the input data necessary for the set of models were personal income in 1972 constant dollars, the price of motor fuel, motor fuel taxation rates and motor-vehicle fuel economy. Personal income was selected as the primary input data because it was highly correlated with registered vehicles and it was felt that a measure of income would be the single variable to best predict the number of registered vehicles. The availability of personal income projections from the U. S. Department of Commerce (16) was also a major factor in its selection as opposed to other socio-economic variables. Constant 1972 dollars were used to exclude the effect of inflation when predicting motor-vehicle registration. Consideration was also given to population as an alternative input variable; however, highway user-revenue forecasts using population as the primary impact variable were significantly higher than those using personal income. Considering historical trends in highway-user revenues, it was determined that estimates made with personal income as the primary input variable were more reasonable than those made using population. Future projections of population used in the analyses were obtained from the University of Louisville's Urban Studies Center (17).

FUEL-PRICE AND FUEL-TAX SCENARIOS

In the first set of scenarios, fuel price increases from the present $1.30 per gallon to $2.50 per gallon were investigated. Motor-fuel tax rates considered were the present rates of approximately $0.10 per gallon for two-axle vehicles and $0.12 per gallon for vehicles having more than two axles and future rates increased by $0.05 per gallon for all types of vehicles. Tables 2 through 7 summarize results from the series of scenarios. To further explain the relationships developed from the scenarios, graphical presentations of each variable for the

period 1964 through 2005 were shown (Figures 2 through 10). Actual data were shown for 1964 through 1984 and each scenario was labeled to show the projected trend for 1990 through 2005. Base year data for 1984 and predicted values for 1984 are also shown in the tables. It may be seen that the predicted values for 1984 are generally close to the actual values for 1984, which is an indication of the accuracy of the predictive models. Because of the detailed analysis performed in an attempt to evaluate population as the primary input variable, the same scenarios were considered as when personal income was used and the results are presented in Appendix E.

Of the six sets of scenarios evaluated for variations in fuel prices and tax rates, the greatest impact on total highway-user revenues occurred when fuel price was kept constant at the current price of $1.30 per gallon and the fuel tax was increased by $0.05 per gallon for all vehicles (Table 5). The smallest increase in total highway-user revenues occurred when the fuel price was assumed to be $2.50 per gallon and the fuel tax remained at the present level of $0.10 per gallon for two-axle vehicles and $0.12 for vehicles having two or more axles.

FUEL-ECONOMY SCENARIOS

Consideration also was given to the impact of fuel economy improvements for passenger cars and trucks. A weighted average for fuel consumed by vehicle type was developed using the distribution of vehicle-miles traveled by vehicle type (11) and the estimated fuel economy by vehicle type (18). The result was approximately 75 percent of the fuel consumed by autos and pickups and 25 percent by trucks. If the same ratio of fuel consumption is assumed to occur in the future, then the impact of fuel economy may be determined. Table 8 is a summary of scenarios showing variations in motor-fuel tax revenues with improvements in the fuel economy of passenger vehicles and trucks.

The scenarios shown in Table 8 indicate that improvement in the fuel economy of automobiles (from the present 16.5 miles per gallon to 25.0 miles per gallon in 1995) while trucks' fuel economy remains constant could have the net effect of only a slight increase in total motor-fuel revenues. Reduced fuel consumption due to increased fuel economy was more than offset by the increased fuel consumption due to increased vehicle-miles traveled in 1995. Improvements in fuel economy of both automobiles and trucks (25.0 miles per gallon for autos and 10.5 miles per gallon for trucks) would reduce fuel consumption, more than the increase in fuel consumption due to the normal growth of vehicle-miles traveled. The result would be a net decrease in fuel-tax revenues in 1995.

USAGE-TAX SCENARIOS

It also was considered important to develop an understanding of the influence of changes in the usage tax rate. Table 9 is a summary of results from an analysis of varying usage tax rates. Presently, the tax rate is five percent on 90 percent of the factory advertised price of automobiles and five percent on 81 percent of the factory advertised price of trucks. For the scenarios in Table 9, it was assumed that the usage tax from purchase of new trucks would be insignificant and the primary influence would be a direct function of the total price of new automobiles. This assumption was made because the amount of usage tax for autos and trucks was not compiled separately and the tax rate of 5.0 percent on 90 percent of the factory advertised price was increased in 0.5-percent increments. It also was assumed that usage-tax revenues could be projected into the future as a function of personal income. This assumption suggests that the future will be a reflection of the past and that socio-economic influences will be the same as in the past.

An analysis of varying usage-tax rates indicated that significant increases in the usage-tax revenue could be obtained with a change from

the rate of five percent on 90 percent of the factory advertised price of automobiles to six percent on 100 percent of the factory advertised price. Without any change in the tax rate, the 1995 predicted revenue from usage tax would be $189 million as compared to $252 million with a six percent tax on 100 percent of the factory advertised price of automobiles.

REGISTRATION FEES INCREASES

A means of assessing the impact of varying motor-vehicle registration fees also was developed. An equation was developed from regression analysis that explains the relationship between total registration fees and the numbers of registered automobiles and registered trucks. Current records indicate 86 percent of the registered vehicles are autos and pickups and the other 14 percent are various types of trucks or buses. A weighted average of percent registration fees paid by automobiles and trucks was determined to be 39 and 61 percent, respectively (19). This weighted average was used as input for the regression equation and the result was the following:

$$TVF = 14.574\ (ATR) + 23.027\ (TRR) \qquad [16]$$

where TVF is motor-vehicle registration fees in thousands of dollars,
ATR is registered autos in thousands, and
TRR is registered trucks in thousands.

Variations in current motor-vehicle registration receipts may be determined by changing the coefficients of ATR and TRR in Equation [16]. This relationship has the limitation of only being able to predict changes in future motor-vehicle registration fees when the numbers of registered autos and trucks are known.

An alternative and probably more accurate procedure for assessing the impact of varying motor-vehicle registration fees is to substitute

new registration fees for the current fee structure. Since there are 13 vehicle type or weight registration categories, the accuracy level would be greater if the impact on each category was investigated. Again, the assumption would have to be made that future distributions of vehicle types would be the same as the present.

COMPARISON OF REGRESSION ESTIMATES WITH OTHER PROJECTIONS

As a means of evaluating the reasonableness of regression estimates, comparisons were made with independent projections of vehicle-miles traveled. Vehicle-miles traveled was selected as the dependent variable rather than other variables because it was found that several projections from other sources were available for comparison. Selected for comparison were 1995 projections because there were several other projections available for that year. Table 10 is a summary of independent projections and those projections produced as a part of this study. It may be seen that there is relatively little difference between the various projections. The 1995 projections obtained by scaling down estimates for Kentucky from the "Final Report on the Federal Highway Cost Allocation Study" (18) are very similar to those obtained from the recommended model (36.800 billion as compared to 35.260 billion).

TAX CREDIT FOR GASOHOL

The Kentucky General Assembly passed a law in 1982 that provided a tax credit for the use of gasoline-alcohol blend fuel. Gasoline dealers receive a credit of $0.35 for each gallon of fuel-grade alcohol they sell that would normally be subjected to the current fuel tax of 9.0 percent of the wholesale price (not less than $1.11 per gallon wholesale price). The credit for gasohol is effective for the time period beginning July 1, 1982, through June 30, 1986.

Prior to 1982, there was no credit for gasohol and consumption was relatively insignificant. However, the consumption attributed to gasohol has increased from 0.95 percent in 1982 to 5.17 in 1983, and then to 16.01 percent in 1984. The gasohol tax credit in 1984 amounted to $12.8 million, which is nearly three times the amount for 1983. A summary of gasohol consumption and revenue is presented in Table 11.

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TABLE 1. VARIABLES INCLUDED IN THE ANALYSIS

A - Input variables:

1 - Socio-economic variables
- total population (TPO)
- urban population (UPO)
- personal income (PIC)
- personal income - 1972 constant dollars (PCC)
- total employment (TEP)
- nonagricultural employment (NAE)
- population at driving age (PDA)
- licensed drivers (LID)

2 - Highway mileage
- total highway miles (THM)
- urban highway miles (UHM)
- rural highway miles (RHM)

3 - Fuel-related variables
- fuel price (FPC)
- tax rate for two-axle vehicle (XG2)
- tax rate for more than two-axle vehicle (XGM)

B - Output variables:

1 - Vehicle registration
- auto registration (ATR)
- truck registration (TRR)
- bus registration (BUR)
- trailer registration (TSR)
- motorcycle registration (MCR)
- total motor vehicle registration (TVR)

2 - Vehicle-miles traveled
- total vehicle-miles (TVM)
- urban vehicle-miles (UVM)
- rural vehicle-miles (RVM)

3 - Fuel consumption
- total fuel consumption (TFC)
- gasoline fuel consumption (GAS)
- special fuel consumption (SFL)

4 - Highway user revenue
- auto registration fee (ARF)
- truck registration fee (TRF)
- bus registration fee (BRF)
- trailer registration fee (TSF)
- motorcycle registration fee (MCF)
- total motor-vehicle usage tax (UTR)
- total vehicle registration fee (TVF)
- weight-distance tax (WDT)
- total registration and miscellaneous revenues (MRT)
- total fuel revenues (MFT)
- total highway-user revenues (HUR)

TABLE 2. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 1

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,779	29,512	2,346	231,481	55,056	126,405	35,182	6,735	454,859
1990	3,155	32,030	2,546	251,256	66,975	161,100	42,656	8,048	530,036
1995	3,459	35,260	2,803	276,592	76,613	189,155	52,242	9,111	603,714
2000	3,746	38,307	3,045	300,492	85,705	215,620	61,285	10,113	673,215
2005	4,038	41,414	3,292	324,866	94,978	242,611	70,507	11,135	744,097

SCENARIO CONDITIONS: Personal income = actual for 1984
= US Department of Commerce projections of personal income in 1972 constant dollars:

Year	Income $ Million
1990	20,127
1995	22,261
2000	24,274
2005	26,327

Fuel Price = constant at $1.30 per gallon

Fuel Tax = constant at $0.10 per gallon for two-axle vehicles
= constant at $0.12 gallon for vehicles having more than two axles

TABLE 3. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 2

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,779	29,512	2,346	231,481	55,056	126,405	35,182	6,735	454,859
1990	3,155	31,732	2,523	248,917	66,975	161,100	41,771	8,048	526,811
1995	3,459	34,710	2,759	272,274	76,613	189,155	50,608	9,111	597,761
2000	3,746	37,493	2,981	294,104	85,705	215,620	58,868	10,113	664,410
2005	4,038	40,348	3,208	316,499	94,978	242,611	67,341	11,135	732,564

SCENARIO CONDITIONS: Personal Income = actual for 1984
= US Department of Commerce projections of personal income in 1972 constant dollars:

Year	Income $ Million
1990	20,127
1995	22,261
2000	24,274
2005	26,327

Fuel Price = $1.30 per gallon in 1984
= Trend line (1969 - 1978) rate of increase of $.04 per gallon per year for 1990 - 2005

Fuel Tax = constant at $0.10 per gallon for two-axle vehicles
= constant at $0.12 per gallon for vehicles having more than two axles

TABLE 4. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 3

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,779	29,512	2,346	231,481	55,056	126,405	35,182	6,735	454,859
1990	3,155	30,654	2,437	240,459	66,975	161,100	38,871	8,048	515,154
1995	3,459	33,884	2,694	265,795	76,613	189,155	48,157	9,111	588,832
2000	3,746	36,931	2,936	289,695	85,705	215,620	57,199	10,113	658,333
2005	4,038	40,038	3,183	314,069	94,978	242,611	66,422	11,135	729,215

SCENARIO CONDITIONS: Personal Income = actual for 1984
= US Department of Commerce projections of personal income in 1972 constant dollars:

Year	Income $ Million
1990	20,127
1995	22,261
2000	24,274
2005	26,327

Fuel Price = constant at $2.50 per gallon

Fuel Tax = constant at $0.10 per gallon for two-axle vehicles
= constant at $0.12 per gallon for vehicles having more than two axles

TABLE 5. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 4

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,779	29,512	2,346	231,481	55,056	126,405	35,182	6,735	454,859
1990	3,155	32,030	2,546	370,902	66,975	161,100	42,656	8,048	649,681
1995	3,459	35,260	2,803	408,303	76,613	189,155	52,242	9,111	735,425
2000	3,746	38,807	3,045	443,583	85,705	215,620	61,285	10,113	816,306
2005	4,038	41,414	3,292	479,565	94,978	242,611	70,507	11,135	898,796

SCENARIO CONDITIONS: Personal Income = actual for 1984
= US Department of Commerce projections of personal income in 1972 constant dollars:

Year	Income $ Million
1990	20,127
1995	22,261
2000	24,274
2005	26,327

Fuel Price = constant at $1.30 per gallon

Fuel Tax = constant at $0.15 per gallon for two-axle vehicles
= constant at $0.17 per gallon for vehicles having two axles or more

TABLE 6. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 5

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,779	29,512	2,346	231,481	55,056	126,405	35,182	6,735	454,859
1990	3,155	31,732	2,523	367,449	66,975	161,100	41,771	8,048	645,343
1995	3,459	34,710	2,759	401,928	76,613	189,155	50,608	9,111	727,415
2000	3,746	37,493	2,981	434,153	85,705	215,620	58,868	10,113	804,459
2005	4,038	40,348	3,208	467,212	94,978	242,611	67,341	11,135	883,277

SCENARIO CONDITIONS: Personal Income = actual for 1984
= US Department of Commerce projections of personal income in 1972 constant dollars:

Year	Income $ Million
1990	20,127
1995	22,261
2000	24,274
2005	26,327

Fuel Price = $1.30 per gallon in 1984
= Trend line (196978) rate of increase of $.04 per gallon per year for 1990 - 2005

Fuel Tax = constant at $0.15 per gallon for two-axle vehicles
= constant at $0.17 per gallon for vehicles having two axles or more

TABLE 7. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 6

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,779	29,512	2,346	231,481	55,056	126,405	35,182	6,735	454,859
1990	3,155	30,654	2,437	354,964	66,975	161,100	38,571	8,048	629,658
1995	3,459	33,884	2,694	392,365	76,613	189,155	48,157	9,111	715,401
2000	3,746	36,931	2,936	427,645	85,705	215,620	57,199	10,113	796,283
2005	4,038	40,038	3,183	463,626	94,978	242,611	66,422	11,135	878,722

SCENARIO CONDITIONS: Personal Income = actual for 1984
= US Department of Commerce projections of personal income in 1972 constant dollars:

Year	Income $ Million
1990	20,127
1995	22,261
2000	24,274
2005	26,327

Fuel Price = constant at $2.50 per gallon

Fuel Tax = constant at $0.15 per gallon for two-axle vehicles
= constant at $0.17 per gallon for vehicles having two axles or more

TABLE 8. FUEL ECONOMY SCENARIOS

SCENARIO NO.	VEHICLE MILES TRAVELED (millions)	FUEL TAX RATE ($/GAL)		FUEL ECONOMY (MPG)		FUEL CONSUMPTION[a]	FUEL TAX REVENUES[b]
		2 AXLES	>2 AXLES	AUTOS	TRUCKS	(Million Gal)	($1,000)
1	27,873 (1984 Actual)	.10	.12	13.6[c]	13.6[c]	2,050	202,275
2	27,873 (1984 Actual)	.10	.12	16.5[d]	7.0[d]	2,262	223,193
3	32,030 (1990 Predicted)	.10	.12	20.0	7.0	2,344	231,284
4	32,030 (1990 Predicted)	.10	.12	20.0	8.5	2,143	211,451
5	35,260 (1995 Predicted)	.10	.12	25.0	7.0	2,316	228,521
6	35,260 (1995 Predicted)	.10	.12	25.0	10.5	1,896	187,079

a TFC = TVM [(0.75/Auto MPG) + (0.25/Trucks MPG)]

b MFT = 939.72 (TFC) [0.75 (XG2) + 0.25 (XGM)]
where
TFC = total fuel consumption in million gallons
TVM = total vehicle-miles traveled in millions
MFT = total fuel-tax revenues in thousand dollars
XG2 = fuel tax rate for two-axle vehicles in dollars per gallon
XGM = fuel tax rate for vehicles having more than two axles in dollars per gallon

c Average fuel economy for all vehicles in Kentucky in 1984 was calculated to be 13.6 miles per gallon based on total vehicle-miles traveled and gallons of fuel consumed. Separate estimates of fuel economy for autos and trucks were not available.

d Estimates of fuel economy from the "Final Report on the Federal Highway Cost Allocation Study" (18).

TABLE 9. USAGE TAX SCENARIOS

YEAR	USAGE TAX RATE (PERCENT)*	USAGE TAX REVENUE($1,000)**
1984	4.5	126,405
	5.0	140,450
	5.5	154,495
	6.0	168,540
1990	4.5	161,100
	5.0	179,000
	5.5	196,900
	6.0	214,800
1995	4.5	189,155
	5.0	210,172
	5.5	231,189
	6.0	252,207

* Presently, the tax rate is 5 percent on 90 percent of the factory advertised price of an automobile or 4.5 percent on the total factory advertised price. Tax rates in this table are shown in terms of percent of total factory advertised price.

** Usage tax revenues projections calculated using the following relationships:

Usage Tax Revenues ($1,000's) = -103,510 + 13.147 (Personal Income - 1972 Dollars)

Purchase Price ($1,000's) = Usage Tax Revenues ($1,000's)/0.045

Usage Tax Revenues ($1,000's) = Usage Tax Rate (Purchase Price in $1,000's)

TABLE 10. 1995 PROJECTIONS OF TOTAL VEHICLE-MILES TRAVELED (MILLIONS)

Independent Projections

36,800	Federal Highway Cost Allocaton Study Scaled down proportion (1983) for KY from US Totals (1995)
34,479	Kentucky's Forecasts for 1974 Interstate Cost Estimate, Division of Planning, KTC
35,794	KTC Division of Planning, (Compounded Growth of 2.3% per Year)

Projections Produced from This Study

37,123	Regression Equation Projection Based on 1964-1984 Data; Vehicle-Miles Traveled = f(Year)
41,233	Regression Equation Projection Based on 1964-1984 Data; Vehicle-Miles Traveled = f(Total Population)
36,222	Regression Equation Projection Based on 1964-1984 Data; Vehicle-Miles Traveled = f(Personal Income in 1972 Constant Dollars)

Recommended Model

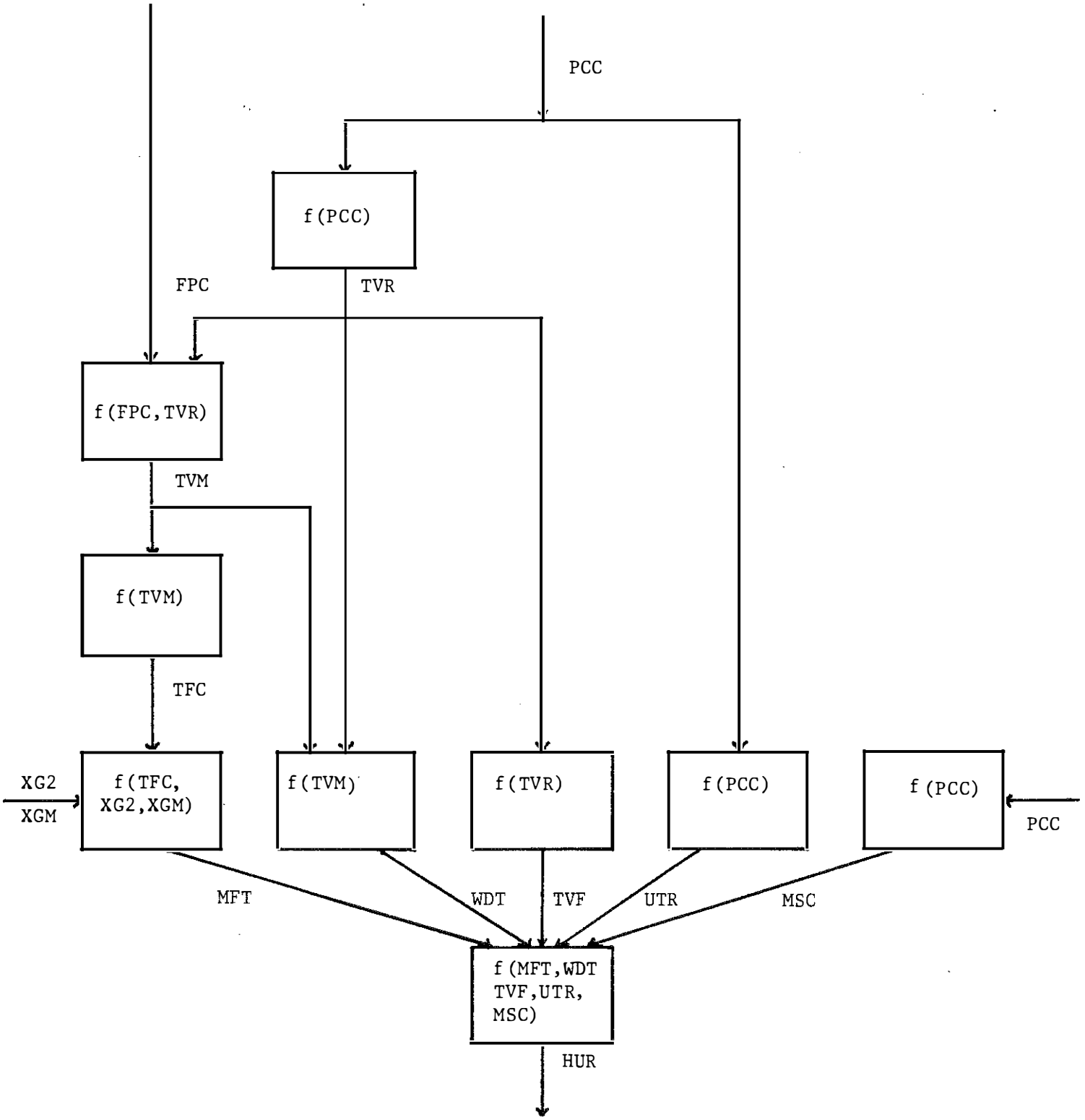
35,260	Regression Equation Based on 1964-1984 Data; Vehicle-Miles Traveled = f(Fuel Price and Total Vehicle Registration)

TABLE 11. GASOHOL CONSUMPTION AND REVENUE

YEAR	GASOHOL CONSUMPTION (GALLONS)	PERCENT OF TOTAL FUEL CONSUMPTION	GASOHOL TAX CREDIT (DOLLARS)*
1979	404,500	.02	
1980	4,764,105	.24	
1981	2,505,815	.13	
1982	18,872,573	.95	539,507
1983	104,625,385	5.17	4,620,692
1984	328,237,733	16.01	12,779,066

* Due to accounting procedures and shrinkage allowances, the gasohol tax credit varies from the standard rate of $0.35 per gallon of fuel-grade alcohol. (For tax credit purposes, gasohol is considered to be 10% fuel-grade alcohol and 90% gasoline.)

Figure 1. Sequence and Interrelationships of the Selected Models



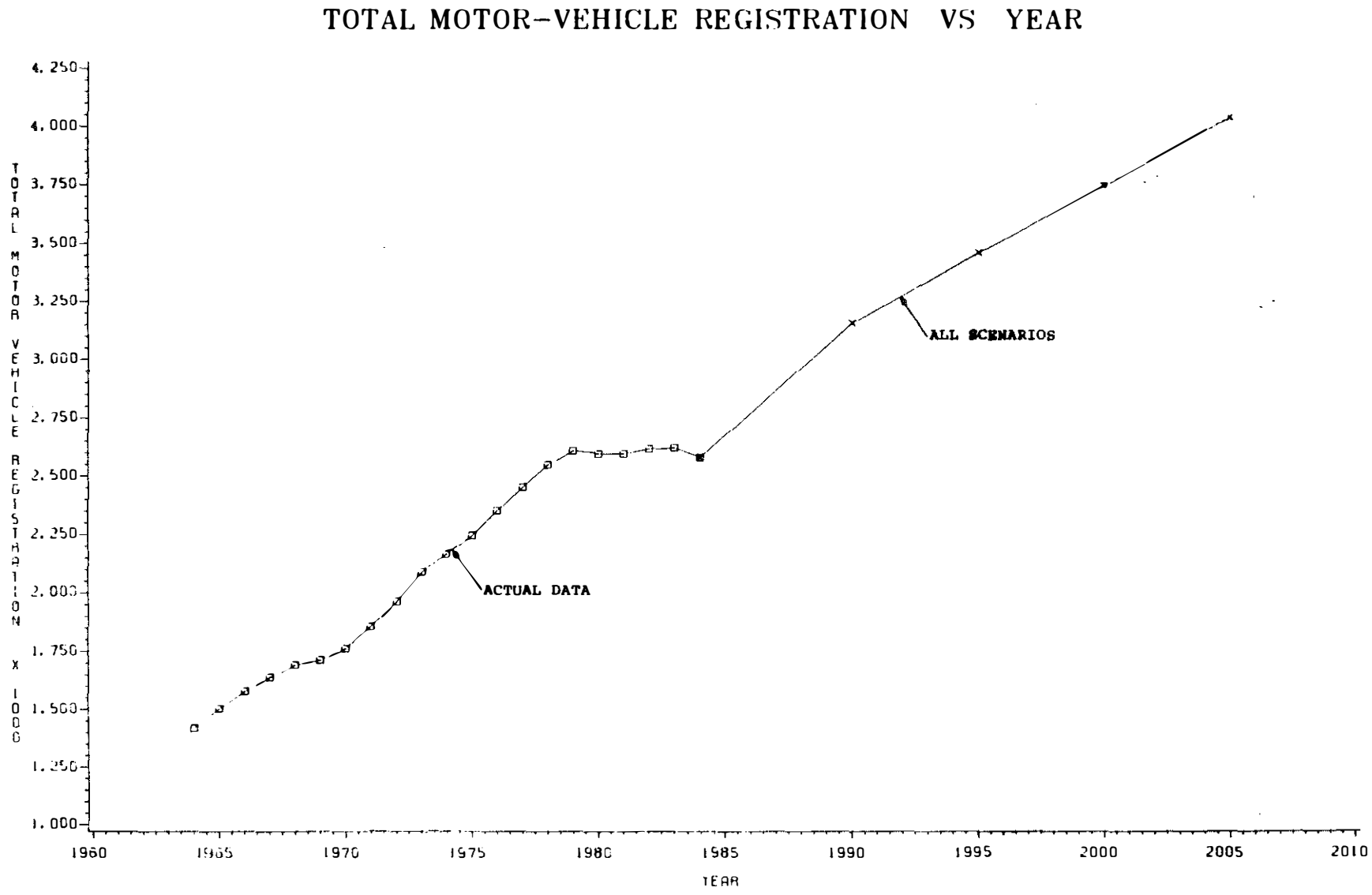


Figure 2. Trends in Total Motor-Vehicle Registration Showing Actual Historical Data and Projections Based on Various Scenarios

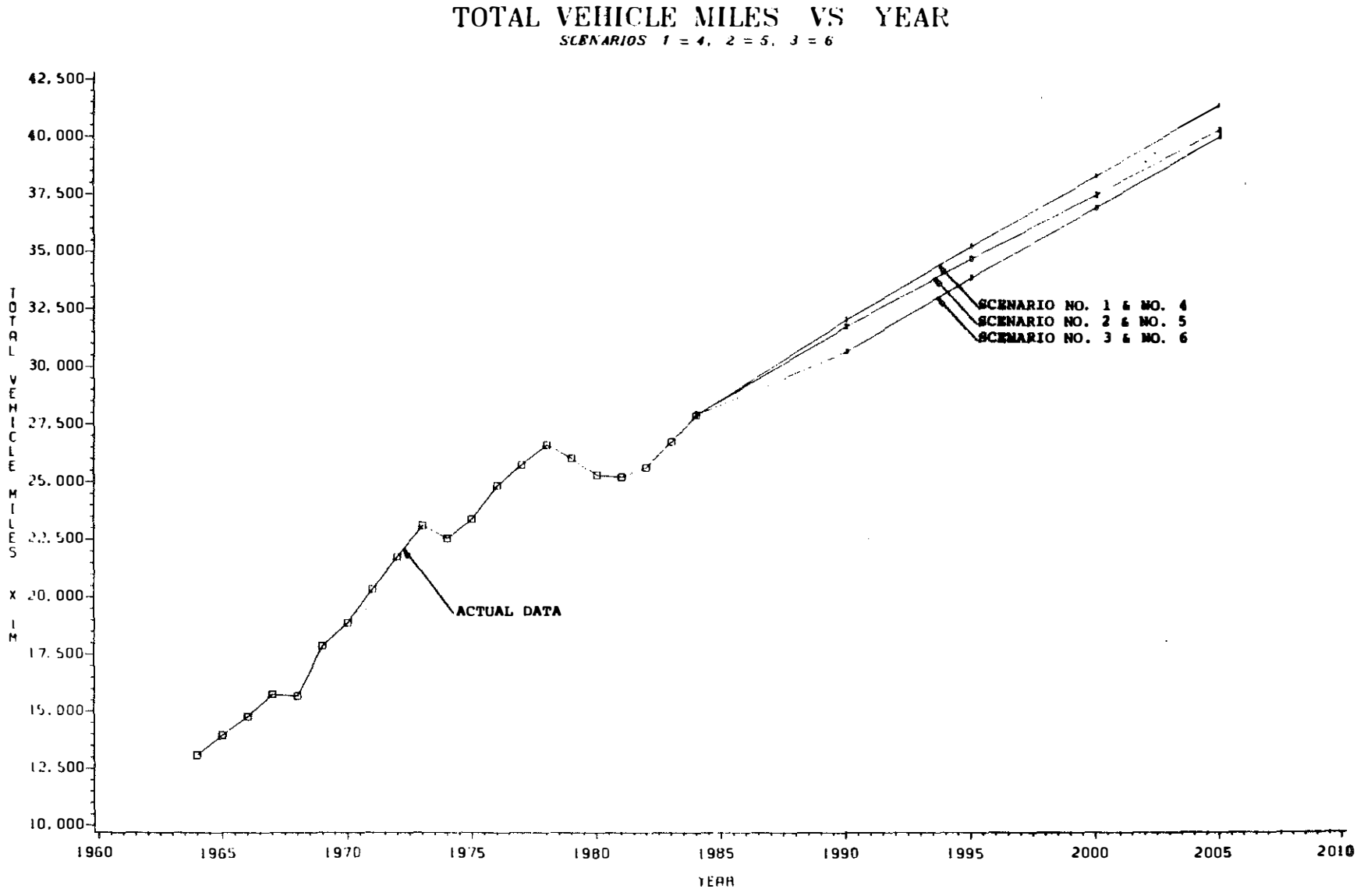


Figure 3. Trends in Total Vehicle Miles Showing Actual Historical Data and Projections Based on Various Scenarios

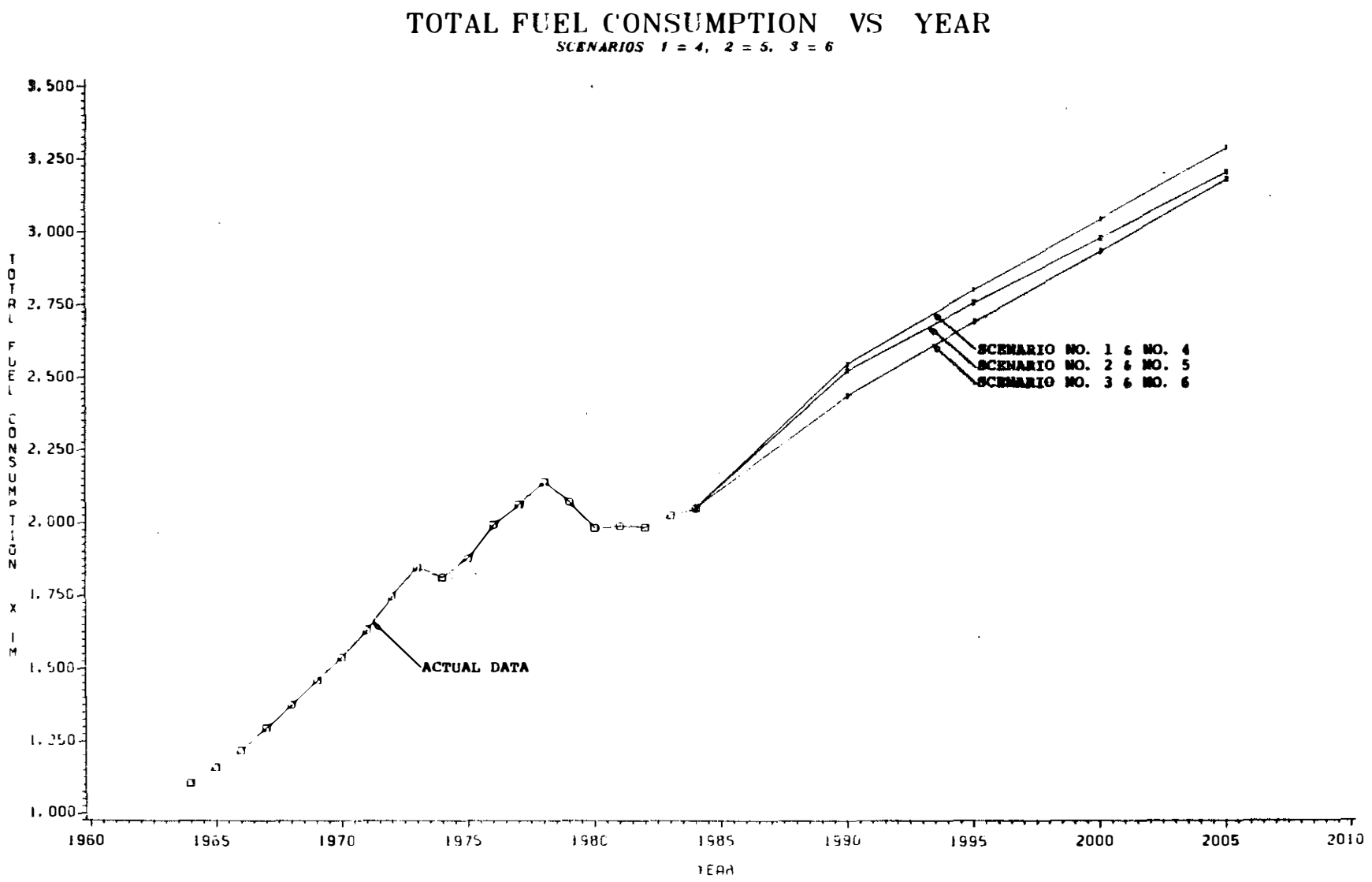


Figure 4. Trends in Total Fuel Consumption Showing Actual Historical Data and Projections Based on Various Scenarios

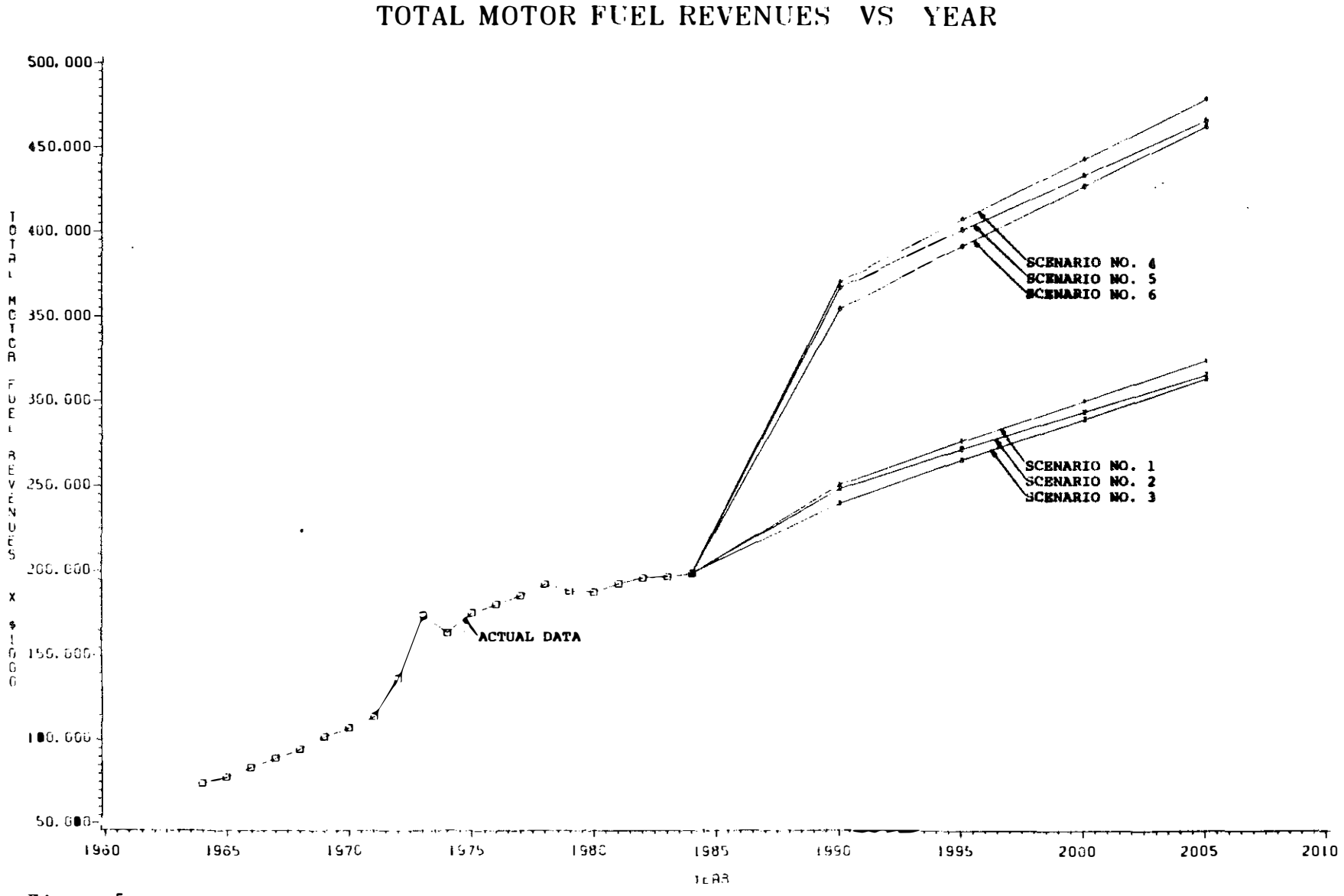


Figure 5. Trends in Total Motor Fuel Revenues Showing Actual Historical Data and Projections Based on Various Scenarios

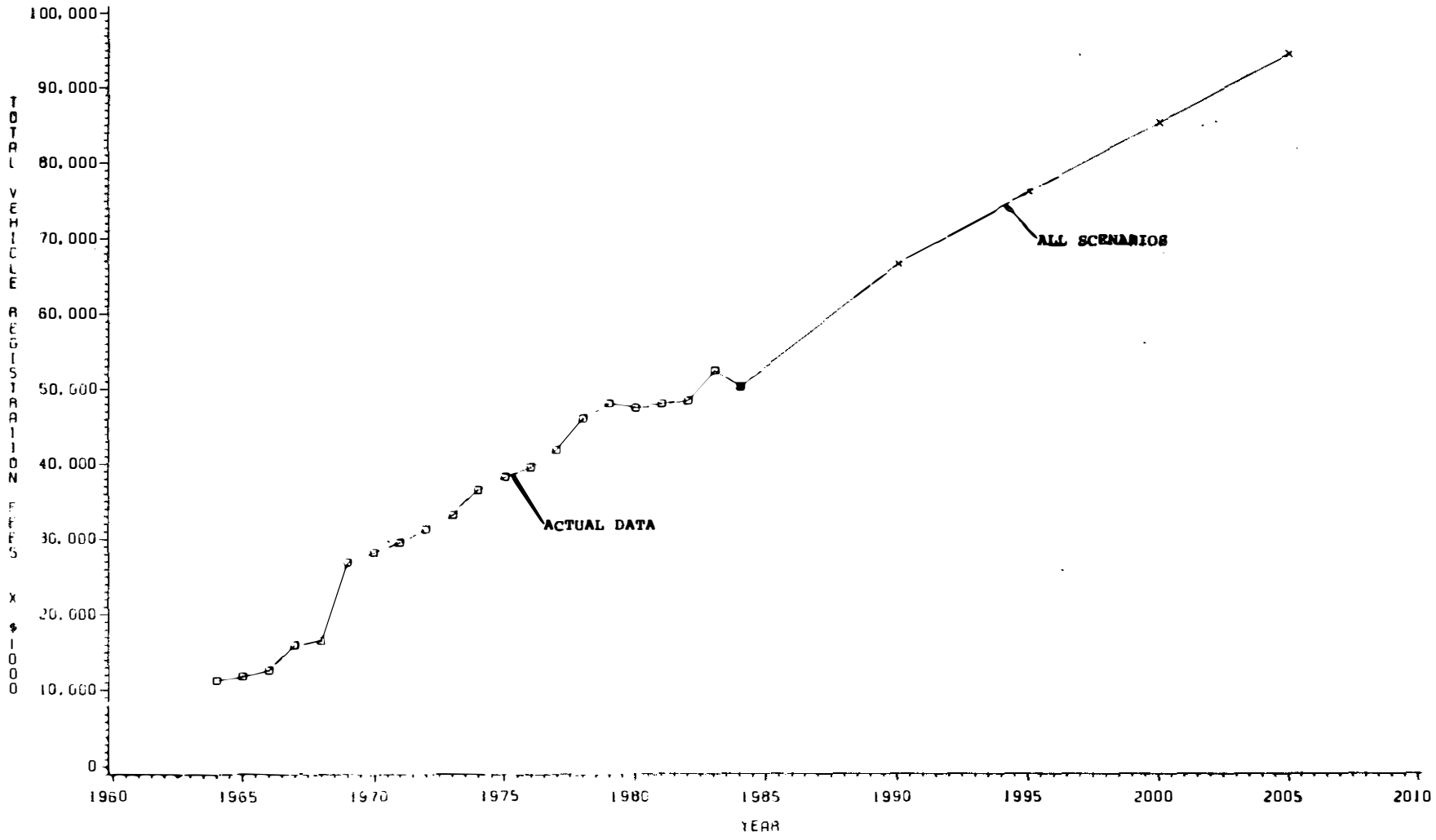


Figure 6. Trends in Total Vehicle Registration Fees Showing Actual Historical Data and Projections Based on Various Scenarios

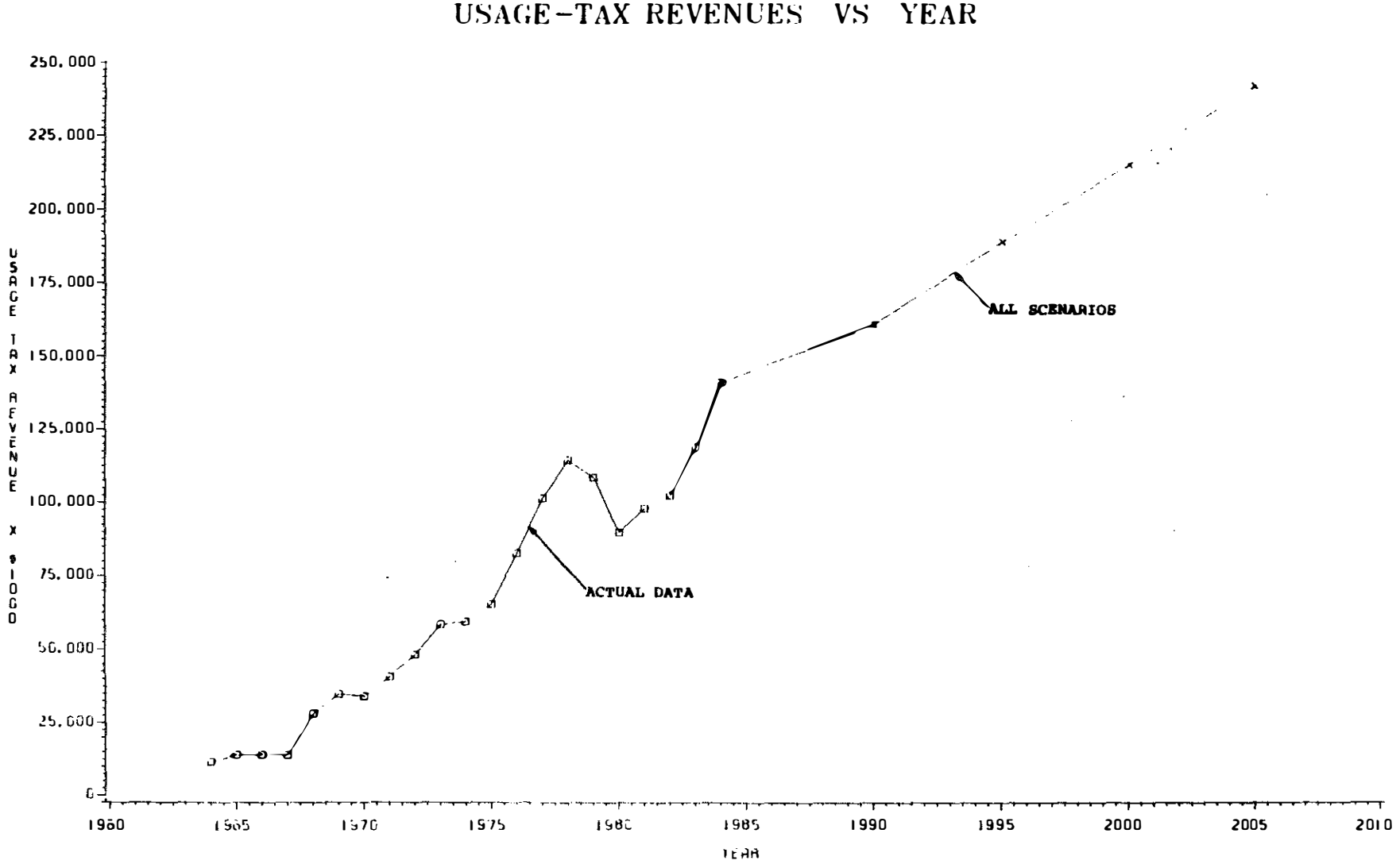


Figure 7. Trends in Usage-Tax Revenues Showing Actual Historical Data and Projections Based on Various Scenarios

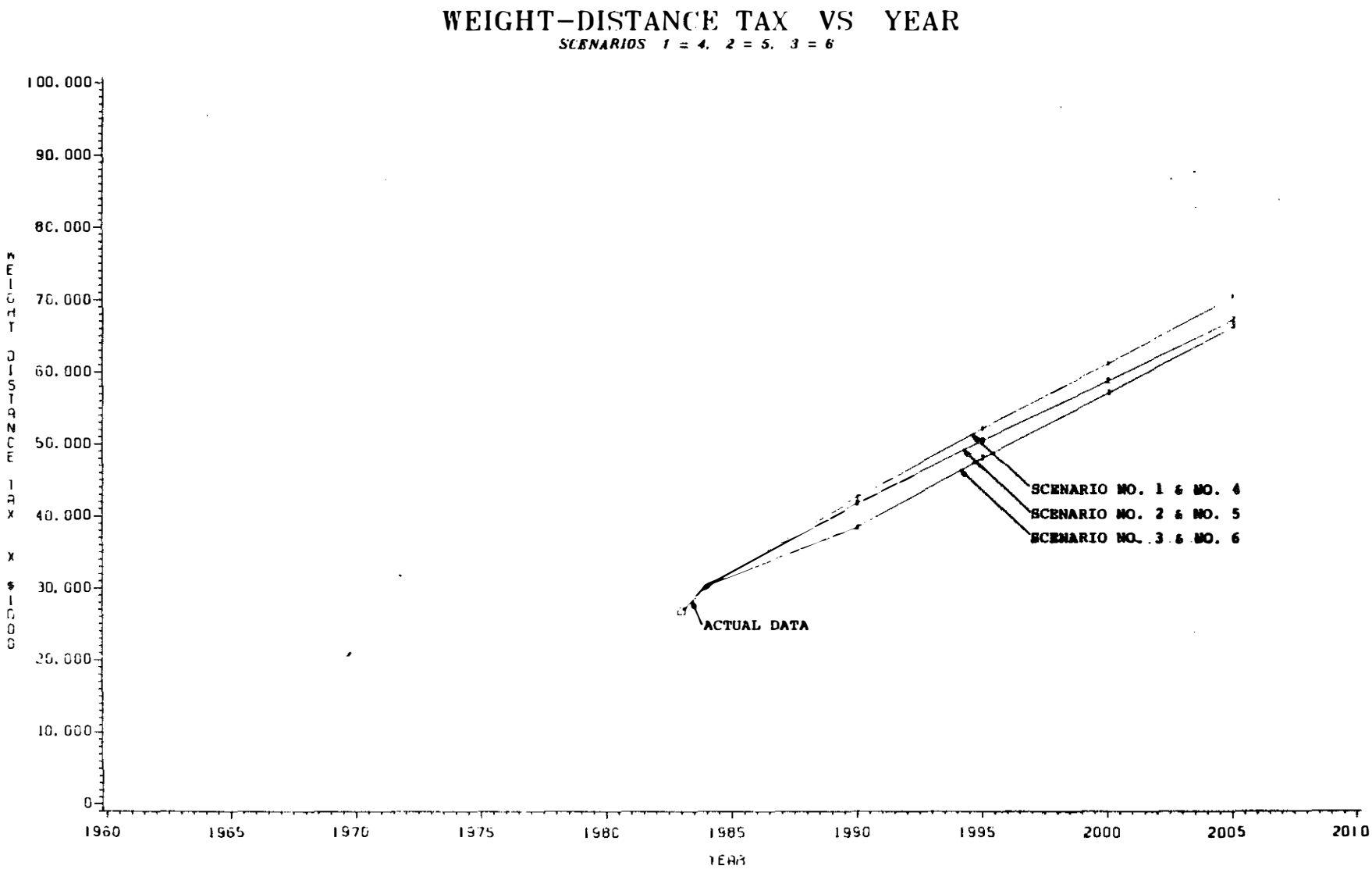


Figure 8. Trends in Weight-Distance Tax Showing Actual Historical Data and Projections Based on Various Scenarios

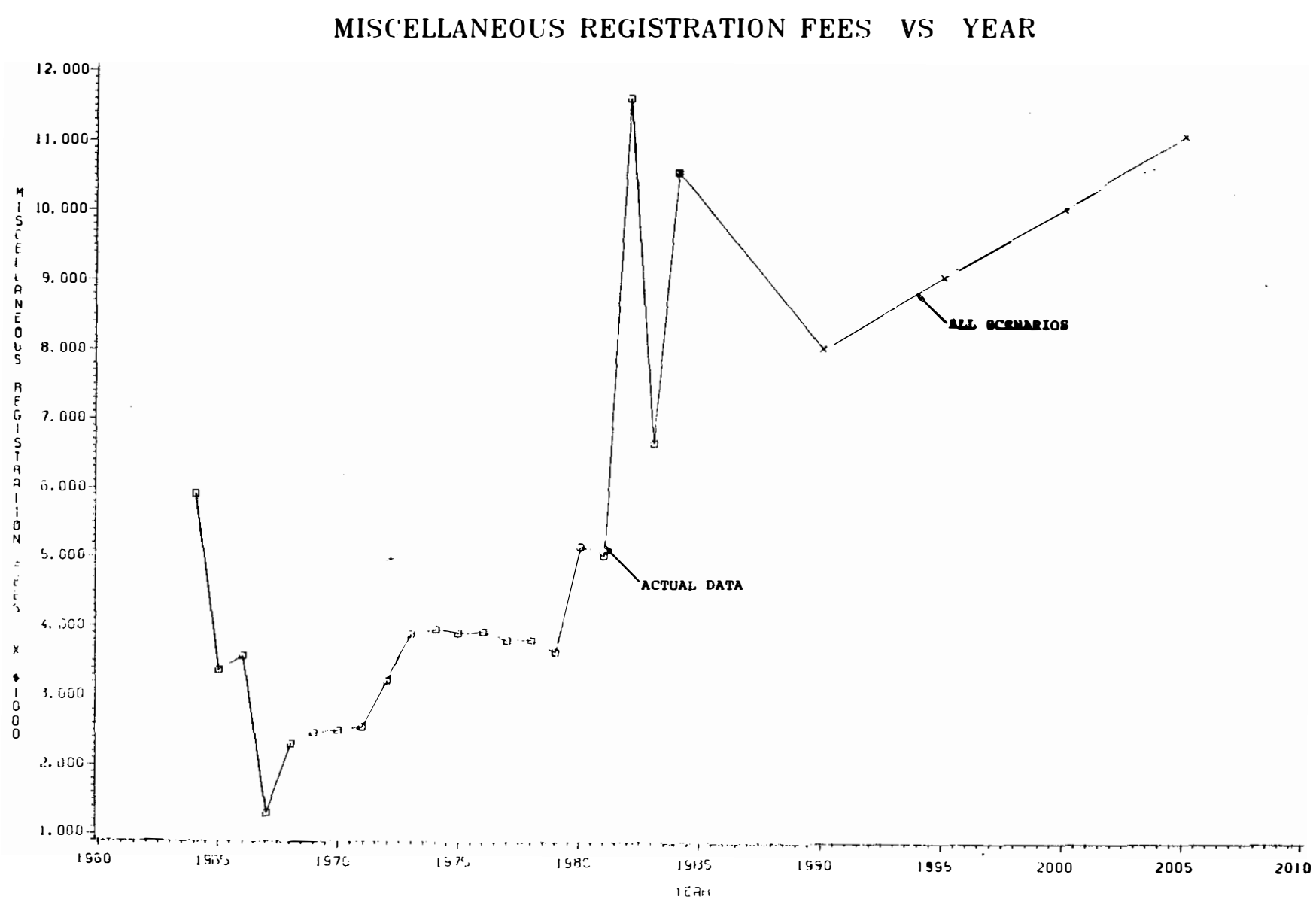


Figure 9. Trends in Miscellaneous Registration Fees Showing Actual Historical Data and Projections Based on Various Scenarios

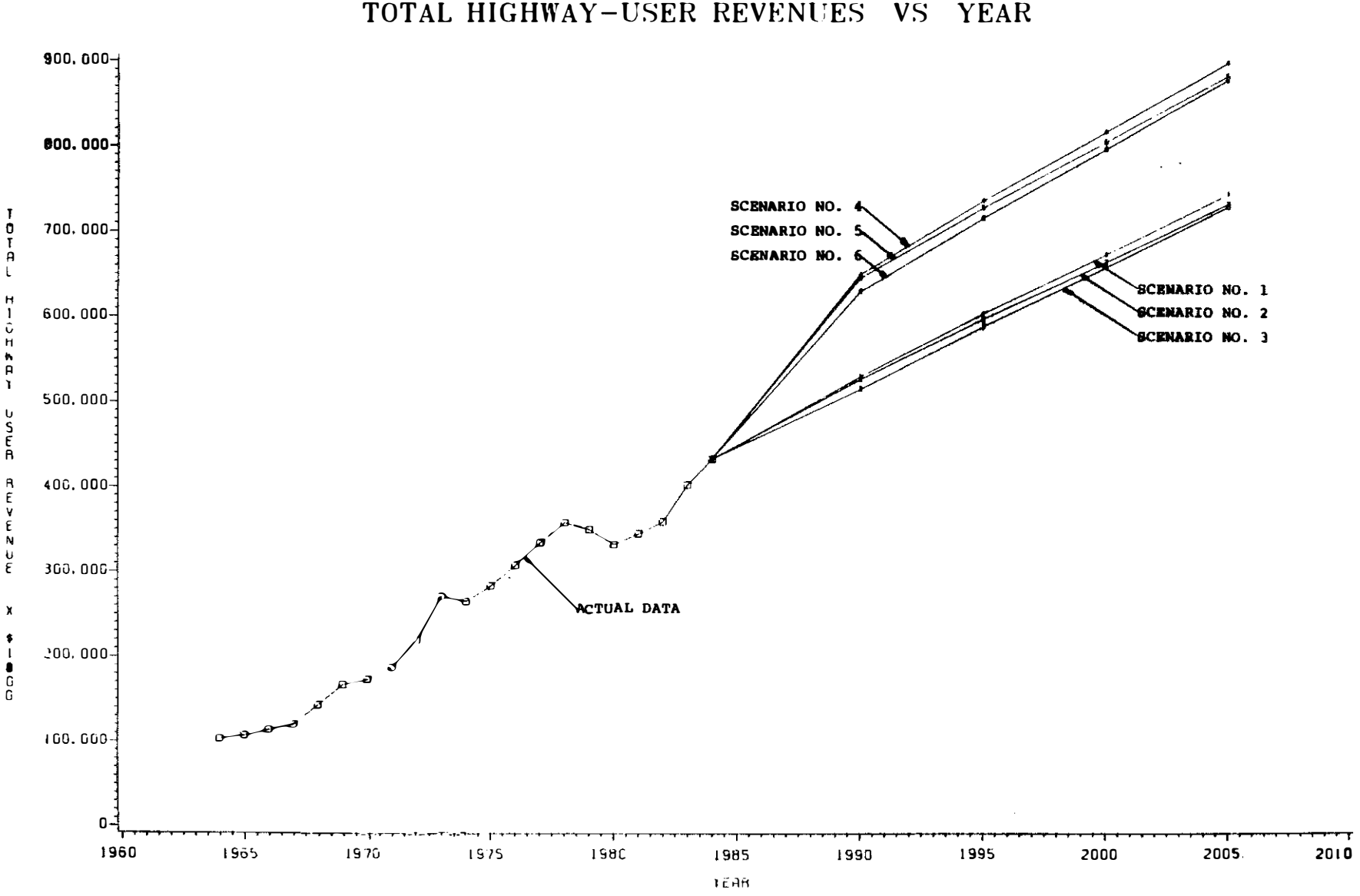


Figure 10. Trends in Total Highway-User Revenues Showing Actual Historical Data and Projection based on Various Scenarios

APPENDIX A

HISTORICAL LISTING OF VARIABLES

TABLE A-1. SOCIO-ECONOMIC VARIABLES

YEAR	TOTAL POPULATION (TPO)	URBAN POPULATION (UPO)	PERSONAL INCOME IN MILLIONS (PIC)	PERSONAL INCOME IN MILLIONS (1972 CONSTANT) (PCC)	TOTAL EMPLOYMENT (TEP)	NON-AGRICULTURAL EMPLOYMENT (NAE)	PERSONS OF DRIVING AGE (PDA)	NUMBER OF LICENSED DRIVERS (LID)
1964	3,169,000	1,510,000	5,781	7,874	943,800	726,000	1,992,000	*
1965	3,175,000	1,537,000	6,500	8,408	986,700	759,000	1,996,000	1,353,000
1966	3,181,000	1,565,000	7,143	8,939	1,040,000	800,000	2,017,000	1,383,000
1967	3,189,000	1,593,000	7,737	9,417	1,085,000	835,000	2,038,000	1,442,000
1968	3,220,000	1,634,000	8,516	9,897	1,109,000	853,000	2,083,000	1,477,000
1969	3,232,000	1,665,000	9,202	10,411	1,167,000	895,000	2,103,000	1,572,000
1970	3,219,000	1,684,000	10,000	10,814	1,216,000	914,000	2,104,000	1,609,000
1971	3,276,000	1,708,000	10,800	11,216	1,226,000	928,000	2,292,000	1,626,000
1972	3,306,000	1,718,000	11,900	11,965	1,309,000	989,000	2,365,000	1,684,000
1973	3,342,000	1,732,000	13,300	12,751	1,378,000	1,038,000	2,438,000	1,722,000
1974	3,357,000	1,735,000	14,800	13,253	1,422,000	1,071,000	2,471,000	1,742,000
1975	3,346,000	1,750,000	16,600	13,255	1,441,000	1,064,000	2,520,000	1,910,000
1976	3,428,000	1,761,000	18,600	14,109	1,448,000	1,112,000	2,564,000	1,957,000
1977	3,458,000	1,772,000	20,600	14,877	1,489,000	1,157,000	2,606,000	1,994,000
1978	3,498,000	1,787,000	23,100	15,388	1,550,000	1,210,000	2,650,000	2,038,000
1979	3,527,000	1,796,000	25,700	15,909	1,563,000	1,245,000	2,686,000	2,067,777
1980	3,661,000	1,859,000	27,900	15,639	1,620,000	1,209,000	2,787,000	2,055,297
1981	3,662,000	1,843,000	31,000	16,177	1,662,000	1,196,000	2,799,000	2,147,255
1982	3,667,000	1,851,000	32,800	16,304	1,675,000	1,161,000	2,812,000	2,141,104
1983	3,714,000	1,869,000	34,000	16,339	1,702,000	1,154,000	2,856,000	2,192,567
1984	3,723,000	*	*	17,488	*	*	*	2,249,117
Mean	3,397,619	1,718,450	16,798	13,147	1,351,625	1,015,800	2,408,950	1,818,106
Std Dev	195,311	107,432	9,361	2,572	242,590	166,125	309,173	290,367
Coef Var	5.8	6.2	55.7	19.6	17.9	16.3	12.8	15.9

* Data not available.

TABLE A-2. HIGHWAY MILEAGE

YEAR	TOTAL HIGHWAY MILES (THM)	URBAN HIGHWAY MILES (UHM)	RURAL HIGHWAY MILES (RHM)
1964	69,849	4,753	65,096
1965	70,145	4,789	65,356
1966	70,085	4,822	65,263
1967	70,225	4,954	65,271
1968	69,909	5,049	64,860
1969	69,615	5,366	64,249
1970	69,071	5,683	63,388
1971	69,123	5,852	63,271
1972	69,639	5,751	63,888
1973	69,791	6,022	63,769
1974	69,933	6,050	63,883
1975	70,131	6,070	64,061
1976	69,706	7,378	62,328
1977	69,938	6,092	63,846
1978	68,781	6,267	62,514
1979	68,952	6,267	62,685
1980	69,321	6,634	62,687
1981	68,429	6,580	61,849
1982	68,674	6,928	61,746
1983	69,150	7,454	61,696
1984	69,339	7,477	61,861
Mean	69,515	6,011	63,503
Std Dev	531	864	1,244
Coef Var	0.8	14.4	1.9

TABLE A-3. FUEL RELATED VARIABLES

YEAR	FUEL PRICE IN CENTS (FPC)	GASOLINE TAX RATE FOR 2-AXLE VEHICLES IN CENTS/GALLON (XG2)	GASOLINE TAX RATE FOR MORE THAN 2-AXLE VEHICLES IN CENTS/GALLON (XGM)
1964	33.9	7.0	9.0
1965	33.9	7.0	9.0
1966	33.9	7.0	9.0
1967	34.9	7.0	9.0
1968	35.9	7.0	9.0
1969	35.9	7.0	9.0
1970	37.9	7.0	9.0
1971	37.9	7.0	9.0
1972	39.9	9.0	11.0
1973	51.9	9.0	11.0
1974	55.9	9.0	11.0
1975	58.9	9.0	11.0
1976	64.9	9.0	11.0
1977	67.9	9.0	11.0
1978	71.9	9.0	11.0
1979	103.0	9.0	11.0
1980	127.3	9.0	11.0
1981	139.0	10.1	12.1
1982	133.2	10.0	12.0
1983	130.8	10.0	12.0
1984	128.7	10.0	12.0
Mean	69.4	8.4	10.4
Std Dev	39.6	1.2	1.2
Coef Var	57.1	14.3	11.5

TABLE A-4. VEHICLE REGISTRATION

YEAR	AUTO REGISTRATION (ATR)	TRUCK REGISTRATION (TRR)	BUS REGISTRATION (BUR)	TRAILER REGISTRATION (TSR)	MOTORCYCLE REGISTRATION (MCR)	TOTAL MOTOR-VEHICLE REGISTRATION (TVR)
1964	1,130,418	282,567	5,837	18,142	10,030	1,418,821
1965	1,195,506	298,814	5,652	20,017	15,276	1,499,972
1966	1,253,903	314,469	6,260	24,440	21,173	1,574,632
1967	1,296,857	329,086	6,437	31,147	26,010	1,632,380
1968	1,330,851	352,974	6,821	37,628	27,389	1,690,646
1969	1,342,309	363,115	7,405	40,230	24,294	1,712,829
1970	1,374,340	380,867	7,310	46,230	26,334	1,762,517
1971	1,444,947	407,513	7,527	54,518	29,547	1,859,987
1972	1,515,550	444,419	7,651	61,635	36,721	1,967,620
1973	1,598,695	484,328	7,725	69,972	49,353	2,090,748
1974	1,626,177	531,404	6,479	70,502	58,034	2,164,060
1975	1,675,990	562,631	6,517	71,779	61,025	2,245,138
1976	1,727,456	616,088	6,602	77,666	59,351	2,350,146
1977	1,770,046	671,841	7,831	81,970	61,405	2,449,718
1978	1,804,146	731,848	7,896	87,588	60,989	2,543,890
1979	1,813,235	784,097	8,165	90,225	62,132	2,605,497
1980	1,807,358	777,278	8,078	88,463	63,574	2,592,714
1981	1,800,574	784,304	8,569	91,627	64,717	2,593,447
1982	1,809,711	797,068	8,562	93,022	62,551	2,615,341
1983	1,812,875	799,057	8,892	89,539	58,636	2,620,824
1984	1,771,182	796,608	8,769	91,609	52,642	2,576,559
Mean	1,566,767	548,113	7,380	63,712	44,342	2,122,261
Std Dev	238,133	196,845	969	26,327	18,942	429,555
Coef Var	15.2	35.9	13.1	41.3	42.7	20.2

TABLE A-5. VEHICLE-MILES TRAVELED

YEAR	TOTAL VEHICLE-MILES IN MILLIONS (TVM)	URBAN VEHICLE-MILES IN MILLIONS (UVM)	RURAL VEHICLE-MILES IN MILLIONS (RVM)
1964	13,114	*	*
1965	13,969	*	*
1966	14,773	4,872	10,732
1967	15,741	5,266	11,360
1968	15,691	5,272	11,301
1969	17,866	5,997	12,874
1970	18,897	6,393	13,567
1971	20,355	7,061	14,439
1972	21,775	8,035	14,965
1973	23,096	8,531	15,864
1974	22,543	8,394	15,417
1975	23,372	9,054	15,634
1976	24,843	9,496	16,213
1977	25,732	11,439	15,740
1978	26,607	11,638	16,465
1979	25,994	11,371	16,086
1980	25,244	9,932	15,301
1981	25,195	9,877	15,318
1982	25,627	10,158	15,469
1983	26,719	11,083	15,636
1984	27,873	11,468	16,405
Mean	22,536	8,702	14,672
Std Dev	4,722	2,315	1,817
Coef Var	20.9	26.6	12.3

* Data not available.

TABLE A-6. FUEL CONSUMPTION

YEAR	TOTAL FUEL CONSUMPTION IN THOUSAND GALLONS (TFC)	GASOLINE CONSUMPTION IN THOUSAND GALLONS (GAS)	SPECIAL FUEL CONSUMPTION IN THOUSAND GALLONS (SFL)
1964	1,107,111	947,449	52,624
1965	1,158,919	989,227	57,512
1966	1,220,721	1,032,027	72,101
1967	1,293,463	1,098,986	78,722
1968	1,373,418	1,161,065	90,883
1969	1,455,911	1,224,484	101,615
1970	1,538,424	1,295,059	110,540
1971	1,633,722	1,379,282	108,932
1972	1,748,374	1,593,345	135,073
1973	1,847,329	1,666,396	163,732
1974	1,812,007	1,638,228	155,402
1975	1,876,640	1,704,999	153,640
1976	1,993,333	1,802,028	173,902
1977	2,062,201	1,853,058	193,541
1978	2,137,001	1,908,662	217,059
1979	2,070,394	1,831,100	226,750
1980	1,980,844	1,722,133	248,942
1981	1,987,854	1,698,743	276,770
1982	1,982,029	1,689,819	282,388
1983	2,025,275	1,703,370	312,399
1984	2,049,874	*	*
Mean	1,731,182	1,496,972	160,628
Std Dev	338,488	320,317	79,163
Coef Var	19.6	21.3	49.3

* Data not available.

TABLE A-7. REGISTRATION FEES

YEAR	AUTO REGISTRATION FEES IN DOLLARS (ARF)	TRUCK REGISTRATION FEES IN DOLLARS (TRF)	BUS REGISTRATION FEES IN DOLLARS (BRF)	TRAILER REGISTRATION FEES IN DOLLARS (TSF)	MOTORCYCLE REGISTRATION FEES IN DOLLARS (MCF)
1964	4,667,000	6,401,000	79,000	159,000	17,000
1965	4,893,000	6,811,000	84,000	171,000	24,000
1966	5,146,000	7,194,000	133,000	206,000	35,000
1967	5,470,000	10,123,000	123,000	390,000	45,000
1968	5,479,000	10,640,000	99,000	422,000	49,000
1969	14,147,000	12,269,000	68,000	461,000	108,000
1970	14,549,000	12,951,000	106,000	516,000	115,000
1971	15,197,000	13,719,000	71,000	557,000	127,000
1972	15,997,000	14,667,000	61,000	625,000	153,000
1973	16,882,000	15,698,000	55,000	700,000	200,000
1974	17,448,000	18,230,000	59,000	744,000	261,000
1975	17,922,988	19,428,988	60,000	770,000	275,000
1976	18,396,000	20,174,988	46,000	837,000	273,000
1977	18,820,000	22,042,000	31,000	911,000	282,000
1978	20,470,988	24,584,988	40,000	988,000	280,000
1979	20,420,988	26,564,988	45,000	1,042,000	283,000
1980	20,380,988	26,068,988	25,000	1,046,000	296,000
1981	20,488,988	26,374,000	23,000	1,069,000	299,000
1982	20,588,988	26,842,988	10,000	1,086,000	289,000
1983	22,814,000	28,624,000	26,000	1,036,000	280,000
1984	20,247,637	28,947,786	28,000	966,000	272,000
Mean	15,258,407	18,016,985	60,571	700,095	188,714
Std Dev	6,206,831	7,654,479	33,921	313,493	107,768
Coef Var	40.6	42.5	56.0	44.8	57.1

TABLE A-8. HIGHWAY USER REVENUES

YEAR	MOTOR-VEHICLE USAGE TAX IN $1,000 (UTR)	MOTOR VEHICLE REGISTRATION FEES IN $1,000 (TVF)	WEIGHT-DISTANCE TAX IN $1,000 (WDT)	TOTAL REGISTRATION AND MISCELLANEOUS REVENUES IN $1,000 (MRT)	TOTAL FUEL REVENUES IN $1,000 (MFT)	TOTAL HIGHWAY-USER REVENUES IN $1,000 (HUR)
1964	11,661	11,323	*	28,906	74,582	103,488
1965	13,978	11,983	*	29,226	77,867	107,193
1966	14,123	12,714	*	30,413	83,561	113,974
1967	13,795	16,151	*	31,256	88,917	120,173
1968	28,173	16,689	*	47,174	94,779	141,953
1969	34,871	27,053	*	64,407	101,640	166,047
1970	34,243	28,237	*	64,993	107,052	172,045
1971	40,897	29,671	*	73,132	113,936	187,068
1972	48,363	31,503	*	83,107	136,390	219,497
1973	58,863	33,535	*	96,302	173,815	270,117
1974	59,767	36,742	*	100,485	163,505	263,991
1975	65,503	38,457	*	107,876	175,158	283,034
1976	82,775	39,727	*	126,453	180,496	306,939
1977	101,552	42,086	*	147,453	185,827	333,280
1978	114,342	46,364	*	164,523	192,750	357,273
1979	108,425	48,356	*	160,434	188,466	348,900
1980	89,720	47,817	*	142,726	188,121	330,847
1981	98,005	48,254	*	151,314	193,024	344,338
1982	102,342	48,817	*	162,781	196,251	359,032
1983	119,057	52,780	26,816	205,310	197,172	402,482
1984	141,129	50,654	30,317	232,660	199,301	431,961
Mean		34,234		107,187	148,219	255,411
Std Dev		13,971		60,319	42,271	105,626
Coef Var		40.9		56.3	31.9	41.4

APPENDIX B

VARIMAX ROTATED FACTOR MATRIX

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ALPHABETICAL LISTING OF VARIABLES

ARF = annual auto registration fees in thousand dollars
ATR = annual auto registration in thousands
BRF = annual bus registration fees in thousand dollars
BUR = bus registration in thousands
FPC = fuel price in cents per gallon
GAS = annual gasoline fuel consumption in million gallons
HUR = total annual highway-user revenues in thousand dollars
LID = licensed drivers in thousands
MCF = annual motorcycle registration fees in thousand dollars
MCR = motorcycle registration in thousands
MFT = total annual fuel revenues in thousand dollars
MRT = total annual registration and miscellaneous fees in thousand dollars
NAE = nonagricultural employment in thousands
PCC = annual personal income - 1972 constant dollars in millions
PDA = persons of driving age in thousands
PIC = annual personal income in million dollars
RHM = rural highway miles
RVM = annual rural vehicle-miles in millions
SFL = annual special fuel consumption in million gallons
TEP = total employment in thousands
TFC = annual total fuel consumption in million gallons
THM = total highway miles
TPO = total population in thousands
TRF = annual truck fees in thousand dollars
TRR = truck registration in thousands
TSF = annual trailer registration fees in thousand dollars
TSR = trailer registration in thousands
TVF = total annual vehicle registration fees in thousand dollars
TVM = total vehicle-miles in millions
TVR = total motor-vehicle registration in thousands
UHM = urban highway miles
UPO = urban population in thousands
UTR = annual motor-vehicle usage tax in thousand dollars
UVM = urban vehicle-miles in millions
WDT = annual weight-distance tax in thousand dollars
XG2 = gasoline tax rate for two-axle vehicles in dollars per gallon
XGM = gasoline tax rate for more than two axle vehicles in dollars per gallon
YR = year (1964 = 64, 1990 = 90, etc.)

VARIMAX ROTATED FACTOR MATRIX

Variables	Factor 1	Factor 2	Factor 3
GAS	.96		
MCR	.93		
TVM	.92		
MCF	.92		
TFC	.92		
RVM	.92		
MFT	.91		
ATR	.89		
UVM	.88		
NAE	.87		
TSR	.86		
HUR	.85		
TVR	.83		
XG2	.82		
XGM	.82		
PDA	.81		
PCC	.81		
TSF	.81	52	
TVF	.80	.54	
ARF	.80	.53	
UTR	.80		
TEP	.79	.52	
LID	.79	.53	
BRF	-.79	-.50	
MRT	.77	.50	
TRR	.76	.56	
TRF	.76	.56	
UPO	.75	.58	
UHM	.72		
SFL	.65	.62	
TPO	.64	.63	
PIC	.62	.64	
RHM	-.56	-.73	
FPC	.51	.69	
THM		-.95	
BUR		.82	
WDT			.91

APPENDIX C

SUMMARY OF PRELIMINARY REGRESSION ANALYSES

ALPHABETICAL LISTING OF VARIABLES

ARF = auto registration fees in thousand dollars
ATR = auto registration in thousands
BRF = bus registration fees in thousand dollars
BUR = bus registration in thousands
FPC = fuel price in cents per gallon
GAS = gasoline fuel consumption in million gallons
HUR = total highway-user revenues in thousand dollars
LID = licensed drivers in thousands
MCF = motorcycle registration fees in thousand dollars
MCR = motorcycle registration in thousands
MFT = total fuel revenues in thousand dollars
MRT = total registration and miscellaneous fees in thousand dollars
NAE = nonagricultural employment in thousands
PCC = personal income - 1972 constant dollars in millions
PDA = persons of driving age in thousands
PIC = personal income in million dollars
RHM = rural highway miles
RVM = rural vehicle-miles in millions
SFL = special fuel consumption in million gallons
TEP = total employment in thousands
TFC = total fuel consumption in million gallons
THM = total highway miles
TPO = total population in thousands
TRF = truck fees in thousand dollars
TRR = truck registration in thousands
TSF = trailer registration fees in thousand dollars
TSR = trailer registration in thousands
TVF = total vehicle registration fees in thousand dollars
TVM = total vehicle-miles in millions
TVR = total motor-vehicle registration in thousands
UHM = urban highway miles
UPO = urban population in thousands
UTR = motor-vehicle usage tax in thousand dollars
UVM = urban vehicle-miles in millions
WDT = weight-distance tax in thousand dollars
XG2 = gasoline tax rate for two-axle vehicles in dollars per gallon
XGM = gasoline tax rate for more than two axle vehicles in dollars per gallon
YR = year (1964 = 64, 1990 = 90, etc.)

NOTE: Regression equations shown in Appendix C reflect results of analyses performed with total vehicle miles traveled taken from "Highway Statistics" for 1964-1984. Final equations shown in the text and other Apendices reflect analyses performed with total vehicle miles traveled taken from "Highway Statistics" for 1980-1984 and adjusted for a change in estimating methodology for the period 1964-1979.

TABLE C-1. REGRESSION SERIES 1: OUTPUT VARIABLE = f(TIME)

ATR = -1157.37 + 36.8126 (YR)	R^2 = .92
TRR = -1754.46 + 31.1158 (YR)	R^2 = .96
BUR = -2.52 + 0.1339 (YR)	R^2 = .73
TSR = -240.84 + 4.1156 (YR)	R^2 = .94
MCR = -158.99 + 2.7477 (YR)	R^2 = .81
TVR = -2899.17 + 67.7896 (YR)	R^2 = .96
TVM = -29302.70 + 700.5319 (YR)	R^2 = .85
UVM = -16735.29 + 343.7464 (YR)	R^2 = .85
RVM = -2918.85 + 237.7270 (YR)	R^2 = .66
GAS = -1910.34 + 46.0449 (YR)	R^2 = .80
SFL = -769.23 + 12.5656 (YR)	R^2 = .97
TFC = -2025.71 + 50.7688 (YR)	R^2 = .86
ARF = -52682.23 + 918.1168 (YR)	R^2 = .84
TRF = -72612.78 + 1224.7270 (YR)	R^2 = .99
BRF = 414.62 - 4.7844 (YR)	R^2 = .77
TSF = -2926.96 + 49.0143 (YR)	R^2 = .94
MCF = -0008.84 + 16.1831 (YR)	R^2 = .87
TVF = -12898.90 + 2205.6690 (YR)	R^2 = .96
MRT = -593837.10 + 9473.3000 (YR)	R^2 = .95
MFT = -389328.60 + 7264.1640 (YR)	R^2 = .91
HUR = -983072.50 + 16736.2600 (YR)	R^2 = .97

TABLE C-2. REGRESSION SERIES 2: OUTPUT VARIABLE = f(POPULATION)

ATR = -2162.88 + 1.0977 (TPO)	R_2^2 = .81
TRR = -2775.82 + 0.9783 (TPO)	R_2^2 = .94
BUR = -6.90 + 0.0042 (TPO)	R_2^2 = .72
TSR = -353.81 + 0.1229 (TPO)	R_2^2 = .83
MCR = -229.74 + 0.8067 (TPO)	R_2^2 = .69
TVR = -4936.40 + 2.0760 (TPO)	R^2 = .89
TVM = -45569.48 + 20.0453 (TPO)	R_2^2 = .69
UVM = -25820.96 + 10.1609 (TPO)	R_2^2 = .73
RVM = -7633.67 + 6.5654 (TPO)	R^2 = .50
GAS = -2893.09 + 1.2921 (TPO)	R_2^2 = .62
SFL = -1200.95 + 0.4007 (TPO)	R_2^2 = .98
TFC = -3252.70 + 1.4668 (TPO)	R^2 = .71
ARF = -75214.79 + 26.6284 (TPO)	R_2^2 = .70
TRF = -110595.60 + 37.8537 (TPO)	R_2^2 = .93
BRF = 577.10 - 0.1520 (TPO)	R_2^2 = .77
TSF = -4329.53 + 1.4803 (TPO)	R_2^2 = .85
MCF = -1429.10 + 4762 (TPO)	R_2^2 = .74
TVF = -191252.30 + 66.3659 (TPO)	R^2 = .86
MRT = -889158.70 + 293.2483 (TPO)	R_2^2 = .90
MFT = -589181.80 + 217.0347 (TPO)	R_2^2 = .80
HUR = -1478235.00 + 510.2531 (TPO)	R^2 = .89

TABLE C-3. REGRESSION SERIES 3: OUTPUT VARIABLE = f(INPUT VARIABLES)

ATR = -30.85 + 0.9541 (NAE) + 0.2608 (PDA)	R^2 = .99
TRR = -312.64 + 0.3911 (LID) + 0.0089 (PIC)	R^2 = .98
BUR = +41.92 + 0.0057 (UPO) - 0.0006 (THM)	R^2 = .80
TSR = -90.77 + 0.0831 (NAE) + 0519 (TEP)	R^2 = .99
MCR = -568.79 + 1241 (NAE) + 0.0070 (THM)	R^2 = .96
TVR = -384.40 + 0.9811 (TEP) + 1.1572 (NAE)	R^2 = .99
TVM = -8376.10 + 32.0435 (NAE) - 23.5868 (FPC)	R^2 = .95
UVM = -51356.37 + 14.7603 (NAE) + 0.6483 (THM)	R^2 = .95
RVM = +1086.14 + 15.1954 (NAE) - 0.1101 (PIC)	R^2 = .84
GAS = -744.80 + 2.4023 (NAE) - 2.8601 (FPC)	R^2 = .97
SFL = -84.89 + 0.0056 (PIC)	R^2 = .99
TFC = -468.03 + 2.2565 (NAE) - 1.3398 (FPC)	R^2 = .97
ARF = -74186.20 + 73.7312 (UPO) - 10.9661 (TPO)	R^2 = .93
TRF = -22410.98 + 20.5696 (LID) + 0.1804 (PIC)	R^2 = .99
BRF = +370.48 - 0.2056 (PDA) + 0.1372 (TEP)	R^2 = .84
TSF = -1125.95 + 0.7279 (TEP) + 0.8290 (NAE)	R^2 = .99
MCF = -489.67 + 0.5052 (NAE) + 19.5835 (XG2)	R^2 = .96
TVF = 85010.16 + 48.3786 (TEP) - 1.8292 (RHM)	R^2 = .98
MRT = -298621.4 + 122.5353 (LID) + 75.9777 (PDA)	R^2 = .95
MFT = -161535.4 + 180.3292 (NAE) + 15009.07 (XG2)	R^2 = .98
HUR = -458335.8 + 288.7550 (LID) + 18075.48 (XGM)	R^2 = .98

TABLE C-4. REGRESSION SERIES 4: OUTPUT VARIABLE = f(OTHER OUTPUT VARIABLES)

ATR = Not Applicable
TRR = Not Applicable
BUR = Not Applicable
TSR = Not Applicable
MCR = Not Applicable
TVR = Not Applicable

TVM = +12280.81 + 244.3235 (TSR) - 9.6886 (TRR)	R^2 = .96
UVM = - 15497.43 + 18.9019 (ATR) - 122.1301 (MCR)	R^2 = .98
RVM = +20521.31 + 208.4687 (TSR) - 9.0354 (TVR)	R^2 = .96
GAS = +192.08 + 0.0758 (TVM) - 54.7742 (BUR)	R^2 = .99
SFL = -19.08 + 0.5338 (TRR) - 0.01297 (UVM)	R^2 = .94
TFC = -76.77 + 0.0505 (TVM) + 0.4264 (ATR)	R^2 = .99
ARF = +12223.03 + 392.1811 (TSR) - 10.3677 (TVR)	R^2 = .93
TRF = -2594.90 + 28.7749 (TRR) + 75.9669 (TSR)	R^2 = .99
BRF = 139.6492 - 0.5906 (TSR) - 0.0756 (TRR)	R^2 = .79
TSF = -378.7915 + 6.9929 (TSR) + 0.2991 (TVR)	R^2 = .99
MCF = -309.5787 + 0.2454 (ATR) + 2.5653 (MCR)	R^2 = .98
TVF = 988.87 + 648.9950 (TSR) - 182.7592 (MCR)	R^2 = .98
MRT = -77234.96 + 194.9350 (TRR) + 8.9147 (UVM)	R^2 = .93
MFT = -175328.1 + 168.2396 (ATR) + 4.0861 (RVM)	R^2 = .98
HUR = -214476.9 + 150.7303 (TVR) + 17.3240 (UVM)	R^2 = .97

TABLE C-5. REGRESSION SERIES 5: OUTPUT VARIABLE = f(INPUT VARIABLES, OTHER OUTPUT VARIABLES)

ATR = Regression Series 3
TRR = Regression Series 3
BUR = Regression Series 3
TSR = Regression Series 3
MCR = Regression Series 3
TVR = Regression Series 3

TVM = 11019.71 + 222.1701 (TSR) - 30.0077 (FPC)	R^2 = .98
UVM = -9807.92 + 21.3169 (NAE) - 70.8989 (MCR)	R^2 = .96
RVM = 9990.90 + 119.7221 (TSR) - 0.1753 (PIC)	R^2 = .98
GAS = 192.0769 + 0.0758 (TVM) - 54.7742 (BUR)	R^2 = .99
SFL = -84.8969 + 0.0056 (PIC) + 0.1121 (TEP)	R^2 = .99
TFC = -76.7734 + 0506 (TVM) + 0.4264 (ATR)	R^2 = .99
ARF = -74186.20 + 73.7312 (UPO) - 10.9961 (TPO)	R^2 = .93
TRF = -16835.82 + 13.4083 (LID) + 19.1111 (TRR)	R^2 = .99
BRF = 370.48 - 0.2056 (PDA) + 0.1372 (TEP)	R^2 = .99
TSF = -27.7707 + 9.7272 (TSR) + 0.0064 (PIC)	R^2 = .99
MCF = -309.58 + 0.2454 (ATR) + 2.5654 (MCR)	R^2 = .98
TVF = -23701.48 + 31.8491 (TEP) + 233.6629 (TSR)	R^2 = .98
MRT = -283369.10 + 176.4686 (LID) + 9446.5300 (BUR)	R^2 = .95
MFT = -189377.8 + 150.2380 (ATR) + 9787.4710 (XSM)	R^2 = .99
HUR = -367299.3 + 265.2710 (LID) + 93.8022 (GAS)	R^2 = .99

TABLE C-6. REGRESSION SERIES 6: OUTPUT VARIABLE = f(SPECIFIC INPUT AND OUTPUT VARIABLES)

ATR = -2162.88 + 1.0977 (TPO)	R_2^2 = .81
= -214.12 + 62.4752 (YR) - 0.8366 (TPO)	R_2^2 = .94
TRR = -2775.82 + 0.9783 (TPO)	R_2^2 = .94
= -2089.93 + 21.9889 (YR) + 0.2952 (TPO)	R_2^2 = .97
BUR = -6.90 + 0.0042 (TPO)	R_2^2 = .72
= -3.84 + 0.0098 (YR) + 0.0012 (TPO)	R_2^2 = .74
TSR = -353.81 + 0.1229 (TPO)	R_2^2 = .83
= -139.06 + 6.8850 (YR) - 0.0903 (TPO)	R_2^2 = .96
MCR = -229.75 + 0.0807 (TPO)	R_2^2 = .69
= -60.21 + 5.4 (YR) - 0.0876 (TPO)	R_2^2 = .85
TVR = -4936.40 + 2.0761 (TPO)	R_2^2 = .89
= -2388.39 + 81.6864 (YR) - 0.4530 (TPO)	R^2 = .96
TVM = -6223.74 + 15.7410 (TVR) - 65.8091 (FPC)	R_2^2 = .96
UVM = -4694.56 + 7.1071 (TVR) - 23.7882 (FPC)	R_2^2 = .96
RVM = +3742.70 + 6.2437 (TVR) - 32.9848 (FPC)	R^2 = .83
GAS = -19.52 + 0.0673 (TVM)	R_2^2 = .98
SFL = -162.78 + 0.0144 (TVM)	R_2^2 = .73
= -53.62 + 0.3909 (TRR)	R_2^2 = .94
TFC = 120.34 + 0.0715 (TVM)	R^2 = .99
ARF = -23117.10 + 24.4934 (ATR)	R_2^2 = .88
TRF = -3806.35 + 38.5383 (TRR)	R_2^2 = .98
BRF = 250.29 - 25.7064 (BUR)	R_2^2 = .53
TSF = -52.09 + 11.8061 (TSR)	R_2^2 = .98
MCF = -58.73 + 5.5804 (MCR)	R_2^2 = .96
TVF = -33246.10 + 31.8712 (TVR)	R^2 = .96
MRT = -175279.20 + 112.3940 (TVR) + 1.9746 (TVM)	R_2^2 = .90
MFT = -87655.51 + 136.2508 (TFC)	R_2^2 = .95
= -130098.80 + 90.6434 (TFC) + 14395.03 (XG2)	R^2 = .98
HUR = -256870.70 + 174.5025 (TVR) + 6.3370 (TVM)	R_2^2 = .96
= -262230.90 + 188.7699 (TVR) + 68.1423 (TFC)	R^2 = .96

TABLE C-7. REGRESSION SERIES 7: OUTPUT VARIABLE = f(SPECIFIC INPUT AND OUTPUT VARIABLES, REGRESSION LINE THROUGH ORIGIN)

ATR = 0.46313 (TPO)
TRR = 0.16389 (TPO)
BUR = 0.00218 (TPO)
TSR = 0.01908 (TPO)
MCR = 0.01326 (TPO)
TVR = 0.62772 (TPO)

TVM = 11.7738 (TVR) - 32.90973 (FPC)
UVM = 3.86193 (TVR) + 8.14239 (FPC)
RVM = 9.97679 (ATR) - 14.27601 (FPC)

GAS = .06646 (TVM)
SFL = - 0.00436 (TVM) + 0.47371 (TRR)
TFC = 0.07660 (TVM)

ARF = 10.05641 (ATR)
TRF = 33.49092 (TRR)
BRF = 7.65874 (BUR)
TSF = 11.10283 (TSR)
MCF = 4.452 (MCR)
TVF = 16.76116 (TVR)

MRT = 53.7298 (TVR)
MFT = 12,724.4025 (XG2) + 4,216.0885 (XGM)
HUR = 152.82678 (TFC)

APPENDIX D

CANDIDATE REGRESSION EQUATIONS AND COMPARISON OF ACTUAL VERSUS PREDICTED DEPENDENT VARIABLES

ALPHABETICAL LISTING OF VARIABLES

ARF = auto registration fees in thousand dollars
ATR = auto registration in thousands
BRF = bus registration fees in thousand dollars
BUR = bus registration in thousands
FPC = fuel price in cents per gallon
GAS = gasoline fuel consumption in million gallons
HUR = total highway-user revenues in thousand dollars
LID = licensed drivers in thousands
MCF = motorcycle registration fees in thousand dollars
MCR = motorcycle registration in thousands
MFT = total fuel revenues in thousand dollars
MRT = total registration and miscellaneous fees in thousand dollars
NAE = nonagricultural employment in thousands
PCC = personal income - 1972 constant dollars in millions
PDA = persons of driving age in thousands
PIC = personal income in million dollars
RHM = rural highway miles
RVM = rural vehicle-miles in millions
SFL = special fuel consumption in million gallons
TEP = total employment in thousands
TFC = total fuel consumption in million gallons
THM = total highway miles
TPO = total population in thousands
TRF = truck fees in thousand dollars
TRR = truck registration in thousands
TSF = trailer registration fees in thousand dollars
TSR = trailer registration in thousands
TVF = total vehicle registration fees in thousand dollars
TVM = total vehicle-miles in millions
TVR = total motor-vehicle registration in thousands
UHM = urban highway miles
UPO = urban population in thousands
UTR = motor-vehicle usage tax in thousand dollars
UVM = urban vehicle-miles in millions
WDT = weight-distance tax in thousand dollars
XG2 = gasoline tax rate for two-axle vehicles in dollars per gallon
XGM = gasoline tax rate for more than two axle vehicles in dollars per gallon
YR = year (1964 = 64, 1990 = 90, etc.)

EQUATION NUMBER		R^2
	TOTAL MOTOR VEHICLE REGISTRATION (TVR)	
1	TVR = -4,945.61 + 2.080 (TPO)	.89
2	TVR = 0.62920 (TPO)	-
3	TVR = 1,389.23 + 0.0436 (PIC)	.90
4	TVR = 0.1075 (PIC)	-
5	*TVR = 287.86 + 0.1424 (PCC)	.98
6	TVR = 0.1637 (PCC)	-
	TOTAL VEHICLE MILES (TVM)	
7	TVM = -51,759 + 21.611 (TPO)	.78
8	TVM = 6.425 (TPO)	-
9	TVM = 14,228 + 0.4428 (PIC)	.76
10	TVM = 1.097 (PIC)	-
11	TVM = 1.693 + 1.551 (PCC)	.95
12	TVM = 1.676 (PCC)	-
13	TVM = -4,772 - 36.263 (FPC) + 13.644 (TVR)	.97
14	*TVM = 10.625 (TVR) - 11.470 (FPC)	-
	TOTAL FUEL CONSUMPTION (TFC)	
15	TFC = 202.894 + 0.0705 (TVM)	.98
16	*TFC = 0.0795 (TVM)	-
	TOTAL MOTOR FUEL REVENUES (MFT)	
17	MFT = -5,078.31 + 969.21 (TFC)[0.75(XG2) + 0.25(XGM)]	.98
18	*MFT = 939.72 (TFC)[.75(XG2) +.25(XGM)]	-
	TOTAL VEHICLE REGISTRATION FEES (TVF)	
19	*TVF = -33,056.02 + 31.706 (TVR)	.96
20	TVF = 16.721 (TVR)	
21	TVF = -26,878.34 + 25.120 (ATR) + 39.614 (TRR)	.96
22	TVF = 14.574 (ATR) + 23.027 (TRR)	-
	TOTAL MOTOR VEHICLE USAGE TAX (UTR)	
23	UTR = -592,200. + 193.662 (TPO)	.88
24	UTR = 19.910 (TPO)	-
25	UTR = -1752.74 + 4.020 (PIC)	.87
26	UTR = 3.943 (PIC)	-
27	*UTR = -103,510 + 13.147 (PCC)	.95
28	UTR = 5.504 (PCC)	
	WEIGHT-DISTANCE TAX (WDT)	
29	*WDT = -52.408.32 + 0.0285 [104.138 (TVM)]	-
	MISCELLANEOUS USER REVENUES (MSC)	
	MSC = -26,607 + 9.138 (TPO)	.50
30	MSC = -14,818.81 + 260.2500 (YR)	.41
31	*MSC = -1,972.76 + 0.4979 (PCC)	.35
32	MSC = -2,274.96 + 3.1692 (TVR)	.29
33	MSC = -1.188 + 0.2597 (TVM)	.24
	TOTAL HIGHWAY USER REVENUES (HUR)	
34	*HUR = MFT + TVF + UTR + WDT + MSC	

*Recommended Models

EQUATION NO. 1

TVR = -4945.61069 + 2.08024 (TPO)

R^2 = .89

	TVR	*PRED	*RESID
1964	1418.8208	1646.6780	-227.8572
1965	1499.9719	1659.1595	-159.1876
1966	1574.6318	1671.6409	-97.0091
1967	1632.3799	1688.2829	-55.9030
1968	1690.6460	1752.7704	-62.1244
1969	1712.8289	1777.7333	-64.9045
1970	1762.5168	1750.6902	11.8267
1971	1859.9868	1869.2640	-9.2772
1972	1967.6199	1931.6713	35.9486
1973	2090.7478	2006.5600	84.1878
1974	2164.0598	2037.7636	126.2962
1975	2245.1379	2014.8810	230.2570
1976	2350.1460	2185.4609	164.6851
1977	2449.7178	2247.8681	201.8496
1978	2543.8899	2331.0778	212.8121
1979	2605.4968	2391.4049	214.0920
1980	2592.7139	2670.1574	-77.4435
1981	2593.4468	2672.2376	-78.7908
1982	2615.3408	2682.6388	-67.2980
1983	2620.8240	2780.4102	-159.5863
1984	2576.5588	2799.1324	-222.5736

EQUATION NO. 2

TVR = 0.6293 (TPO)

	TVR	*PRED	*RESID
1964	1418.8208	1993.9301	-575.1093
1965	1499.9719	1997.7053	-497.7334
1966	1574.6318	2001.4805	-426.8487
1967	1632.3799	2006.5141	-374.1342
1968	1690.6460	2026.0193	-335.3733
1969	1712.8289	2033.5696	-320.7408
1970	1762.5168	2025.3901	-262.8732
1971	1859.9868	2061.2544	-201.2676
1972	1967.6199	2080.1303	-112.5105
1973	2090.7478	2102.7815	-12.0337
1974	2164.0598	2112.2195	51.8404
1975	2245.1379	2105.2983	139.8397
1976	2350.1460	2156.8926	193.2534
1977	2449.7178	2175.7685	273.9493
1978	2543.8899	2200.9364	342.9534
1979	2605.4968	2219.1832	386.3136
1980	2592.7139	2303.4958	289.2181
1981	2593.4468	2304.1250	289.3218
1982	2615.3408	2307.2710	308.0698
1983	2620.8240	2336.8433	283.9806
1984	2576.5588	2342.5061	234.0527

EQUATION NO. 3

TVR = 1389.23734 + .04364 (PIC)

R^2 = .90

	TVR	*PRED	*RESID
1964	1418.8208	1641.4918	-222.6710
1965	1499.9719	1672.8654	-172.8935
1966	1574.6318	1700.9228	-126.2910
1967	1632.3799	1726.8421	-94.4622
1968	1690.6460	1760.8338	-70.1878
1969	1712.8289	1790.7675	-77.9386
1970	1762.5168	1825.5883	-63.0714
1971	1859.9868	1860.4964	-0.5095
1972	1967.6199	1908.4950	59.1249
1973	2090.7478	1969.5841	121.1637
1974	2164.0598	2035.0367	129.0231
1975	2245.1379	2113.5799	131.5580
1976	2350.1460	2200.8501	149.2959
1977	2449.7178	2288.1203	161.5975
1978	2543.8899	2397.2080	146.6819
1979	2605.4968	2510.6593	94.8376
1980	2592.7139	2606.6565	-13.9426
1981	2593.4468	2741.9253	-148.4785
1982	2615.3408	2820.4684	-205.1276
1983	2620.8240	2872.8305	-252.0066
1984	2576.5588		

EQUATION NO. 4

TVR = .10754 (PIC)

	TVR	*PRED	*RESID
1964	1418.8208	621.6714	797.1494
1965	1499.9719	698.9906	800.9814
1966	1574.6318	768.1369	806.4950
1967	1632.3799	832.0138	800.3660
1968	1690.6460	915.7852	774.8608
1969	1712.8289	989.5556	723.2733
1970	1762.5168	1075.3701	687.1468
1971	1859.9868	1161.3997	698.5871
1972	1967.6199	1279.6904	687.9295
1973	2090.7478	1430.2422	660.5056
1974	2164.0598	1591.5477	572.5121
1975	2245.1379	1785.1143	460.0236
1976	2350.1460	2000.1884	349.9576
1977	2449.7178	2215.2624	234.4554
1978	2543.8899	2484.1049	59.7850
1979	2605.4968	2763.7011	-158.2043
1980	2592.7139	3000.2825	-407.5687
1981	2593.4468	3333.6473	-740.2005
1982	2615.3408	3527.2139	-911.8731
1983	2620.8240	3656.2583	-1035.4343
1984	2576.5588		

EQUATION NO. 5

TVR = 287.86656 + .14245 (PCC)

R^2 = .98

	TVR	*PRED	*RESID
1964	1418.8208	1409.5042	9.3166
1965	1499.9719	1485.5716	14.4003
1966	1574.6318	1561.2116	13.4202
1967	1632.3799	1629.3019	3.0780
1968	1690.6460	1697.6771	-7.0311
1969	1712.8289	1770.8955	-58.0666
1970	1762.5168	1828.3021	-65.7853
1971	1859.9868	1835.5663	-25.5795
1972	1967.6199	1992.2601	-24.6402
1973	2090.7478	2104.2244	-13.4766
1974	2164.0598	2175.7335	-11.6737
1975	2245.1379	2176.0184	69.1196
1976	2350.1460	2297.6692	52.4768
1977	2449.7178	2407.0695	42.6483
1978	2543.8899	2479.8605	64.0294
1979	2605.4968	2554.0761	51.4208
1980	2592.7139	2515.6150	77.0988
1981	2593.4468	2592.2522	1.1946
1982	2615.3408	2610.3431	4.9977
1983	2620.8240	2615.3288	5.4951
1984	2576.5588	2779.0019	-202.4431

EQUATION NO. 6

TVR = .16370 (PCC)

	TVR	*PRED	*RESID
1964	1418.8208	1288.9973	129.8235
1965	1499.9719	1376.4147	123.5572
1966	1574.6318	1463.3410	111.2908
1967	1632.3799	1541.5911	90.7888
1968	1690.6460	1620.1685	70.4775
1969	1712.8289	1704.3118	8.5170
1970	1762.5168	1770.2841	-7.7673
1971	1859.9868	1836.0927	23.8941
1972	1967.6199	1958.7063	8.9136
1973	2090.7478	2087.3768	3.3710
1974	2164.0598	2169.5557	-5.4959
1975	2245.1379	2169.8831	75.2548
1976	2350.1460	2309.6855	40.4605
1977	2449.7178	2435.4094	14.3084
1978	2543.8899	2519.0616	24.8283
1979	2605.4968	2604.3509	1.1460
1980	2592.7139	2560.1511	32.5628
1981	2593.4468	2648.2233	-54.7765
1982	2615.3408	2669.0136	-53.6727
1983	2620.8240	2674.7432	-53.9192
1984	2576.5588	2862.8379	-286.2791

EQUATION NO. 7

TVM = 51759.03 + 21.611 (TPO)

R^2 = .78

	TVM	*PRED	*RESID
1964	13114.0000	16727.1517	-3613.1517
1965	13969.0000	16856.8195	-2887.8195
1966	14773.0000	16986.4872	-2213.4872
1967	15741.0000	17159.3776	-1418.3776
1968	15691.0000	17829.3276	-2138.3276
1969	17866.0000	18088.6631	-222.6631
1970	18897.0000	17857.7163	1039.2837
1971	20355.0000	19039.5600	1315.4400
1972	21775.0000	19687.8987	2087.1013
1973	23096.0000	20465.9053	2630.0947
1974	22543.0000	20790.0747	1752.9253
1975	23372.0000	20552.3504	2819.6496
1976	24843.0000	22324.4764	2518.5236
1977	25732.0000	22972.8152	2759.1848
1978	26607.0000	23837.2669	2769.7331
1979	25994.0000	24463.9943	1530.0057
1980	25244.0000	27359.9075	-2115.9075
1981	25195.0000	27331.5188	-2136.5188
1982	25627.0000	27479.5753	-1852.5753
1983	26719.0000	28505.3060	-1736.3060
1984	27874.0000	28699.8076	-826.8076

EQUATION NO. 8

TVM = 6.42517 (TPO)

	TVM	*PRED	*RESID
1964	13114.0000	20361.3709	-7247.3709
1965	13969.0000	20399.9220	-6430.9220
1966	14773.0000	20408.4730	-5635.4730
1967	15741.0000	20439.8744	-4698.8744
1968	15691.0000	20689.0547	-4998.0547
1969	17866.0000	20756.1568	-2890.1568
1970	18897.0000	20632.6295	-1735.6295
1971	20355.0000	21048.8644	-693.8644
1972	21775.0000	21241.6195	533.3805
1973	23096.0000	21472.9257	1623.0743
1974	22543.0000	21569.3033	973.6967
1975	23372.0000	21498.6264	1873.3736
1976	24843.0000	22025.4905	2817.5095
1977	25732.0000	22218.2457	3513.7543
1978	26607.0000	22475.2526	4131.7474
1979	25994.0000	22661.5826	3332.4174
1980	25244.0000	23522.5557	1721.4443
1981	25195.0000	23528.9809	1656.0191
1982	25627.0000	23561.1067	2065.8933
1983	26719.0000	23863.0898	2855.9102
1984	27873.0000	23920.9164	3952.0836

EQUATION NO. 9

TVM = 14228.58 + .4428 (PIC)

R^2 = .76

	TVM	*PRED	*RESID
1964	13114.0000	16788.6655	-3674.6655
1965	13969.0000	17107.0708	-3138.0708
1966	14779.0000	17391.8198	-2613.8198
1967	15741.0000	17654.8695	-1913.8695
1968	15691.0000	17929.8454	-2238.8454
1969	17866.0000	18303.6368	-437.6368
1970	19897.0000	18657.0267	239.9733
1971	20355.0000	19011.3024	1343.6976
1972	21775.0000	19498.4414	2276.5586
1973	23096.0000	20118.4138	2977.5862
1974	22543.0000	20782.6806	1760.3194
1975	23372.0000	21579.8008	1792.1992
1976	24843.0000	22465.4900	2377.5100
1977	25732.0000	23351.1791	2380.8209
1978	26607.0000	24458.2905	2148.7095
1979	25994.0000	25609.8864	384.1136
1980	25244.0000	26583.9444	-1339.9444
1981	25195.0000	27956.7625	-2761.7625
1982	25627.0000	28753.9328	-3126.9328
1983	26719.0000	29235.2962	-2516.2962
1984	27874.0000	-0.1000D 08	-0.1000D 08

EQUATION NO. 10

TVM = 1.09661 (PK)

	TVM	*PRED	*RESID
1964	13114.0000	6[illegible]9.4926	6774.5074
1965	13960.0000	7127.9540	6841.0460
1966	14775.0000	7843.0731	6931.9269
1967	15741.0000	8484.4585	7256.5415
1968	15691.0000	9[illegible]8.7163	6[illegible]52.2837
1969	17866.0000	10090.[illegible]396	7775.0104
1970	18897.0000	10956.0631	7930.9169
1971	20355.0000	11843.3697	8511.6303
1972	21775.0000	13049.6[illegible]88	8725.[illegible]512
1973	23096.0000	14584.8[illegible]05	8511.1095
1974	22545.0000	16220.8029	6[illegible]13.1971
1975	23372.0000	18203.6979	5168.3021
1976	24843.0000	20[illegible]96.9145	4446.0855
1977	25732.0000	22590.1[illegible]11	3141.[illegible]689
1978	26607.0000	25331.[illegible]519	1275.3481
1979	25994.0000	28132.[illegible]834	-2138.[illegible]834
1980	25244.0000	30595.3717	-5351.3717
1981	25195.0000	33924.[illegible]875	-8729.[illegible]875
1982	25627.0000	35968.7524	-10341.7524
1983	26719.0000	37284.6824	-10565.6824
1984	27873.0000	-0.10000 08	-0.10000 08

EQUATION NO. 11

TVM = 1693.08 + 1.5511 (PCC)

R^2 = .95

	TVM	*PRED	*RESID
1964	13114.0000	13906.6577	-792.6577
1965	13969.0000	14724.3593	-755.3593
1966	14773.0000	15558.6076	-785.6076
1967	15741.0000	16300.0462	-559.0462
1968	15691.0000	17044.5870	-1353.5870
1969	17866.0000	17841.9761	24.1239
1970	18897.0000	18466.9702	430.0298
1971	20355.0000	19090.5231	1264.4769
1972	21775.0000	20252.3170	1522.6830
1973	23095.0000	21471.5926	1624.4074
1974	22542.0000	22250.1582	292.8418
1975	23372.0000	22253.2794	1118.7206
1976	24843.0000	23577.9326	1265.0674
1977	25752.0000	24799.1979	952.8021
1978	26607.0000	25561.8237	1045.1763
1979	25994.0000	26369.9607	-375.9607
1980	25244.0000	25951.1365	-707.1365
1981	25105.0000	26735.6626	-1630.6626
1982	25627.0000	26982.5557	-1355.6557
1983	26719.0000	27036.9452	-317.9452
1984	27873.0000	28819.1307	-946.1307

EQUATION NO. 12

TVM = 1.67614 (PCC)

	TVM	*PRED	*RESID
1964	13114.0000	13127.8969	-33.8969
1965	13969.0000	14092.9537	-123.9537
1966	14773.0000	14982.9820	-209.9820
1967	15741.0000	15784.1751	-43.1751
1968	15691.0000	16588.7205	-897.7205
1969	17366.0000	17450.2546	415.7454
1970	18897.0000	18125.7375	771.2625
1971	20355.0000	18799.5443	1555.4557
1972	21775.0000	20054.9703	1720.0297
1973	23096.0000	21372.4134	1723.5866
1974	22543.0000	22213.8338	329.1662
1975	23372.0000	22217.1861	1154.8139
1976	24843.0000	23648.6065	1194.3935
1977	25752.0000	24955.8791	796.1209
1978	26607.0000	25792.3847	814.6153
1979	25094.0000	26655.6517	-671.6517
1980	25244.0000	26213.0249	-969.0249
1981	25195.0000	27114.8562	-1919.8562
1982	25627.0000	27327.7256	-1700.7256
1983	26719.0000	27386.3903	-667.3903
1984	27873.0000	29312.2709	-1439.2709

EQUATION NO. 13

TVM = -4772.14 + 13.6443 (TVR) - 36.3638 (FPC)

R^2 = .97

	TVM	*PRED	*RESID
1964	13114.0000	13557.4267	-243.4267
1965	13969.0000	14464.6803	-495.6803
1966	14773.0000	15483.3656	-710.3656
1967	15741.0000	16215.0568	-474.0568
1968	15691.0000	16993.7765	-1302.7765
1969	17866.0000	17296.4473	569.5527
1970	18897.0000	17971.8816	925.1184
1971	20355.0000	19231.7951	1123.2049
1972	21775.0000	20627.8516	1147.1484
1973	23096.0000	21672.6978	1423.3022
1974	22543.0000	22727.9408	-184.9408
1975	23372.0000	23725.4100	-353.4100
1976	24843.0000	24940.5091	-97.5091
1977	25732.0000	26190.4020	-458.4020
1978	26607.0000	27330.2674	-723.2674
1979	25994.0000	27043.0509	-1049.0509
1980	25241.0000	25987.4309	-743.4309
1981	25195.0000	25573.2061	-378.2061
1982	25527.0000	26032.2601	-455.2601
1983	26719.0000	26244.1051	474.8949
1984	27873.0000	25716.2880	2156.7120

EQUATION NO. 14

TVM = 10.6254 (TVR) - 11.4695 (FPC)

	TVM	*PRED	*RESID
1964	13114.0000	14686.7888	-1572.7888
1965	13969.0000	15549.0557	-1580.0557
1966	14773.0000	16332.3506	-1559.3506
1967	15741.0000	16944.4799	-1203.4799
1968	15691.0000	17552.1138	-1861.1138
1969	17866.0000	17787.8166	78.1834
1970	18897.0000	18292.8347	604.1653
1971	20355.0000	19328.4967	1026.5033
1972	21775.0000	20449.2070	1325.7930
1973	23096.0000	21619.8624	1476.1376
1974	22543.0000	22452.9573	190.0427
1975	23372.0000	23180.0401	191.9599
1976	24843.0000	24226.9807	616.0193
1977	25732.0000	25260.5668	471.4332
1978	26607.0000	26205.3096	401.6904
1979	25994.0000	26503.2098	-509.2098
1980	25244.0000	26058.6769	-814.6769
1981	25195.0000	25952.2713	-757.2713
1982	25627.0000	26261.4283	-634.4283
1983	26719.0000	26347.2161	371.7839
1984	27873.0000	25900.9651	1972.0349

EQUATION NO. 15

TFC = 202.894 + .0705 (TVM)

R^2 = .98

	TFC	*PRED	*RESID
1965	1107.1108	1127.8555	-20.7447
1966	1158.9187	1188.1607	-29.2420
1967	1293.4626	1313.1441	-19.6814
1968	1373.4180	1309.6175	63.8005
1969	1455.9109	1463.0254	-7.1145
1970	1548.4286	1545.7443	2.6793
1971	1633.7217	1638.5805	-4.8588
1972	1748.3735	1738.7365	9.6371
1973	1847.3286	1831.9097	15.4189
1974	1812.0068	1792.9053	19.1015
1975	1876.6899	1851.3767	25.2632
1976	1993.3628	1955.1298	38.2330
1977	2062.2007	2017.8331	44.3676
1978	2137.0007	2079.5489	57.4518
1979	2070.3938	2036.3126	34.0812
1980	1980.8438	1983.4133	-2.5695
1981	1987.8548	1979.9572	7.8976
1982	1982.0236	2010.4272	-28.3986
1983	2025.2747	2037.4485	-12.1739
1984	2049.3738	2168.8429	-118.4691

EQUATION NO. 16

TFC = .07948 (TVM)

	TFC	*PRED	*RESID
1964	1107.1108	1042.3411	54.7697
1965	1158.9187	1110.2992	48.6195
1966	1220.7207	1174.2036	46.5171
1967	1293.4626	1251.1432	42.3195
1968	1373.4180	1247.1590	126.2489
1969	1455.9109	1420.0447	35.8662
1970	1538.4236	1501.9918	36.4318
1971	1633.7217	1617.8781	15.8436
1972	1748.3735	1730.7441	17.6294
1973	1847.3286	1835.7412	11.5874
1974	1812.0068	1791.7871	20.2197
1975	1876.6409	1857.6786	18.9613
1976	1993.3328	1974.5982	18.7346
1977	2062.2007	2045.2586	16.9420
1978	2137.0007	2114.8063	22.1944
1979	2070.3938	2066.0832	4.3106
1980	1980.8468	2006.4709	-25.6272
1981	1987.8538	2002.5762	-14.7225
1982	1982.0236	2036.9129	-54.8844
1983	2025.2747	2123.7084	-98.4338
1984	2060.6738	2215.4319	-155.5581

EQUATION NO. 17

$MFT = -5078.3133 + .00096921\ (TFC)\ [.75\ (XG2) + .25\ (XGM)]$

$R^2 = .98$

	MFT	*PRED	*RESID
1964	74582.0000	75398.0139	-816.0139
1965	77866.9375	79163.9595	-1297.0220
1966	83560.9375	83656.3597	-95.4222
1967	88916.9375	88943.9893	-27.0518
1968	94778.9375	94755.9669	22.9706
1969	0.1016E 06	0.1008D 06	837.5498
1970	0.1071E 06	0.1068D 06	301.6553
1971	0.1139E 06	0.1137D 06	258.4088
1972	0.1364E 06	0.1559D 06	-19512.3473
1973	0.1738E 06	0.1650D 06	8801.3124
1974	0.1635E 06	0.1618D 06	1743.5945
1975	0.1752E 06	0.1677D 06	7445.5945
1976	0.1805E 06	0.1785D 06	2039.1354
1977	0.1858E 06	0.1848D 06	1029.0795
1978	0.1928E 06	0.1917D 06	1064.9664
1979	0.1885E 06	0.1856D 06	2913.7899
1980	0.1881E 06	0.1773D 06	10814.0315
1981	0.1930E 06	0.1991D 06	-6121.4052
1982	0.1963E 06	0.1966D 06	-375.0446
1983	0.1972E 06	0.2010D 06	-3854.9823
1984	0.1993E 06	0.2045D 06	-5222.7994

EQUATION NO. 18

MFT = .00093972 (TFC) [.75 (XG2) + .25 (XGM)]

	MFT	*PRED	*RESID
1964	74582.0000	78028.4268	-3446.4268
1965	77866.9375	81679.8212	-3812.8837
1966	83560.9375	86035.5731	-2474.6356
1967	88916.9375	91162.3655	-2245.4280
1968	94778.9375	96797.5564	-2018.6189
1969	0.1016E 06	0.1026D 06	-971.6408
1970	0.1071E 06	0.1084D 06	-1375.0935
1971	0.1139E 06	0.1151D 06	-1207.6294
1972	0.1364E 06	0.1561D 06	-19694.0079
1973	0.1738E 06	0.1649D 06	8896.7954
1974	0.1635E 06	0.1618D 06	1740.1508
1975	0.1752E 06	0.1675D 06	7623.1681
1976	0.1805E 06	0.1780D 06	2543.5301
1977	0.1858E 06	0.1841D 06	1726.3524
1978	0.1928E 06	0.1908D 06	1971.7309
1979	0.1885E 06	0.1848D 06	3634.0083
1980	0.1881E 06	0.1768D 06	11233.4472
1981	0.1930E 06	0.1980D 06	-4937.7138
1982	0.1963E 06	0.1956D 06	682.0119
1983	0.1972E 06	0.1998D 06	-2664.0578
1984	0.1993E 06	0.2032D 06	-3925.5118

EQUATION NO. 19

TVF = -33056.02642 + 31.70658 (TVR)

R^2 = .96

	TVF	*PRED	*RESID
1964	11323.0000	11929.9314	-606.9314
1965	11983.0000	14502.9561	-2519.9561
1966	12714.0000	16870.1667	-4156.1667
1967	16151.0000	18701.1599	-2550.1599
1968	16689.0000	20548.5792	-3859.5792
1969	27052.9883	21251.9219	5801.0664
1970	28236.9883	22827.3581	5409.6301
1971	29670.9883	25917.7977	3753.1905
1972	31502.9883	29330.4741	2172.5142
1973	33534.9883	33234.4398	300.5484
1974	36742.0000	35558.9131	1183.0869
1975	38456.9883	38129.6233	327.3649
1976	39726.9883	41459.0699	-1732.0816
1977	42086.0000	44616.1506	-2530.1506
1978	46364.0000	47602.0266	-1238.0266
1979	48356.0000	49555.3719	-1199.3719
1980	47816.9883	49150.0679	-1333.0797
1981	48254.0000	49173.3060	-919.3060
1982	48816.9883	49867.4913	-1050.5030
1983	52780.0000	50041.3434	2738.6566
1984	50647.1016	48637.8472	2009.2544

EQUATION NO. 20

TVF = 16.72132 (TVR)

	TVF	*PRED	*RESID
1964	11323.0000	23724.5605	-12401.5605
1965	11983.0000	25081.5146	-13098.5146
1966	12714.0000	26329.9271	-13615.9271
1967	16151.0000	27295.5508	-11144.5508
1968	16689.0000	28269.8373	-11580.8373
1969	27052.9883	28640.7641	-1587.7758
1970	28236.9883	29471.6130	-1234.6247
1971	29670.9883	31101.4398	-1430.4515
1972	31502.9883	32901.2069	-1398.2186
1973	33534.9883	34960.0687	-1425.0805
1974	36742.0000	36185.9425	556.0575
1975	38456.9883	37541.6760	915.3122
1976	39726.9883	39297.5496	429.4386
1977	42086.0000	40962.5215	1123.4785
1978	46364.0000	42537.2039	3826.7961
1979	48356.0000	43567.3533	4788.6467
1980	47816.9883	43353.6053	4463.3830
1981	48254.0000	43365.8605	4888.1395
1982	48816.9883	43731.9579	5085.0304
1983	52780.0000	43823.6435	8956.3565
1984	50647.1016	43083.4718	7563.6297

EQUATION NO. 21

TVF = -26878.34429 + 25.1202746 (ATR) + 39.61433604 (TRR)

R^2 = .96

	TVF	*PRED	*RESID
1964	11323.0000	12733.0024	-1410.0024
1965	11983.0000	15012.8641	-3029.8641
1966	12714.0000	17101.1287	-4387.1287
1967	16151.0000	18760.3132	-2609.3132
1968	16689.0000	20562.3451	-3873.3451
1969	27052.9883	21252.6738	5800.3145
1970	28236.9883	22761.8432	5475.1451
1971	29670.9883	25593.0945	4077.8938
1972	31502.9883	28831.4481	2671.5402
1973	33534.9883	32504.0241	1030.9642
1974	36742.0000	35062.8084	1679.1916
1975	38456.9883	37553.5076	903.4807
1976	39726.9883	40968.0312	-1241.0429
1977	42086.0000	44250.7200	-2164.7200
1978	46364.0000	47488.9786	-1124.9786
1979	48356.0000	49791.0237	-1435.0237
1980	47816.9883	49372.7505	-1555.7623
1981	48254.0000	49481.1994	-1227.1994
1982	48816.9883	50217.3190	-1400.3307
1983	52780.0000	50375.7359	2404.2641
1984	50647.1016	49231.1848	1415.9167

EQUATION NO. 22

TVF = 14.57425 (ATR) + 23.0270 (TRR)

	TVF	*PRED	*RESID
1964	11323.0000	22931.6667	-11658.6667
1965	11983.0000	24304.3943	-12321.3943
1966	12714.0000	25515.9613	-12801.9613
1967	16151.0000	26478.5850	-10327.5850
1968	16689.0000	27524.0859	-10835.0859
1969	27052.9883	27924.6000	-871.6117
1970	28236.9883	28800.1883	-563.2000
1971	29670.9883	30442.8204	-771.8321
1972	31502.9883	32321.6448	-818.6565
1973	33534.9883	34452.3958	-917.4075
1974	36742.0000	35936.9484	805.0516
1975	38456.9883	37381.9995	1074.9888
1976	39726.9883	39363.0339	363.9544
1977	42086.0000	41267.5806	818.4194
1978	46364.0000	43146.3499	3217.6501
1979	48356.0000	44481.9478	3874.0522
1980	47816.9883	44239.2746	3577.7137
1981	48254.0000	44302.1943	3951.8057
1982	48816.9883	44729.2753	4037.7129
1983	52780.0000	44821.1855	7958.8145
1984	50647.1016	44157.1411	6489.9604

EQUATION NO. 23

UTR = -592200 + 193.66295 (TPO)

R^2 = .88

	UTR	*PRED	*RESID
1964	11660.7617	21514.5848	-9853.8231
1965	13977.9063	22676.5625	-8698.6562
1966	14123.2227	23838.5401	-9715.3175
1967	13795.0039	25387.8437	-11592.8398
1968	28172.8633	31391.3950	-3218.5317
1969	34870.5742	33715.3504	1155.2239
1970	34243.2461	31197.7321	3045.5140
1971	40897.4844	42236.5200	-1339.0356
1972	48362.5898	48046.4083	316.1815
1973	58863.3594	55018.2744	3845.0850
1974	59766.5898	57923.2186	1843.3713
1975	65502.5430	55792.9262	9709.6168
1976	82775.0000	71673.2877	11101.7123
1977	0.1016E 06	77483.1760	24068.4490
1978	0.1143E 06	85229.6939	29112.6186
1979	0.1084E 06	90845.9193	17578.6432
1980	89720.0000	0.1168D 06	-27076.7540
1981	98005.3125	0.1170D 06	-18935.1044
1982	0.1023E 06	0.1180D 06	-15617.1066
1983	0.1191E 06	0.1271D 06	-8004.1401
1984	0.1411E 06	0.1288D 06	12324.8934

EQUATION NO. 24

UTR = 19.91098 (TPO)

	UTR	*PRED	*RESID
1964	11660.7617	63095.6660	-51434.9043
1965	13977.9063	63215.1277	-49237.2214
1966	14123.2227	63334.5893	-49211.3667
1967	13795.0039	63493.8715	-49698.8676
1968	28172.8633	64111.0901	-35938.2268
1969	34870.5742	64350.0134	-29479.4392
1970	34243.2461	64091.1798	-29847.9337
1971	40897.4844	65226.0656	-24328.5812
1972	48362.5898	65823.3739	-17460.7840
1973	58863.3594	66540.1438	-7676.7844
1974	59766.5898	66838.7980	-7072.2081
1975	65502.5430	66619.7849	-1117.2420
1976	82775.0000	68252.4276	14522.5724
1977	0.1016E 06	68849.7359	32701.8891
1978	0.1143E 06	69646.1469	44696.1656
1979	0.1084E 06	70223.5450	38201.0175
1980	89720.0000	72891.5220	16828.4780
1981	98005.3125	72911.4323	25093.8802
1982	0.1023E 06	73010.9837	29330.6413
1983	0.1191E 06	73946.7667	45109.9333
1984	0.1411E 06	74125.9591	67002.7909

EQUATION NO. 25

UTR = -1752.74494 + 4.02063 (PIC)

R^2 = .87

	UTR	*PRED	*RESID
1964	11660.7617	21490.5190	-9829.7573
1965	13977.9063	24381.3522	-10403.4460
1966	14123.2227	26966.6175	-12843.3949
1967	13795.0039	29354.8719	-15559.8680
1968	28172.8633	32486.9430	-4314.0797
1969	34870.5742	35245.0954	-374.5211
1970	34243.2461	38453.5584	-4210.3123
1971	40897.4844	41670.0626	-772.5783
1972	48362.5898	46092.7560	2269.8338
1973	58863.3594	51721.6385	7141.7209
1974	59766.5898	57752.5840	2014.0059
1975	65502.5430	64989.7185	512.8244
1976	82775.0000	73030.9792	9744.0208
1977	0.1016E 06	81072.2399	20479.3351
1978	0.1143E 06	91123.8157	23218.4968
1979	0.1084E 06	0.1016D 06	6847.1079
1980	89720.0000	0.1104D 06	-20702.8413
1981	98005.3125	0.1229D 06	-24881.4828
1982	0.1023E 06	0.1301D 06	-27782.3049
1983	0.1191E 06	0.1349D 06	-15891.9363
1984	0.1411E 06		

EQUATION NO. 26

UTR = 3.94325 (PIC)

	UTR	*PRED	*RESID
1964	11660.7617	22795.9312	-11135.1695
1965	13977.9063	25631.1284	-11653.2221
1966	14123.2227	28166.6385	-14043.4158
1967	13795.0039	30508.9293	-16713.9254
1968	28172.8633	33580.7214	-5407.8581
1969	34870.5742	36.285.7913	-1415.2171
1970	34243.2461	39432.5052	-5189.2591
1971	40897.4844	42587.1056	-1689.6212
1972	48362.5898	46924.6812	1437.9087
1973	58863.3594	52445.2319	6418.1275
1974	59766.5898	58360.1077	1406.4822
1975	65502.5430	65457.9586	44.5844
1976	82775.0000	73344.4596	9430.5404
1977	0.1016E 06	81230.9607	20320.6643
1978	0.1143E 06	91089.0870	23253.2255
1979	0.1084E 06	0.1013D 06	7083.0242
1980	89720.0000	0.1100D 06	-20296.6895
1981	98005.3125	0.1222D 06	-24235.4536
1982	0.1023E 06	0.1293D 06	-26996.9920
1983	0.1191E 06	0.1341D 06	-15013.7676
1984	0.1411E 06		

EQUATION NO. 27

UTR = -103510 + 13.14705 (PCC)

R^2 = .95

	UTR	*PRED	*RESID
1964	11660.7617	6.8157	11653.9460
1965	13977.9063	7027.3380	6950.5682
1966	14123.2227	14008.4192	114.8035
1967	13795.0039	20292.7069	-6497.7030
1968	28172.8633	26603.2888	1569.5745
1969	34870.5742	33360.8701	1509.7041
1970	34243.2461	38659.1295	-4415.8834
1971	40897.4844	43944.2418	-3046.7574
1972	48362.5898	53791.3788	-5428.7890
1973	58863.3594	64124.9566	-5261.5972
1974	59766.5898	70724.7734	-10958.1836
1975	65502.5430	70751.0675	-5248.5245
1976	82775.0000	81978.6443	796.3557
1977	0.1016E 06	92075.5753	9476.0497
1978	0.1143E 06	98793.7155	15548.5970
1979	0.1084E 06	0.1056D 06	2781.2363
1980	89720.0000	0.1021D 06	-12373.6239
1981	98005.3125	0.1092D 06	-11161.4219
1982	0.1023E 06	0.1108D 06	-8494.7842
1983	0.1191E 06	0.1113D 06	7760.1942
1984	0.1411E 06	0.1264D 06	14726.2390

EQUATION NO. 28

UTR = 5.50413 (PCC)

	UTR	*PRED	*RESID
1964	11660.7617	43339.5030	-31678.7413
1965	13977.9063	46278.7073	-32300.8010
1966	14123.2227	49201.3992	-35078.1765
1967	13795.0039	51832.3723	-38037.3684
1968	28172.8633	54474.3537	-26301.4904
1969	34870.5742	57303.4754	-22432.9012
1970	34243.2461	59521.6390	-25278.3929
1971	40897.4844	61734.2984	-20836.8140
1972	48362.5898	65856.8902	-17494.3003
1973	58863.3594	70183.1347	-11319.7753
1974	59766.5898	72946.2069	-13179.6170
1975	65502.5430	72957.2151	-7454.6722
1976	82775.0000	77657.7403	5117.2597
1977	0.1016E 06	81834.9106	19666.7144
1978	0.1143E 06	84697.5199	29644.7926
1979	0.1084E 06	87565.1705	20859.3920
1980	89720.0000	86079.0560	3640.9440
1981	98005.3125	89040.2768	8965.0357
1982	0.1023E 06	89739.3010	12602.3240
1983	0.1191E 06	89931.9455	29124.8045
1984	0.1411E 06	96256.1885	44872.5615

EQUATION NO. 30

MSC = -26607.04 + 9.1378 (TPO)

R^2 = .50

	MSC	*PRED	*RESID
1964	5922.2383	2350.6176	3571.6207
1965	3265.1088	2405.4444	859.6594
1966	3575.7750	2460.2711	1115.5048
1967	1310.0000	2533.3734	-1223.3734
1968	2312.1438	2816.6450	-504.5012
1969	2483.4238	2926.2985	-442.8746
1970	2512.7520	2807.5072	-294.7552
1971	2563.5198	3328.3613	-764.8415
1972	3241.4080	3602.4430	-361.0371
1973	3903.6479	3931.4555	-27.8075
1974	3976.3909	4068.5224	-92.1225
1975	3916.4639	3968.0067	-51.5428
1976	3950.9758	4717.3055	-766.3297
1977	3815.3118	4991.4393	-1176.1275
1978	3816.6719	5356.9509	-1540.2791
1979	3663.3918	5621.9469	-1958.5550
1980	5189.0727	6846.4109	-1657.4382
1981	5054.6523	6855.5487	-1800.8963
1982	11622.3359	6901.2376	4721.0983
1983	6581.1992	7330.7138	-749.5146
1984	10567.1172	7412.9540	3154.1632

EQUATION NO. 31

MSC = -1972.76199 + .49795 (PCC)

R^2 = .35

	MSC	*PRED	*RESID
1964	5922.2383	1948.1222	3974.1161
1965	3265.1038	2214.0292	1051.0745
1966	3575.7759	2478.4424	1097.3334
1967	1310.0000	2716.4641	-1406.4641
1968	2312.1438	2955.4817	-643.3379
1969	2483.4238	3211.4297	-728.0059
1970	2512.7520	3412.1049	-899.3529
1971	2563.5198	3612.2821	-1048.7623
1972	3241.4080	3985.2491	-743.8411
1973	3903.6479	4376.6404	-472.9924
1974	3976.3999	4626.6129	-650.2130
1975	3916.4639	4627.6088	-711.1450
1976	3950.9758	5052.8609	-1101.8851
1977	3815.3118	5435.2891	-1619.9773
1978	3816.6719	5689.7432	-1873.0713
1979	3653.3918	5949.1769	-2295.7850
1980	5188.9727	5814.7295	-625.7568
1981	5054.6523	6082.6283	-1027.9760
1982	11622.3359	6145.8684	5476.4675
1983	6581.1992	6163.2968	417.9025
1984	10567.1172	6735.4451	3831.6721

EQUATION NO. 32

MSC = -2274.96374 + 3.1692 (TVR)

R^2 = .29

	MSC	*PRED	*RESID
1964	5922.2383	2214.0652	3708.1731
1965	3265.1038	2470.8205	794.2833
1966	3575.7759	2707.0381	868.7378
1967	1310.0000	2889.7480	-1579.7480
1968	2312.1438	3074.0971	-761.9533
1969	2483.4238	3144.2818	-660.8579
1970	2512.7520	3301.4904	-788.7384
1971	2563.5198	3609.8771	-1046.3573
1972	3241.4080	3950.4190	-709.0110
1973	3903.6479	4339.9853	-436.3374
1974	3976.3999	4571.9383	-595.5384
1975	3916.4639	4828.4627	-911.9988
1976	3950.9758	5160.6993	-1209.7234
1977	3815.3118	5475.7359	-1660.4242
1978	3816.6719	5773.6885	-1957.0167
1979	3653.3918	5968.6077	-2315.2158
1980	5188.9727	5928.1635	-739.1908
1981	5054.6523	5930.4823	-875.8300
1982	11622.3359	5999.7532	5622.5827
1983	6581.1992	6017.1015	564.0978
1984	10567.1172	5877.0503	4690.0669

EQUATION NO. 33

MSC = -1188.173 + 0.2597 (TVM)

R^2 = .24

	MSC	*PRED	*RESID
1964	5922.2[illegible]	2217.9519	3704.2765
1965	3265.1038	2440.0233	825.0705
1966	3575.7759	2648.8584	926.9175
1967	1310.0000	2900.2797	-1590.2797
1968	2312.1458	2887.2930	-575.1492
1969	2483.4238	3452.2117	-968.7879
1970	2512.7520	3719.9961	-1207.2442
1971	2561.5198	4003.6864	-1565.1666
1972	3241.4080	4467.5069	-1226.0989
1973	3903.6479	4810.6138	-906.9658
1974	3076.3999	4696.9816	-620.5817
1975	3916.4639	4832.3000	-915.8362
1976	3950.9758	5264.3669	-1313.3910
1977	3815.3118	5495.2592	-1679.9575
1978	3816.6719	5722.5654	-1905.8935
1979	3653.3018	5563.3192	-1909.9274
1980	5188.9727	5358.5197	-170.5470
1981	5054.6523	5455.7928	-401.1404
1982	11622.3359	5467.9973	6154.3386
1983	6581.1092	5751.6254	829.5738
1984	10567.1172	6051.3570	4515.7602

APPENDIX E

FUEL-PRICE AND FUEL-TAX SCENARIOS WITH POPULATION AS PRIMARY INPUT VARIABLE

TABLE E-1. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 1

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,798	28,238	2,244	221,417	55,657	128,796	31,401	7,414	444,685
1990	3,503	35,732	2,840	280,222	78,021	194,455	53,679	10,512	616,890
1995	4,005	41,058	3,263	321,991	93,915	241,128	69,492	12,741	739,240
2000	4,421	45,478	3,615	356,655	107,104	279,860	82,615	14,541	840,776
2005	4,774	49,235	3,913	386,118	118,316	312,783	93,770	16,095	927,081

SCENARIO CONDITIONS: Population = projections by the Urban Studies Center, University of Louisville

Year	Population (Thousands)
1984	3,723
1990	4,062
1995	4,303
2000	4,503
2005	4,673

Fuel Price = constant at $1.30 per gallon

Fuel Tax = constant at $0.10 per gallon for two-axle vehicles
= constant at $0.12 gallon for vehicles having more than two axles

TABLE E-2. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 2

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,798	28,238	2,244	221,417	55,657	128,796	31,401	7,414	444,685
1990	3,503	35,434	2,816	277,884	78,021	194,455	52,794	10,512	613,665
1995	4,005	40,508	3,220	317,674	93,915	241,128	67,858	12,714	733,288
2000	4,421	44,664	3,550	350,268	107,104	279,860	80,197	14,541	831,971
2005	4,774	48,168	3,828	377,753	118,316	312,783	90,603	16,095	915,549

SCENARIO CONDITIONS: Population = projections by the Urban Studies Center, University of Louisville

Year	Population (Thousands)
1984	3,723
1990	4,062
1995	4,303
2000	4,503
2005	4,673

Fuel Price = $1.30 per gallon in 1984
= Trend line (1969 - 1978) rate of increase of $.04 per gallon per year for 1990 - 2005

Fuel Tax = constant at $0.10 per gallon for two-axle vehicles
= constant at $0.12 gallon for vehicles having more than two axles

TABLE E-3. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 3

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,798	28,238	2,244	221,417	55,657	128,796	31,401	7,414	444,685
1990	3,503	34,356	2,731	269,428	78,021	194,455	49,593	10,512	602,009
1995	4,005	39,682	3,154	311,197	93,915	241,128	65,406	12,714	724,359
2000	4,421	44,102	3,505	345,860	107,104	279,860	78,529	14,541	825,895
2005	4,774	47,859	3,804	375,324	118,316	312,783	89,683	16,095	912,201

SCENARIO CONDITIONS: Population = projections by the Urban Studies Center, University of Louisville

Year	Population (Thousands)
1984	3,723
1990	4,062
1995	4,303
2000	4,503
2005	4,673

Fuel Price = constant at $2.50 per gallon

Fuel Tax = constant at $0.10 per gallon for two-axle vehicles
= constant at $0.12 gallon for vehicles having more than two axles

TABLE E-4. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 4

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,798	28,238	2,244	221,417	55,657	128,796	31,401	7,414	444,685
1990	3,503	35,732	2,840	413,662	78,021	194,455	53,679	10,512	750,329
1995	4,005	41,058	3,263	475,321	93,915	241,128	69,492	12,714	892,569
2000	4,421	45,478	3,615	526,490	107,104	279,860	82,615	14,541	1,010,611
2005	4,774	49,235	3,913	569,984	118,316	312,783	93,770	16,095	1,110,947

SCENARIO CONDITIONS: Population = projections by the Urban Studies Center, University of Louisville

Year	Population (Thousands)
1984	3,723
1990	4,062
1995	4,303
2000	4,503
2005	4,673

Fuel Price = constant at $1.30 per gallon

Fuel Tax = constant at $0.15 per gallon for two-axle vehicles
= constant at $0.17 gallon for vehicles having two axles or more

TABLE E-5. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 5

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,798	28,238	2,244	221,417	55,657	128,796	31,401	7,414	444,685
1990	3,503	35,434	2,816	410,209	78,021	194,455	52,794	10,512	745,991
1995	4,005	40,508	3,220	468,947	93,915	241,128	67,858	12,714	884,561
2000	4,421	44,664	3,550	517,062	107,104	279,860	80,197	14,541	998,766
2005	4,774	48,168	3,828	557,635	118,316	312,783	90,603	16,095	1,095,431

SCENARIO CONDITIONS: Population = projections by the Urban Studies Center, University of Louisville

Year	Population (Thousands)
1984	3,723
1990	4,062
1995	4,303
2000	4,503
2005	4,673
1995	22,261
2000	24,274
2005	26,327

Fuel Price = $1.30 per gallon in 1984
= Trend line (196978) rate of increase of $.04 per gallon per year for 1990 - 2005

Fuel Tax = constant at $0.15 per gallon for two-axle vehicles
= constant at $0.17 per gallon for vehicles having two axles or more

TABLE E-6. FUEL PRICE AND FUEL TAX SCENARIO NUMBER 6

YEAR	VEHICLE REGISTRATION (Thousands)	VEHICLE-MILES TRAVELED (Millions)	GALLONS OF FUEL CONSUMPTION (Millions)	MOTOR-FUEL REVENUES (Thousands)	VEHICLE REGISTRATION FEES (Thousands)	USAGE-TAX REVENUES (Thousands)	WEIGHT-DISTANCE TAX (Thousands)	MISC REGISTRATION FEES (Thousands)	HIGHWAY-USER REVENUES (Thousands)
1984 (Actual)	2,577	27,873	2,050	199,301	50,654	141,129	30,317	10,560	431,961
1984 (Predicted)	2,798	28,238	2,244	221,417	55,657	128,796	31,401	7,414	444,685
1990	3,503	34,356	2,731	397,727	78,021	194,455	49,593	10,512	730,308
1995	4,005	39,682	3,154	459,386	93,915	241,128	65,406	12,714	872,549
2000	4,421	44,102	3,505	510,556	107,104	279,860	78,529	14,541	990,590
2005	4,774	47,859	3,804	554,050	118,316	312,783	89,683	16,095	1,090,926

SCENARIO CONDITIONS: Population = projections by the Urban Studies Center, University of Louisville

Year	Population (Thousands)
1984	3,723
1990	4,062
1995	4,303
2000	4,503
2005	4,673

Fuel Price = constant at $2.50 per gallon

Fuel Tax = constant at $0.15 per gallon for two-axle vehicles
= constant at $0.17 per gallon for vehicles having two axles or more