

# Long-Range Transportation Revenue Forecasting

ALAN R. FRIEND AND RICHARD E. ESCH

Transportation financing has relied heavily on user fees such as fixed per-gallon fuel taxes and vehicle weight taxes. In many states, these tax structures have contributed to a decline in revenues because of lighter, more fuel-efficient vehicles, energy conservation, and high fuel prices. It has become increasingly important to monitor expected revenue and to propose changes in tax schemes to offset declining revenue. In Michigan, long-term revenue forecasting for transportation is a computerized process that uses forecasts of vehicle registration, miles of travel, fuel consumption rates, and a fuel and weight tax scheme. Not only tax schemes can be tested, but also economic and travel alternatives, such as what happens to revenue if people drive less and what happens if people buy fewer cars than expected. The forecasting process is not isolated from the rest of transportation planning. All output is available on computer files for later use by computerized report, graphing, and analysis programs. Many computer graphics examples are presented. During recent work in Michigan on the State Transportation Plan, the revenue forecasting work was integrated with a prioritized needs analysis with assigned priorities to compare expected revenues on a year-by-year basis to 1990. The long-range transportation revenue forecasting process is a valuable tool to use in developing a strategy for dealing with the changing environment of transportation financing.

Characteristics of society, transportation, and the economy that suggested the present forms of taxation to finance transportation have changed. However, taxation schemes in Michigan had not significantly changed until January 1, 1983. Revenues from these taxes had been decreasing and were expected to continue decreasing while the costs of providing transportation were increasing. Revenue decreases and cost increase estimates have become extremely important in dealing with the problems of financing transportation.

Traditionally revenue forecasts were prepared by two different bureaus within the Michigan Department of Transportation (DOT). The Bureau of Finance used forecasts for their cash flow and budget process. The Bureau of Transportation Planning was generally interested in longer-range revenue forecasts as a complement to transportation needs studies (i.e., comparing estimates of revenue needed with revenue to be received).

These early methods were based on the recognized increasing fuel efficiency of vehicles and on travel forecasts, which produced forecasts of fuel use. The fuel use forecast could then be applied to a per-gallon tax for the revenue forecasts. Weight tax forecasts were based on average fees per vehicle and estimates of future vehicle registrations.

To provide for a quicker response and a more coordinated effort, a computerized process of revenue forecasting was developed. An important aspect of this process was the emphasis on expanding previous methods rather than developing an entirely new approach to forecasting. Although the system was developed by the Bureau of Transportation Planning, the Bureau of Finance had a major role in defining the process and the products. This cooperative effort is apparent when the use of the system is examined. More than half of the application runs were for the Bureau of Finance. This cooperation played an important part in making the process a useful tool rather than an intellectual exercise.

## GENERAL INPUT AND OUTPUT

The basic results of the long-range revenue forecasting process are revenue forecasts from gas and weight taxes. Input requirements are some type of tax structure and a forecast of transportation-related variables such as vehicle registrations and vehicle miles of travel. The results can be presented in a simple list that gives, by year, fuel tax revenue, weight tax revenue, other revenue, total revenue, and the percentage change in total revenue from the previous year (see Figure 1).

All output results are stored on computer files that are later used as input to report programs or graph programs. Figure 2 shows a line graph of the revenue from Figure 1.

Another graph (see Figure 3) shows a percentage comparison to 1977 not only for revenue but also for two transportation-related input variables: vehicle miles of travel and passenger fleet miles per gallon (MPG). The graphs can be used for in-house projects or more professional finished reports. For a more finished report, color reproductions are available. The color diagrams are made from a 35-mm slide taken of a color graphics computer terminal. The graph shown in Figure 3 is also available with an additional output option that shows the revenue adjusted for three different inflation rates (blue = 0 percent, yellow = 6 percent, and red = 10 percent).

Transportation revenue is divided between state and local agencies based on a percentage split after certain deductions. Figure 4 shows the distribution

Figure 1. Transportation fund forecast.

YEAR	FLEET	REVENUE				TOTAL	% INCREASE
		WEIGHT	FUEL	OTHER			
76-77	4890094.	987822.	8184,940,827.80	9426,950,748.30	816,664,381.40	8608,445,957.50	0.00%
77-78	5126907.	1081900.	8174,381,607.56	8438,474,353.89	817,409,791.00	8630,245,718.45	3.92%
78-79	5162138.	1122898.	8235,652,479.48	8593,404,383.88	822,316,860.34	8761,372,694.88	29.81%
79-80	5228972.	1055334.	8238,391,482.52	8473,842,041.12	828,852,639.66	8739,086,163.30	-2.93%
80-81	4848824.	1047584.	810,619,589.11	8438,129,878.41	833,992,688.56	8688,741,758.08	-7.62%
81-82	5000000.	1100000.	8211,736,397.60	8416,684,714.83	828,432,988.00	8668,474,099.83	-2.94%
82-83	5200000.	1100000.	8218,514,813.82	8416,617,087.92	828,280,837.00	8668,411,818.28	-0.04%
83-84	5400000.	1155000.	8220,685,870.86	8416,068,873.32	829,386,191.00	8668,141,135.20	0.56%
84-85	5470000.	1170000.	8221,786,686.57	8409,298,378.67	829,264,078.00	8668,147,064.35	-0.07%
85-86	5530000.	1170000.	8221,426,946.00	8403,698,934.84	828,874,073.00	8659,999,953.84	-0.96%
86-87	5600000.	1190000.	8222,319,679.40	8397,807,677.90	828,861,528.00	8648,988,885.30	-0.77%
87-88	5645500.	1200000.	8222,777,913.41	8383,467,454.50	828,874,944.00	8635,120,311.90	-2.14%
88-89	5699750.	1210000.	8222,143,583.58	8370,408,947.41	828,890,638.00	8621,443,160.00	-2.15%
89-90	5735000.	1220000.	8221,481,788.24	8358,656,487.56	828,921,658.00	8609,059,351.79	-1.09%
90-91	5770250.	1250000.	8222,372,105.64	8347,228,567.91	829,335,184.00	8598,933,857.55	-1.66%
91-92	5805500.	1280000.	8223,234,957.53	8338,958,685.91	829,786,323.00	8591,079,966.44	-1.16%
92-93	5840750.	1310000.	8226,345,956.53	8330,958,395.12	830,267,652.00	8587,572,003.64	-0.74%
93-94	5876000.	1340000.	8229,456,955.52	8322,945,710.63	830,748,831.00	8583,151,497.05	-0.75%
94-95	5911250.	1380000.	8233,367,748.64	8318,546,237.69	831,438,835.00	8581,341,819.23	-0.31%
95-96	5946500.	1410000.	8236,468,745.63	8316,241,449.22	832,000,522.00	8583,710,718.85	0.41%

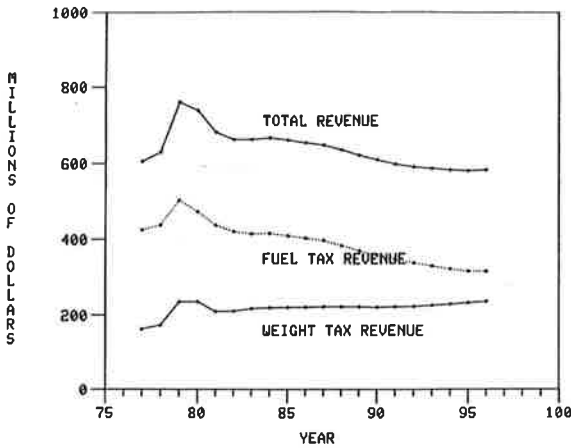
of the total Michigan Transportation Fund (MTF) to state and local funds. This graph is also available with each portion of the fund shown in a different color. A more detailed report is available for the MTF and the two other state funds, the State Trunk-

line Fund and the Comprehensive Transportation Fund (see Figure 5).

A summary of most of the input variables is available for all years of the forecast. Figure 6 shows these variables, all of which can be changed to examine a particular "what if" question about future conditions and tax structures.

Because a portion of automobile-related sales tax is available for the Comprehensive Transportation Fund, forecasts of sales tax are needed. These are obtained from the Office of Revenue and Tax Analysis of the Department of Management and Budget. Their forecasts are based on a computer model driven by interest rates, automobile production, and wages and salaries.

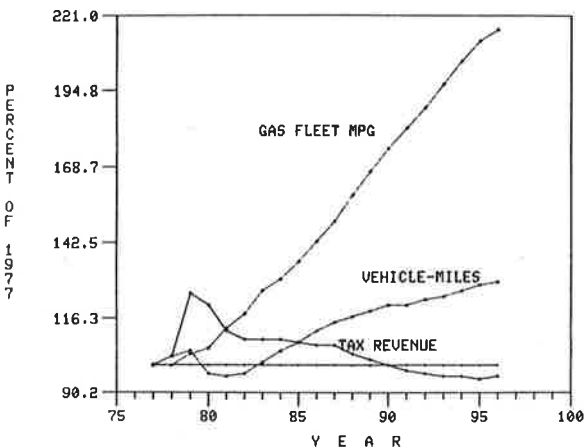
Figure 2. MTF revenue.



SYSTEM DESCRIPTION

The transportation revenue forecasting system, which produced the charts and graphs mentioned previously, is composed of several computer programs that perform all of the calculations and produce the output lists, tables, and graphs. The system can be divided into three main parts. Phase 1 involves forecasts of revenue coming into the MTF from taxes, fees, and interest. Phase 2 involves distribution of the fund to state and local governments. Phase 3 uses the MTF revenue and some further estimates of revenue to present the total revenue for the other state funds, the STF and the CTF (see Figures 7 and 8).

Figure 3. Present tax structure.

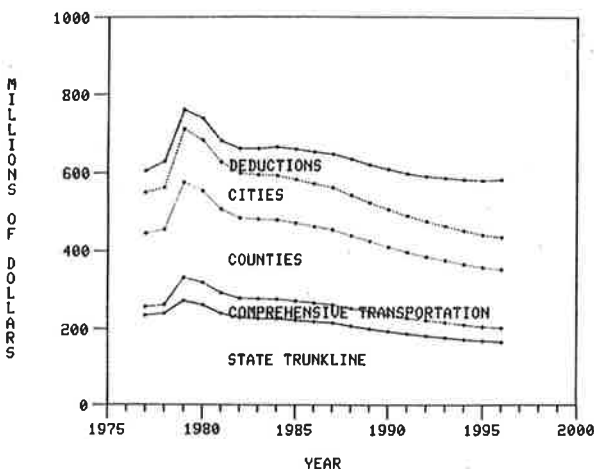


The system is generally used in three different ways:

1. It is used to monitor the long-range implications of keeping the present tax structure.
2. It is used to evaluate various tax changes, such as raising the fixed-rate-per-gallon fuel tax, instituting a percentage tax based on the price of fuel, or indexing the fuel tax to maintenance costs. To evaluate a flat fee per vehicle instead of the present vehicle tax by weight, the same input structure is used except the average tax per hundredweight is replaced by the flat vehicle fee.
3. The output of this revenue forecasting process serves as input to another process used in the recent State Transportation Plan (STP) produced by the Michigan DOT. The STP uses the forecasts of future revenue and compares them with future transportation needs, which are also expressed in dollars.

The operation of each of these three phases is discussed in more detail in the following paragraphs.

Figure 4. MTF distribution.



TECHNICAL OPERATIONS

The programs for all three phases are written in FORTRAN and run on the Burroughs B7700. Revenues are forecast by year for each year in the future for which forecast variables are supplied. Currently, forecasts are not completed beyond 1996. Although there are a number of input files (eight input files for the first phase of forecasting fuel and weight tax revenue), all are small files that contain input parameters or forecast variables. Each file with forecast variables contains one record for each year of the forecast and from one to four variables for that year.

Phase 1: MTF Revenue

Most of the analytic capabilities for examining different options are contained in the first phase of forecasting transportation revenue. This capability is related to the wide variety of input data that

Figure 5. Long-range revenue forecasts (current dollars in millions).

	1982	1983	1984	1985	1986	1987	1988
<b>MICHIGAN TRANSPORTATION FUND</b>							
-----							
GASOLINE TAX	\$398.2	\$390.2	\$388.8	\$381.0	\$373.4	\$365.9	\$350.6
DIESEL FUEL TAX	\$22.5	\$24.3	\$26.1	\$27.1	\$29.1	\$30.5	\$31.4
MOTOR VEHICLE WEIGHT TAX	\$211.7	\$218.5	\$220.7	\$221.8	\$221.4	\$222.3	\$222.8
MISC TAXES & FEES (INCLUDES LPG)	\$10.3	\$11.6	\$12.7	\$12.8	\$12.9	\$13.4	\$13.4
DIESEL FUEL LICENSE	\$8.5	\$8.9	\$9.2	\$9.4	\$9.4	\$9.5	\$9.6
EARNINGS ON INVESTMENTS	\$11.5	\$8.9	\$8.6	\$8.2	\$7.8	\$7.4	\$7.3
-----							
TOTAL REVENUES	\$662.7	\$662.4	\$666.1	\$660.3	\$654.0	\$649.0	\$635.1
LESS: ADMINISTRATION & GRANTS	\$63.1	\$66.5	\$72.9	\$77.1	\$81.5	\$86.3	\$91.3
-----							
NET REVENUES	\$599.6	\$595.9	\$593.2	\$583.2	\$572.5	\$562.7	\$543.8
-----							
ALLOCATIONS FROM MTF							
TO COMPREHENSIVE TRANS FUND	\$49.8	\$49.5	\$49.3	\$48.4	\$47.5	\$46.7	\$45.2
TO STATE TRUNK LINE FUND	\$230.2	\$228.8	\$227.8	\$224.0	\$219.8	\$216.1	\$208.8
TO COUNTY ROAD COMMISSIONERS	\$205.6	\$204.4	\$203.5	\$200.1	\$196.4	\$193.0	\$186.5
TO CITIES AND VILLAGES	\$113.9	\$113.2	\$112.7	\$110.8	\$108.8	\$106.9	\$103.3
-----							
TOTAL ALLOCATED	\$599.5	\$595.8	\$593.3	\$583.3	\$572.5	\$562.7	\$543.8
-----							
<b>COMPREHENSIVE TRANSPORTATION FUND</b>							
-----							
FROM GENERAL FUND (SALES TAXES)							
MOTOR VEHICLES	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
FUEL	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
ACCESSORY DEALERS	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
GAS STATION NONFUEL SALES	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
-----							
TOTAL TAXES	\$389.3	\$463.3	\$523.5	\$575.9	\$633.5	\$696.9	\$725.0
-----							
ALLOCATION TO CTF	\$27.2	\$32.3	\$36.5	\$40.2	\$44.2	\$48.6	\$50.6
FROM MTF	\$49.8	\$49.5	\$49.3	\$48.4	\$47.5	\$46.7	\$45.2
MISCELLANEOUS (F.AID NOT INCLUDED)	\$7.8	\$8.3	\$8.7	\$9.0	\$9.4	\$9.7	\$9.8
EARNINGS ON INVESTMENTS	\$2.7	\$2.9	\$3.0	\$3.1	\$3.2	\$3.3	\$3.3
-----							
TOTAL CTF REVENUES	\$87.5	\$93.0	\$97.5	\$100.7	\$104.3	\$108.4	\$108.8
-----							
<b>STATE TRUNK LINE FUND</b>							
-----							
FROM MTF	\$230.2	\$228.8	\$227.8	\$224.0	\$219.8	\$216.1	\$208.8
MISCELLANEOUS (F.AID NOT INCLUDED)	\$21.8	\$21.7	\$21.6	\$21.2	\$20.8	\$20.5	\$19.8
EARNING ON INVESTMENTS	\$6.0	\$5.9	\$5.9	\$5.8	\$5.7	\$5.6	\$5.4
TOTAL STATE TRUNK LINE FUND REVENUES	\$258.0	\$256.4	\$255.3	\$251.0	\$246.3	\$242.2	\$234.0
-----							

require the variables by year and by state totals for Michigan. The input variables are as follows:

1. Tax structure variables--Average tax per passenger vehicle (or average tax per hundredweight and average hundredweight), average tax per commercial vehicle (or average tax per hundredweight and average hundredweight), diesel fuel tax (per gallon or percentage of price), diesel fuel price, diesel tax discount, gasoline fuel tax (per gallon or percentage of price), and gasoline fuel price; and

2. Other variables--Passenger vehicle registrations, commercial vehicle registrations, total vehicle miles of travel, passenger fleet MPG (gasoline), commercial fleet MPG (diesel), percentage commercial vehicle miles for diesel use, revenue factor for interest revenue, commercial vehicle factor for miscellaneous fees, and commercial vehicle factor for diesel discount permit revenue.

Output items forecast by year are as follows:

1. Total fuel tax revenue,
2. Total weight tax revenue,
3. Total other revenues,
4. Total transportation revenues,
5. Liquid petroleum gasoline (LPG) fuel tax revenue,
6. Interest revenue,
7. Diesel carrier fuel permits revenue,
8. Miscellaneous fees and permits revenue,
9. Revenue from diesel fuel tax,
10. Revenue from gasoline tax,
11. Commercial weight tax revenue,
12. Passenger weight tax revenue,

13. Gallons of gasoline, and
14. Gallons of diesel fuel.

When all input files are ready, the program for the first phase is started at a computer terminal. After approximately 30 sec of elapsed time and 5 sec of computer processing time, a preliminary report is printed at the terminal. Gallons of gasoline and diesel fuel are also output. The report is a summary by year of the forecast revenue by three broad categories and the percentage change from the previous year. Figure 9, an example taken directly from a computer terminal, shows the running of the program with its associated files.

Most of the outputs are various categories of revenue written to a computer file. Although the program goes on to allow on-line changes in the tax structure or selected variables for trying a variety of alternatives, we have usually found it best to isolate each alternative with its own set of input and output variables for later use.

Revenues are calculated by using the following procedures.

Fuel revenue is calculated (see Figure 10) according to

$$\text{Total fuel tax revenue} = \text{gasoline tax revenue} + \text{diesel tax revenue} + \text{LPG revenue} \quad (1)$$

where

$$\begin{aligned} \text{gasoline} &= \text{GFUEL} * \text{GTAX}; \\ \text{tax revenue} & \\ \text{diesel tax} &= \text{D1 FUEL} * (\text{DTAX} - \text{DTAXDIS}) \\ \text{revenue} &+ \text{D2 FUEL} * \text{DTAX}; \end{aligned}$$



close to DOE adjusted estimates, as shown in Figure 11.

The percentage of total vehicle miles attributable to diesel vehicles does not compare quite as well with DOE national values for "heavy-heavy" trucks (see Figure 12). The difference may be the location of Michigan in the United States, which would result in fewer through trips by trucks. The Michigan percentage increases faster because there is some accounting for increasing use of diesel fuel by automobiles.

Figure 7. Michigan long-range transportation revenue forecasting system.

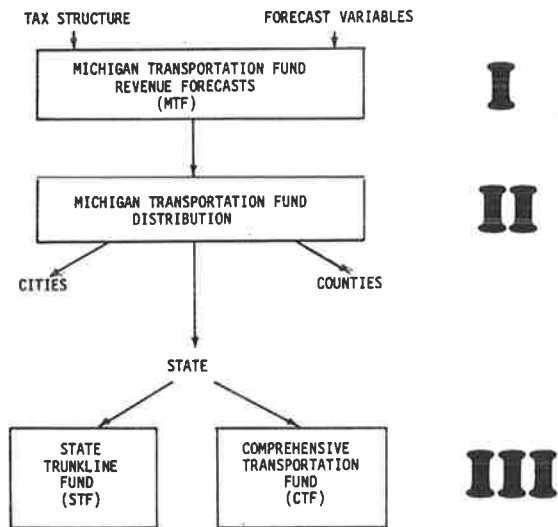
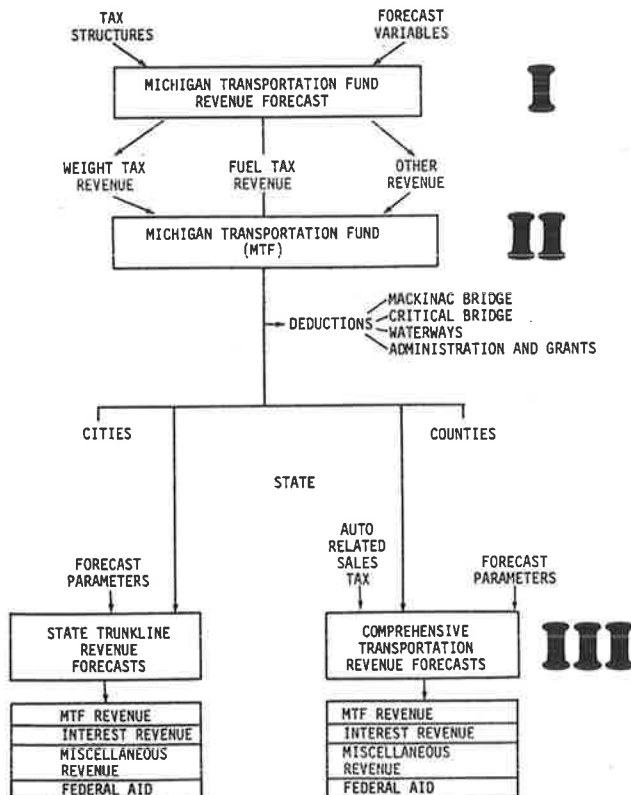


Figure 8. Michigan long-range transportation revenue forecasting system in greater detail.



Vehicle revenue is calculated (see Figure 13) according to

$$\begin{aligned} \text{Total vehicle tax revenue} = & \text{passenger weight tax revenue} \\ & + \text{commercial weight tax revenue} \\ & + \text{miscellaneous} \end{aligned} \quad (2)$$

where

$$\begin{aligned} \text{miscellaneous} = & (\text{passenger weight tax revenue} \\ & + \text{commercial weight tax revenue}) * 0.052, \\ \text{passenger weight tax revenue} = & \text{average tax per passenger vehicle} * \text{passenger registrations, and} \\ \text{commercial weight tax revenue} = & \text{average tax per commercial vehicle} * \text{commercial registrations.} \end{aligned}$$

The average tax per vehicle is estimated directly or as follows: average tax per vehicle = average tax per 100 lb \* average vehicle weight in 100s.

Other revenue is calculated (see Figure 14) according to

$$\begin{aligned} \text{Other revenue} = & \text{miscellaneous fees and permits} + \text{interest} \\ & + \text{special diesel permits} \end{aligned} \quad (3)$$

where

$$\begin{aligned} \text{miscellaneous} = & \text{a factor} * \text{commercial registrations (changes somewhat with time and seems to go up during good economic times and down in bad);} \\ \text{interest revenue} = & \text{a factor} * \text{fuel and weight revenue (closely follows interest rates as expected; for 1977 to 1981, the factor equals 0.1444 times the yield on 90-day securities); and} \\ \text{special diesel permits} = & \text{factor} * \text{commercial registrations (these permits were not available until May 1980 and allow the purchaser of the permit a discount, currently $0.06/gal, on all diesel fuel purchased).} \end{aligned}$$

Phase 2: Distribution of MTF

In phase 2 of the process, the deductions are estimated by four categories:

1. Waterways,
2. Mackinac Bridge Authority,
3. Critical Bridge Program, and
4. Administrative and other grants.

The remaining amount is then divided into four amounts to be distributed to

1. Cities,
2. Counties,
3. The STF, and
4. The CTF.

The portion of each fund is governed by law at a fixed percentage. The forecasting process allows changes in these percentages for future proposals as well as some changes in the amount of deductions. This breakdown of deductions and distributions is written for each year of the forecast to a computer file for later use.

For one specified year, an estimate is also made of how the total city and county money is split

Figure 9. Phase 1 computer terminal display.

```

@FILE (STUD)TAX/ALTI/DO ON STATEWIDE
@
R TAX/PROG/RTF/INCOME/APR82;PT-10;N
FILE FILE2(TITLE-TAX/ALTI/INPUT/VEHREG/MAY82/DB1);N
FILE FILE3(TITLE-TAX/ALTI/INPUT/UTTAX/MAY82/DB1);N
FILE FILE4(TITLE-TAX/ALTI/INPUT/VEHMI/JUL82);N
FILE FILE5(TITLE-TAX/ALTI/INPUT/MIPERGA/JUL82/MATL/RICH);N
FILE FILE6(TITLE-TAX/ALTI/INPUT/GASTAX/RETAIL/OCT81);N
FILE FILE7(TITLE-TAX/ALTI/RTF/PLOT/4014);N
FILE FILE8(TITLE-TAX/ALTI/RTF/PLOT/4027);N
FILE FILE9(TITLE-TAX/ALTI/RTF/PLOT/LABEL1);N
FILE FILE10(TITLE-TAX/ALTI/RTF/INCOME);N
FILE FILE11(TITLE-TAX/ALTI/RTF/NARRATIVE);N
FILE FILE12(TITLE-TAX/ALTI/INPUT/OTHERPTS/MAY82/DB1);N
FILE FILE13(TITLE-TAX/ALTI/INPUT/LPG/PROPORTION/MAY82/DB1);N
FILE FILE14(TITLE-TAX/ALTI/INPUT/DIESEL/DISCOUNTS/ALL/APR82);N
FILE FILE15(TITLE-TAX/ALTI/RTF/GALLONS);N
FILE FILE16(TITLE-TAX/ALTI/RTF/UTTAX);N
@RUNNING 1948
@?

```

ENTER NARRATIVE ('END' TO GO ON):  
PRESENT TAX STRUCTURE  
END

YEAR	FLEET	REVENUE				TOTAL	% INCREASE
		WEIGHT	FUEL	OTHER			
76-77	4890094. 987822.	8164,940,827.00	8425,950,748.30	816,554,381.40	8606,445,957.59	0.00%	
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95-96	5946500. 1410000.	8236,468,745.63	8315,242,449.22	832,000,522.00	8583,710,716.85	0.41%	

Figure 10. Calculation of fuel tax revenue.

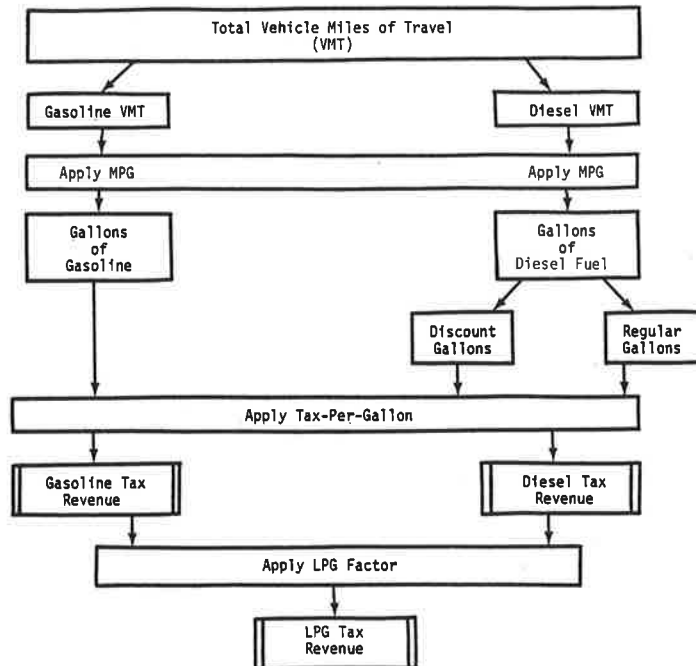


Figure 11. National versus Michigan miles per gallon.

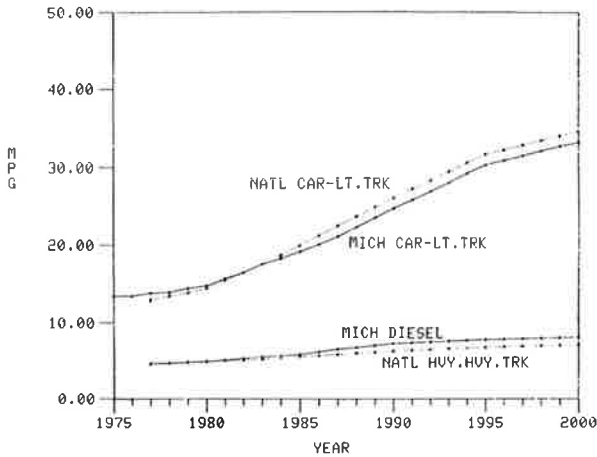


Figure 12. National versus Michigan DOT model: percentage of diesel vehicle miles.

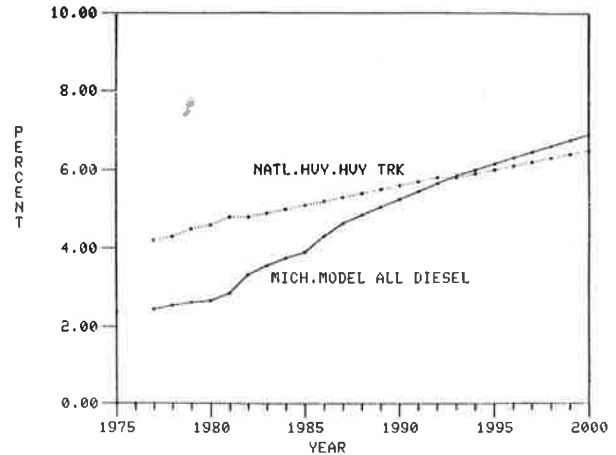
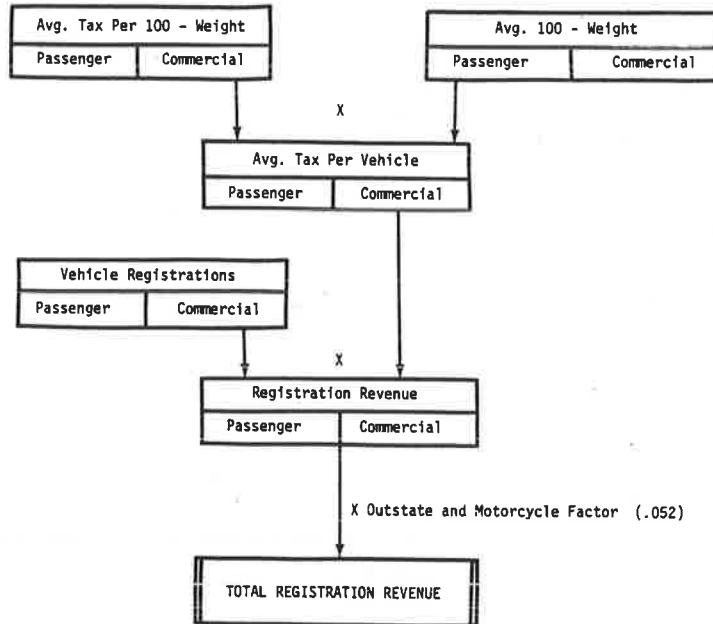


Figure 13. Calculation of vehicle registration tax revenue.



among the various counties. This future estimate is based on the actual process used each year to distribute the funds to counties and cities. This process is documented in the Annual Progress Report, Report 162, published by the Michigan DOT. It is a complex process involving population, miles of roadway, snowfall, and weight taxes collected. Our version of this process, adapted for estimating the future distribution, uses population forecasts by county, weight taxes from phase 1, and values from a known year for snowfall and miles of roadway.

In summary, the major input requirements for each year are:

1. MTF forecasts from phase 1;
2. Deductions to the Mackinac Bridge Authority, the Critical Bridge Program, waterways (the actual amount or calculated as 1.023 percent of gasoline revenue less 1 percent for administration), and administration and grants (the actual amount or the percentage increase from the previous year); and

3. Percentage of the fund to cities, counties, the STF, and the CTF.

For distribution of the total county and city funds among counties for one future year, the following variables are input:

1. Year;
2. Population forecasts;
3. Snowfall data;
4. Weight tax collections; and
5. Miles of roadway by city and county, major and local streets.

When all input files are ready, the program for phase 2 is started at a computer terminal. The program is finished after less than 30 sec of elapsed time and about 10 sec of computer processing.

The outputs are written to a computer file for later use in reports and graphs as well as input to phase 3 programs. The major outputs for each year are

1. Amount of deductions (four categories and total) from the MTF before distribution of funds;
2. Amount of distribution to the two state funds, the STF and CTF;
3. Amount of distribution to cities; and
4. Amount of distribution to counties.

For the selected year, the output is the total probable distribution to each county for city and county roads.

Phase 3: Further Estimates for Two State Funds

The gasoline and weight tax revenue from phase 2 accounts for more than half of the income to both the STF and the CTF. The figures in both state funds for federal aid, interest, and miscellaneous have been estimated so that they are in line with the short-range budget projections of the Financial Planning Section of the Michigan DOT and to give a more complete ballpark figure for the long-range forecasts for these funds. The main emphasis of the long-range forecasts is generally to evaluate gasoline and weight tax revenue for different economic, travel, or tax assumptions. The method of estimating the federal aid, interest, and miscellaneous income is less rigorous and involves using a percentage method based on historical patterns and the short-range budget forecasts.

Additional revenue for the STF is divided into three categories:

1. Federal aid,
2. Miscellaneous, and
3. Interest.

Two methods of forecasting these items are available. One is by increasing (or decreasing) each amount from a known base year by a given percentage each year. The other is to assume that each portion will remain the same percentage of the total each year. The total would be determined by assuming the gasoline and weight revenue from the MTF from phase 2 to be a certain percentage of the total.

Generally this method has been used, assuming the gasoline and weight total to be 58 percent of the total. During the past few years, this value has varied between 54 and 61 percent. Miscellaneous is assumed to be 5.5 percent of the total, interest is 1.5 percent, and federal aid is 35 percent. This is not the best way to estimate federal aid because other considerations, such as the ability to obtain matching funds, are now important. Recent work with the STP, which used these revenue forecasts, did not make use of the federal aid estimate but used a more detailed method.

The input requirements by year are gasoline and weight tax revenue from phase 2: either percentage of total income from (a) gasoline and weight taxes,

(b) miscellaneous, (c) interest, and (d) federal aid or income in a known year from the preceding four categories and the percentage increase (four values) to be applied each year to the four categories.

The output is a computer file containing one record for each year of the forecast with total STF income, gasoline and weight tax income, miscellaneous income, interest income, and federal aid income. There is also a total that does not include federal aid.

The approach for CTF revenue is similar to the STF process. Generally, more than 50 percent of CTF income comes from the gasoline and weight taxes. About 25 percent of the income comes from automobile-related sales tax. Sales tax forecasts are available from the Department of Management and Budget and are based on a model that uses AAA bond yields, wages and salaries, and automobile production. By law, 27.9 percent of 25 percent of the automobile-related sales tax goes to the CTF. The 27.9 percent is an input variable for each year and can be changed.

The method for estimating miscellaneous, federal aid, and interest revenue for the CTF is currently fixed in the program at

$$\text{Miscellaneous revenue} = 0.102 * \text{CTF sales tax revenue} + \text{CTF gasoline and weight tax revenue} \quad (4)$$

$$\text{Federal aid revenue} = 0.06 * \text{CTF sales tax revenue} + \text{CTF gasoline and weight tax revenue} \quad (5)$$

$$\text{Interest revenue} = 0.03 * \text{all CTF revenue other than interest} \quad (6)$$

Input requirements by year are gasoline and weight tax revenue from phase 2, total automobile-related sales tax, and that portion of the 25 percent of the automobile-related sales tax to go to the CTF.

Output results are written to a file containing one record for each year of the forecast with total CTF revenue, CTF sales tax revenue, interest, miscellaneous, and federal aid. A total that does not include federal aid is also included.

This last phase, which also includes producing a final summary report as previously noted in Figure 5, is completed in less than 30 sec of elapsed time and less than 5 sec of computer processing time. The graphs previously seen are produced by a general-purpose graph program that uses as input the various files produced by the process. Graphs are not limited to those shown but can be produced for any of the output items mentioned.

APPLICATIONS

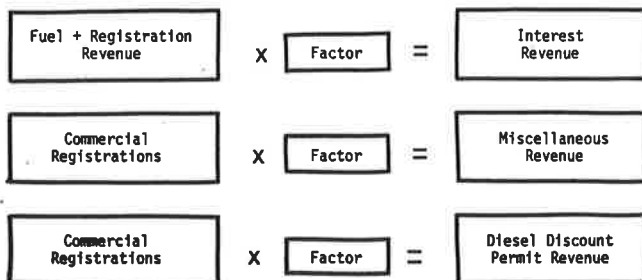
Between July 1980 and August 1982, more than 80 different alternatives were examined for a variety of users. Most of the alternatives have been used to analyze proposed tax changes or to prepare a proposal for tax changes. The most popular proposals have been the following. For the fuel tax,

1. Increase the fixed tax per gallon from \$0.01 to \$0.03,
2. Change the fixed tax per gallon to a percentage of the wholesale price,
3. A combination of items 1 and 2,
4. Index the tax per gallon to maintenance costs, and
5. Index the tax per gallon inversely to gallons of fuel consumed.

For the vehicle tax,

1. Increase the present average tax per vehicle by a given amount or by a percentage,

Figure 14. Calculation of other tax revenue.





2. Convert from a weight tax to a fixed rate per vehicle, and
3. Index the tax rate to Michigan personal income.

Most of the alternatives have been examined for the following users for the purpose stated (in order of frequency of request):

1. Deputy Director of the Bureau of Finance, Michigan DOT--Analysis of tax proposals;
2. Financial Planning Section, Bureau of Finance, Michigan DOT--Cash flow analysis;
3. State Transportation Plan, Bureau of Transportation Planning, Michigan DOT--Analysis of funds available versus funds needed for priority needs;
4. Director, Michigan DOT--Comparison of fixed fuel tax per gallon versus percentage of wholesale price; and
5. Department of Management and Budget--Analysis of Governor's tax proposal.

The third application involving the STP deserves special note. It represents a continuing trend in the Bureau of Transportation Planning to integrate various planning functions into a more responsive and integrated system. Preparation of the STP brought together transportation demand forecasting, needs analysis, a process to determine priorities, and fiscal analysis. The costs of future needs are compared on a year-to-year basis with forecast revenues from the long-range revenue forecasting process. Analyses of shortfalls can be examined. Either tax proposals to generate more revenue can be examined or strategies to lessen deficiencies can be evaluated in order to bring income and costs more in line.

#### MODIFICATIONS

Proposed modifications center around either improvement in forecasting ability or improvement in the presentation of results. Some of the modifications that are being considered are

1. Use of a forecast interest rate instead of a special interest factor in determining interest revenue;
2. Modifying the estimates of federal aid forecasts to use the process developed for the STP;
3. For the STF and the CTF, allowing the variables for miscellaneous interest and federal aid to be by year instead of constant for all years;
4. More development of simple summary reports; and
5. Changes to better account for diesel automobiles.

The most important goal will be to keep the system useful and responsive to the user while maintaining compatibility with other planning processes.

#### CONCLUSIONS

The long-range transportation revenue forecasting model has become a useful tool not only for estimating future revenue based on the present situation but also for testing tax structures or different types of future socioeconomic schemes. Although there may be models that are technically more sophisticated, few will match the usefulness and flexibility to users of the Michigan model. There can be little claim to success unless a model is used. The more than 80 tax alternatives examined attest to the use of the systems.

Graphs of the results and input assumptions can be displayed in black and white or color. These charts can be used for in-house, day-to-day applications or for publication in final documents.

Finally, the revenue forecasting process is not an isolated process. Input variables to the forecasting process come from other departmental products, and the revenue forecasting outputs are used as input in other departmental analyses.