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16. Abstract

 This study presents estimates of the Texas transportation bill from 1970 through 1982 and forecasts of the transportation bill from 1983 to 2005. The transportation bill is all expenditures for transportation by the private sector in Texas. The historical data were divided into passenger and freight expenditures and subdivided by transportation mode to establish the relationships between modes and between each mode and the total transportation bill. Mathematical equations were developed from the historical data and utilized to forecast future trends in the transportation bill. Transportation is forecasted to play a vital role in the Texas economy, constituting approximately one-quarter of the Gross Texas Product through 2005.

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FORECASTS OF PASSENGER AND FREIGHT
TRANSPORTATION EXPENDITURES IN TEXAS: 1983 - 2005

by

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PREFACE

This study was prepared by the Texas Transportation Institute for the Texas State Department of Highways and Public Transportation. It was prepared in cooperation with the U.S. Department of Transportation, Federal Highway Administration.

The contents of this report reflect the views of the author, who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

EXECUTIVE SUMMARY

This report presents estimates of Texas' transportation bill for 1970 through 1982 and forecasts of the bill from 1983 to 2005. The transportation bill represents expenditures for transportation by the private sector in Texas. The forecasts were derived using econometric models which utilize estimates of the transportation bill and data on Gross Texas Product, real gasoline prices, United States and Texas unemployment rates, and Texas population.

Transportation expenditures in Texas are forecasted to increase both in current and constant dollar terms due to growth in the state's economy and population. Transportation will continue to play a vital role in the health of the economy, comprising approximately one-quarter of the Gross Texas Product. The highway transportation bill will continue to increase relative to other modes of transportation, and will constitute 87.4 percent of the total transportation bill by the year 2000.

IMPLEMENTATION STATEMENT

This report presents estimates of private sector transportation expenditures in Texas from 1970 through 1982 and forecasts of these expenditures for 1983 through 2005. These estimates can be used by highway officials and other state leaders to evaluate the importance of transportation in the Texas economy.

Continued growth of the Texas population is expected to be accompanied by an even larger growth in the Texas economy, as measured by the value of total output of goods and services (Gross Texas Product). Transportation expenditures for all modes of transport will continue to increase at about the same rate as the Gross Texas Product. This growth will necessitate increased public expenditures for transportation facilities to accommodate this growth.

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INTRODUCTION

This study updates previous research on the relationship between transportation and economic activity in Texas [1]. The previous study established the importance of transportation to the Texas economy from 1960 through 1975 and used this information with forecasts of economic activity to estimate the level of future transportation expenditures in Texas.

This study revised the data from 1970 through 1975 and gathered data through 1982, the latest year for which all necessary information was available. The larger data base permitted a more accurate analysis of the relationship between transportation and the economy.

The analysis will proceed with a presentation of the historical transportation expenditure and Gross Texas Product data. This is followed by a presentation of the forecasting procedure which describes the methodology used to derive forecasts of transportation expenditures in the state and presents the forecast equations. The final chapter presents the estimates and analysis of future transportation expenditures.

THE TEXAS TRANSPORTATION BILL

For several years the Transportation Association of America (TAA) conducted[1] studies at the national level to estimate the nation's freight and passenger bills. The method used to calculate Texas' transportation bill was similar to that used by TAA for the United States' transportation bill [2]. Advantages of the TAA approach are that the data are gathered by passenger and freight mode categories and are applicable to time series analysis.

Tables 1 and 2 present estimates of the Texas transportation bill in current dollars. Table 1 includes the passenger bill and Table 2 contains the freight bill components of the total transportation expenditures in Texas. Under the passenger and freight bill headings, total expenditures by transportation modes are arrayed in columns. Current dollar Gross Texas Product (GTP) for each year is given along with the respective passenger and freight bills as percentages of GTP to indicate the magnitude of the bills relative to general economic activity in the state. As Figure 1 illustrates, the relationship of the transportation bill to the economy has remained relatively stable with the total bill hovering around 24 percent of GTP. Appendix A details the procedures used in developing the historical data.

The magnitude of the transportation bill is determined by the usage and the cost of transportation services. The usage of transportation service is affected by per capita usage and the total state population. Both inflation and constant dollar per unit cost increases determine the cost of transportation. The effects of population and inflation are removed by analyzing the bill on a constant

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[1] TAA went out of existence in March 1983.

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Table 1. Texas Passenger Transportation Bill
(In Millions of Current Dollars)

	1970	1971	1972	1973	1974	1975	1976
Highway							
Private Auto:							
New and Used Cars	$ 2,286.6	$ 2,314.1	$ 2,947.3	$ 3,474.8	$ 3,456.5	$ 4,845.1	$ 6,322.8
Auto Repair	778.0	882.1	994.5	1,106.3	1,244.4	1,427.1	1,571.4
Gasoline	1,731.9	1,862.5	1,999.0	2,202.7	2,726.2	2,866.2	3,155.3
Registrations	98.7	103.9	110.0	117.2	120.8	125.4	133.9
Operators' Licenses	5.5	9.0	8.9	10.8	11.4	11.3	12.3
Tolls	14.9	15.9	17.1	18.1	16.9	18.1	18.4
Fines and Penalties	25.7	27.2	29.2	32.3	37.2	40.9	51.8
Parking	5.8	5.3	5.0	7.2	5.8	9.5	11.6
Insurance	290.5	391.7	429.7	349.2	354.0	297.5	408.2
Interest on Debt	343.0	347.1	442.1	521.2	518.5	694.8	1,029.5
Total Auto	$ 5,580.6	$ 5,958.8	$ 6,982.8	$ 7,839.8	$ 8,491.7	$10,335.9	$ 12,715.2
Bus, Taxi and Transit	128.5	136.6	139.8	145.6	159.7	246.6	240.1
School Bus	33.6	33.3	35.0	42.8	53.3	53.3	53.3
Total Highway	$ 5,742.7	$ 6,128.7	$ 7,157.6	$ 8,028.2	$ 8,704.7	$10,635.8	$ 13,008.6
Nonhighway							
Air	$ 432.2	$ 456.8	$ 470.8	$ 598.8	$ 737.5	$ 788.7	$ 855.6
General Aviation	103.6	119.0	119.4	144.8	178.7	200.6	271.4
Rail	2.5	2.8	3.0	3.0	4.7	4.4	4.3
Total Nonhighway	$ 538.3	$ 578.6	$ 593.2	$ 746.6	$ 920.9	$ 993.7	$ 1,131.3
Total Passenger	$ 6,281.0	$ 6,707.3	$ 7,750.8	$ 8,774.8	$ 9,625.6	$11,629.5	$ 14,139.9
Gross Texas Product (GTP)	$51,792.9	$59,683.9	$62,921.1	$73,624.1	$83,616.1	$94,196.2	$107,424.0
Highway Passenger as a Percentage of GTP	11.09	10.27	11.38	10.90	10.41	11.29	12.11
Total Passenger as a Percentage of GTP	12.13	11.24	12.32	11.92	11.51	12.35	13.16

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(Continued)

Table 1. Texas Passenger Transportation Bill (Continued)
(In Millions of Current Dollars)

	1977	1978	1979	1980	1981	1982
Highway						
Private Auto:						
New and Used Cars	$ 7,645.3	$ 9,123.9	$ 7,588.2	$ 7,374.2	$ 9,229.0	$ 9,696.2
Auto Repair	1,715.6	1,935.8	2,329.4	2,481.5	2,723.8	2,868.8
Gasoline	3,444.3	3,629.1	4,818.0	6,106.2	6,908.2	6,697.1
Registrations	143.0	179.7	151.4	150.4	153.0	173.5
Operators' Licenses	12.6	13.9	13.1	14.1	15.1	19.5
Tolls	19.3	13.3	12.6	16.7	20.1	24.2
Fines and Penalties	57.6	66.7	72.0	65.2	77.3	42.8
Parking	14.8	17.4	22.3	24.9	20.9	22.1
Insurance	624.2	607.8	556.2	705.7	535.1	548.4
Interest on Debt	1,480.2	1,809.3	1,904.6	1,973.6	2,324.8	2,855.6
Total Auto	$ 15,156.9	$ 17,396.9	$ 17,467.8	$ 18,912.5	$ 22,007.3	$ 22,948.2
Bus, Taxi and Transit	275.0	305.2	424.4	455.6	515.4	539.7
School Bus	54.1	61.7	66.0	87.8	96.7	134.7
Total Highway	$ 15,486.0	$ 17,763.8	$ 17,958.2	$ 19,455.9	$ 22,619.4	$ 23,622.6
Nonhighway						
Air	$ 1,079.4	$ 1,213.9	$ 1,609.2	$ 2,162.9	$ 2,401.6	$ 2,504.2
General Aviation	300.7	379.1	479.1	565.0	675.4	736.6
Rail	4.2	4.8	5.3	4.3	6.1	4.1
Total Nonhighway	$ 1,384.3	$ 1,597.8	$ 2,093.6	$ 2,732.2	$ 3,083.1	$ 3,244.9
Total Passenger	$ 16,870.3	$ 19,361.6	$ 20,051.8	$ 22,188.1	$ 25,702.5	$ 26,867.5
Gross Texas Product (GTP)	$124,235.4	$141,395.7	$159,142.8	$197,834.8	$218,885.1	$229,713.0
Highway Passenger as a Percentage of GTP	12.47	12.56	11.28	9.83	10.33	10.28
Total Passenger as a Percentage of GTP	13.58	13.69	12.60	11.22	11.74	11.70

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Table 2. Texas Freight Transportation Bill
(In Millions of Current Dollars)

	1970	1971	1972	1973	1974	1975	1976
Highway							
Truck-Intercity	$ 2,258.1	$ 2,594.6	$ 2,917.3	$ 3,218.5	$ 3,525.4	$ 3,668.4	$ 4,349.0
Truck-Local	2,222.7	2,602.1	3,109.4	3,535.8	3,688.2	4,933.0	5,599.4
Bus	3.9	4.0	4.2	4.4	4.6	5.0	5.7
Total Highway	$ 4,484.7	$ 5,200.7	$ 6,030.9	$ 6,758.7	$ 7,218.2	$ 8,606.4	$ 9,954.1
Nonhighway							
Railroads	$ 641.6	$ 712.5	$ 772.4	$ 901.8	$ 1,027.4	$ 1,042.6	$ 1,125.7
Water	396.0	414.6	444.4	579.1	722.1	770.9	922.6
Oil Pipeline	479.7	497.7	522.8	466.8	534.6	583.1	652.9
Air	35.8	42.7	59.4	56.5	58.0	70.4	77.1
Other Shipper Costs	122.0	123.0	130.8	147.2	159.6	197.1	219.0
Total Nonhighway	$ 1,675.1	$ 1,790.5	$ 1,929.8	$ 2,151.4	$ 2,501.7	$ 2,664.1	$ 2,997.3
Total Freight	$ 6,159.8	$ 6,991.2	$ 7,960.7	$ 8,910.1	$ 9,719.9	$11,270.5	$ 12,951.4
Gross Texas Product (GTP)	$51,792.9	$59,683.9	$62,921.1	$73,624.1	$83,616.1	$94,196.2	$107,424.0
Highway Freight as a Percentage of GTP	8.66	8.71	9.58	9.18	8.63	9.14	9.27
Total Freight as a Percentage of GTP	11.89	11.71	12.65	12.10	11.62	11.96	12.06

(Continued)

Table 2. Texas Freight Transportation Bill (Continued)
(In Millions of Current Dollars)

|	1977	1978	1979	1980	1981	1982
Highway						
Truck-Intercity	$ 5,381.8	$ 6,671.4	$ 8,424.7	$ 9,121.8	$ 11,480.2	$ 12,900.8
Truck-Local	6,269.8	6,980.7	8,831.1	9,620.4	11,409.1	12,544.1
Bus	5.7	6.5	7.4	6.0	6.5	6.1
Total Highway	$ 11,657.3	$ 13,658.6	$ 17,263.2	$ 18,748.2	$ 22,895.8	$ 25,451.0
Nonhighway						
Railroads	$ 1,278.2	$ 1,443.1	$ 1,721.6	$ 2,064.6	$ 2,405.1	$ 2,143.5
Water	1,135.5	1,296.7	1,515.6	1,542.9	1,583.4	1,446.5
Oil Pipeline	691.5	784.4	930.9	1,113.5	1,280.4	1,330.0
Air	94.7	118.0	139.6	159.2	149.6	154.8
Other Shipper Costs	237.7	252.6	283.4	242.1	260.1	238.9
Total Nonhighway	$ 3,437.6	$ 3,894.8	$ 4,591.1	$ 5,122.3	$ 5,678.6	$ 5,313.7
Total Freight	$ 15,094.9	$ 17,553.4	$ 21,854.3	$ 23,870.5	$ 28,574.4	$ 30,764.7
Gross Texas Product (GTP)	$124,235.4	$141,395.7	$159,142.8	$197,834.8	$218,885.1	$229,713.0
Highway Freight as a Percentage of GTP	9.38	9.66	10.85	9.48	10.46	11.08
Total Freight as a Percentage of GTP	12.15	12.41	13.73	12.07	13.05	13.39

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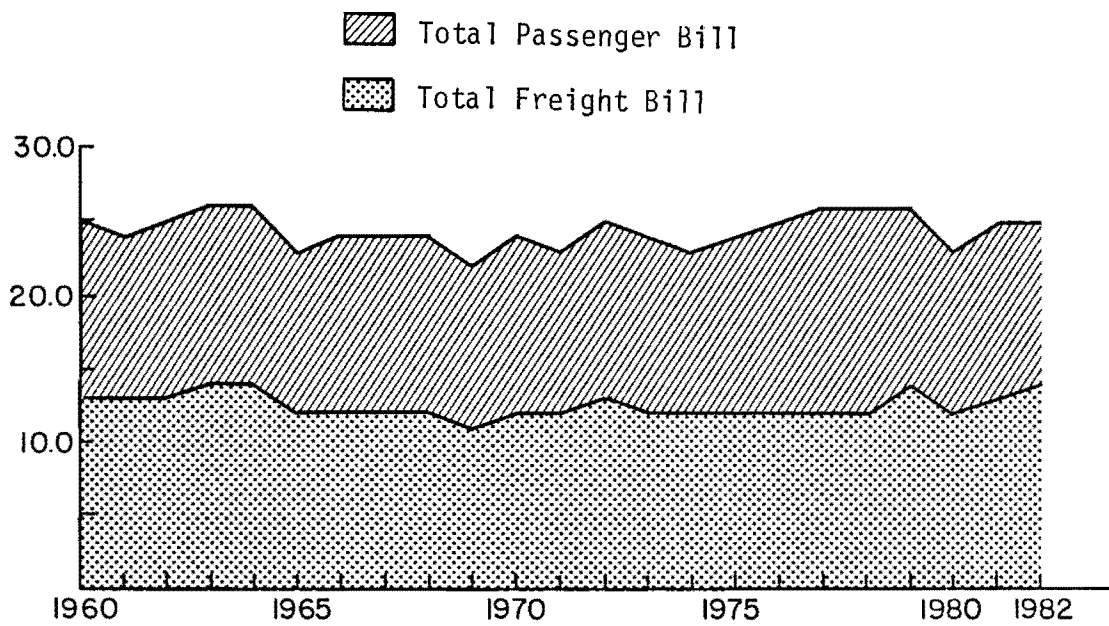
Figure 1. Texas Transportation Bill as a Percentage of Gross Texas Product
1960-1982

dollar per capita basis. The effect of inflation on the transportation bill can be seen by comparing the total bill in current dollars (Figure 2) to the total bill in constant dollars (Figure 3). The slope of the line is less in Figure 3 than in Figure 2 because the effect of inflation has been eliminated. The effects of both population and inflation have been removed from the bill in Figure 4, which presents the bill as constant dollar per capita expenditures.

The current and constant dollar data show:

1. The total Texas transportation bill increased from $12.4 billion in 1970 to $57.6 billion in 1982. This was an increase of 363 percent in current dollars and 187 percent in constant dollars.

2. Texas' freight transportation bill was $6.2 billion in 1970 and $30.7 billion in 1982. This was an increase of 399 percent in current dollars and 196 percent in constant dollars.

3. Texas' passenger transportation bill increased $20.6 billion, from $6.3 billion to $26.9 billion in 1970 and 1982, respectively. The current dollar increase was 328 percent and the constant dollar increase was 176 percent.

These figures indicate that from 1970 to 1982 expenditures for freight transportation have increased faster than expenditures for passenger transportation. Freight transportation accounted for more than half of the transportation bill from 1971 to 1974 and 1979 to 1982, returning to the historical relationship seen during most of the 1960's. The dominance of highway transportation modes continues. Highway transportation has increased from 82.2 percent of the transportation bill in 1970 to 85.1 percent in 1982. This steady increase was interrupted by the effect of escalating gasoline prices in 1974, 1979, and 1980. Most
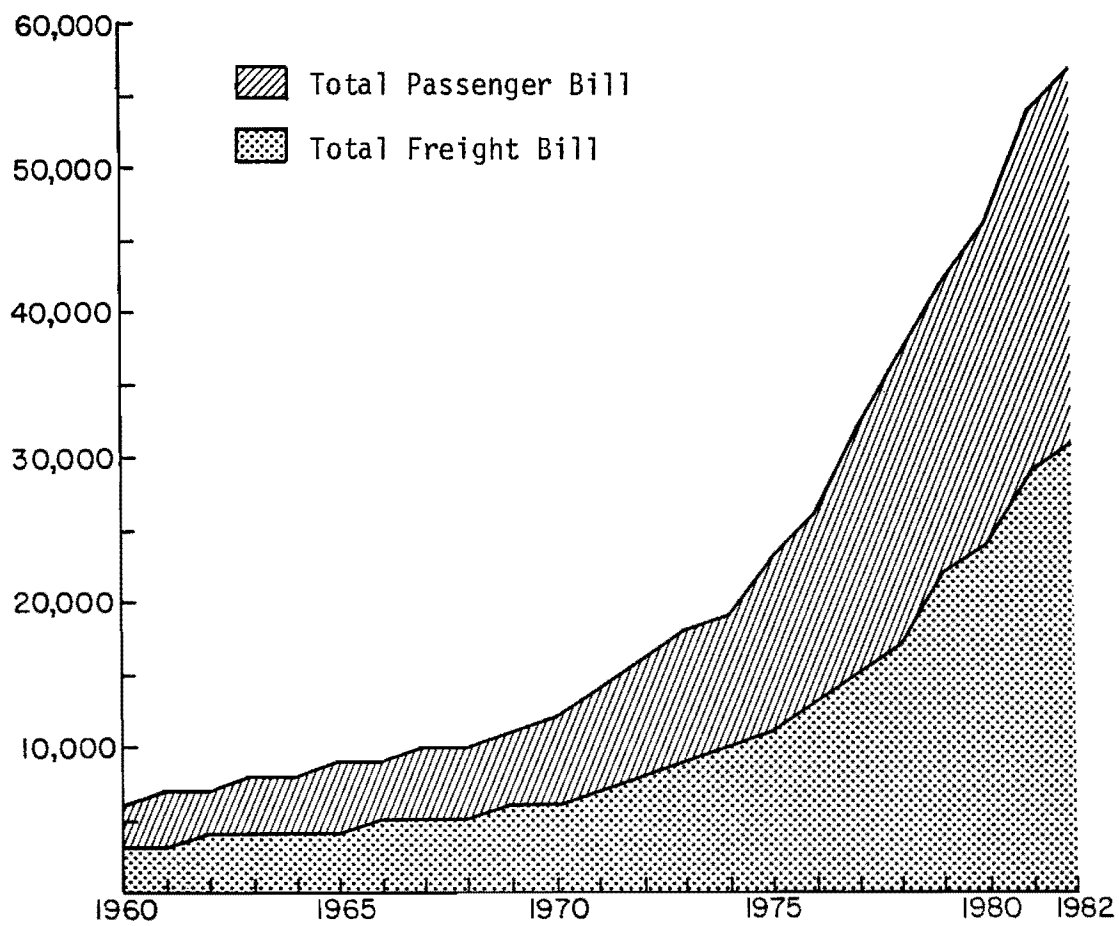
Figure 2. Total Texas Transportation Bill, 1960-1982
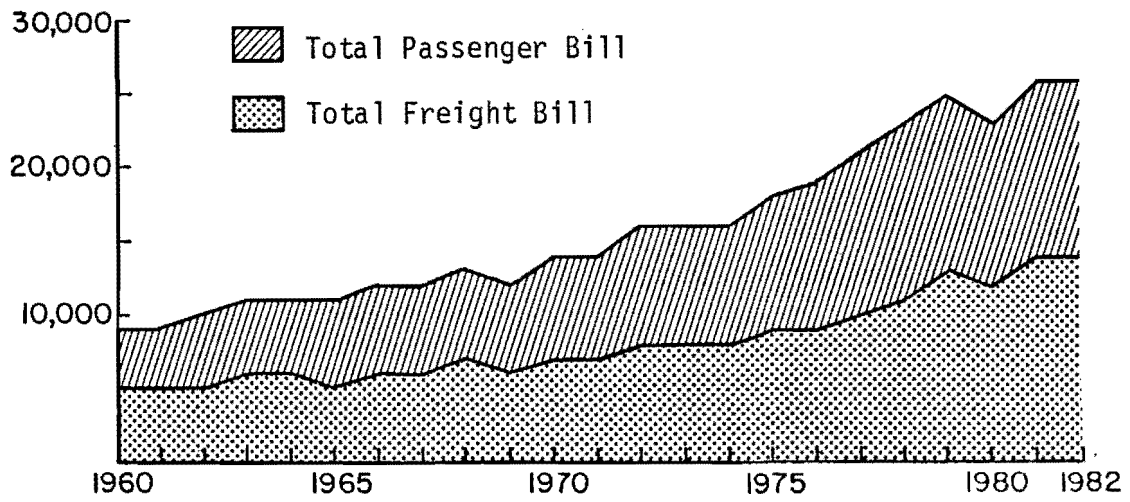(In millions of current dollars)

Figure 3. Total Texas Transportation Bill, 1960-1982
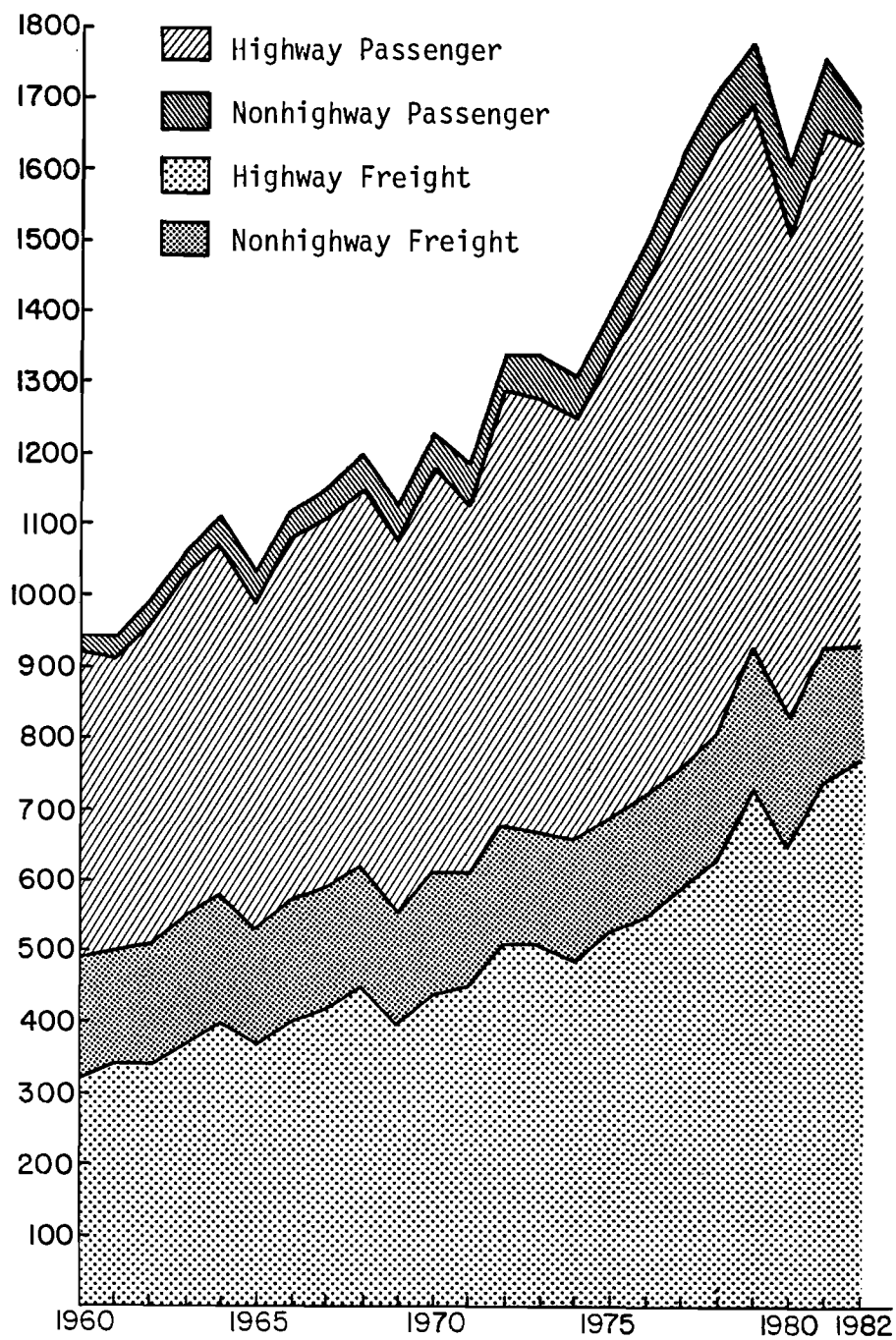(In millions of 1972 dollars)

Figure 4. Texas Per Capita Transportation Expenditures, 1960-1982
(In 1972 dollars)

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of the long-run growth in the Texas transportation bill is attributable to the large growth in the automobile and highway freight modes. However, most of the other modes of transportation have shown a continual increase over time. Expenditures for air transportation represent the fastest growing category of passenger transport. Transport by rail, water, and pipeline continue to grow and to play a critical role in the state's economy, especially for the transport of bulk commodities.

Tables 3 and 4 further illustrate the relationships between the various modes of passenger and freight transportation. Although automobile travel continues to dominate passenger transportation, a greater percentage of each dollar was spent on air travel in 1980 than in 1970. The portion of each freight dollar spent for highway freight was greater in 1980 than in 1970 (78.5 cents in 1980 versus 72.8 cents in 1970). The portion of each freight dollar spent on railroads, water freight, oil pipelines, and other modes decreased during the decade. The largest decrease was in the oil pipeline mode, which fell 40 percent.

Table 3. How the Passenger Transportation Dollar Was Spent

	1970	1980
Automobile	88.8¢	85.2¢
Bus, Taxi, and Transit	2.0	2.1
School Bus	.5	.4
Air	6.9	9.7
General Aviation	1.6	2.5
Rail	.2	.1
Total	100.0¢	100.0¢

Table 4. How the Freight Transportation Dollar Was Spent

	1970	1980
Truck - Intercity	36.7¢	38.2¢
Truck - Local	36.1	40.3
Bus	*	*
Railroads	10.4	8.6
Water	6.4	6.5
Oil Pipeline	7.8	4.7
Air	0.6	0.7
Other	2.0	1.0
Total	100.0¢	100.0¢

*Less than one-tenth of one cent

FORECAST PROCEDURE

Methodology

Estimates of expenditures for transportation in Texas, general Texas and national economic indicators, and the Texas gasoline price index were used to derive single-equation models for forecasting transportation expenditures. Estimators were determined for passenger and freight highway, nonhighway, and total expenditures. The appropriate estimators were determined on the basis of economic theory and statistical tests. The independent variables used were limited by the availability of consistent historical and forecast data.

The historical data from 1960 through 1975[1] were converted to real (1972) dollars to remove the cumulative effect of the rising price level. Transportation bill expenditures and state economic indicators were converted to per capita data to remove the effect of the population increase which Texas has experienced. The per capita constant dollar data was then used to estimate the best forecasting equations. The real per capita forecasts derived from the equations were converted to current dollars and multiplied by the state's forecasted population to arrive at the total transportation bill forecast.

Equations and forecasts were made for passenger and freight highway and non-highway and total transportation expenditures. Equations were chosen on the basis of several statistics: the coefficient of correlation (R^2), the F-statistic, the Durbin-Watson statistic and the coefficients' t-statistics. The coefficient of correlation measures the proportion of variation in the dependent variable which is "explained" by the regression equation. The F-statistic is the

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[1] Data from 1959 through 1975 were presented in Holmes [1]. The 1970 through 1975 data were revised in this report.

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ratio of explained to unexplained variance in the dependent variable. Only equations with an F-statistic large enough to imply at least 95 percent reliability were considered for the model. The Durbin-Watson statistic tests whether or not the error term is autoregressive. Equations which showed autoregression were re-estimated using an iterative technique to correct for autoregression. A coefficient's t-statistic tests whether the coefficient in the equation is significantly different from zero. Equations with coefficients not significantly different from zero at the 90 percent level of reliability were rejected. Each possible equation was analyzed with respect to these criteria. When more than one equation satisfied all criteria, the equation with the highest coefficient of determination was selected.

In order to be useful in the regression analysis and forecasts, independent variables must fulfill two primary requirements. First, each variable must be relevant, in terms of economic theory, to transportation expenditures. Second, consistent historical data as well as forecasts of the variable must be available. This second criterion was found to be the most difficult to meet.

There are five independent variables which fulfilled these requirements and were used in determining the regression equations:

(1) the real (constant dollar) Gross Texas Product per capita,

(2) the real gasoline price index for Texas,

(3) the United States unemployment rate,

(4) the Texas unemployment rate, and

(5) the per capita real personal income in Texas.

Annual data and forecasts were collected and analyzed with respect to each of these five variables. The following section presents the estimators derived from the historical data.

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Estimators

Using the economic variables described earlier, equations were estimated for highway, nonhighway, and total passenger and freight transportation bills. The regression analysis yielded some interesting results: while the highway and total transportation bills could be fitted to statistically significant equations, the non-highway freight bill could not. This was due in part to the difficulty, noted by Holmes [1], in modeling the waterborne commerce and oil pipeline transportation bills. Changes in these nonhighway freight expenditures are related to changes in the national and international economies and are more difficult to forecast than highway expenditures which are more directly related to the Texas economy.

The forecast equations are presented below with their coefficients of correlation (R^2), standard errors (SE) and t-statistics. All F-statistics were significant at the 95 percent level of confidence. All coefficients' t-statistics were significant at the 95 percent level of confidence, except for real gross state product in the highway freight equation, which was significant at the 90 percent level of confidence. All Durbin-Watson statistics indicated no auto-regression.

Passenger Equations

The best per capita estimators of expenditures for passenger transportation have the real gas price index and per capita real gross state product as independent variables. The equation for the highway passenger bill is:

$$Y = 104.76 - 2.1202 \ X_1 + 0.137482 \ X_2, \quad R^2 = .9276, \quad SE = 33.55,$$
$$(.91) \quad (02.85) \quad (5.77)$$

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where Y is constant dollar per capita highway passenger expenditures, X_1 is the real gas price index and X_2 is the per capita real Gross Texas Product. The equation for the total passenger bill is:

$$Y = 40.1502 - 1.89738\ X_1 + 0.155237\ X_2, \quad R^2 = .9461, \quad SE = 33.51,$$
$$(.35) \qquad (-2.56) \qquad\quad (6.57)$$

where Y is the constant dollar total passenger bill per capita, and X_1 and X_2 are the same as in the highway passenger equation. The nonhighway passenger bill is the difference between the total passenger and highway passenger bills.

Freight Equations

Both freight equations indicate that real per capita freight expenditures are a function of the real gas price index and the per capita real Gross Texas Product. The best equation for forecasting the highway freight bill is:

$$Y = -216.206 + 0.914078\ X_1 + 0.112462\ X_2, \quad R^2 = .9427, \quad SE = 33.84,$$
$$(-4.67) \qquad (1.95) \qquad\quad (12.80)$$

where Y is the per capita highway freight bill in constant dollars, X_1 is the real gas price index and X_2 is the per capita real Gross Texas Product. The regression equation for the total freight bill is:

$$Y = -79.2075 + 1.14805\ X_1 + 0.113110\ X_2, \quad R^2 = .9344, \quad SE = 37.47,$$
$$(-1.55) \qquad (2.21) \qquad\quad (11.62)$$

where Y is the per capita total freight bill in constant dollars and X_1 and X_2 represent the same variables as in the previous equation. The nonhighway freight transportation bill is the difference between the total freight and highway freight bills.

TRANSPORTATION BILL FORECAST

The equations presented in the previous chapter were used to estimate per capita constant dollar transportation expenditures. The real gross state product forecast was made by Plaut [3]. The per capita forecasts were multiplied by the state's projected population [4] to yield the state's real transportation bill forecast, which was then multiplied by the Texas gross product deflator [3] to arrive at the current dollar transportation bill forecast. Appendix B gives the sources of the independent variable forecasts.

The Texas transportation bill is expected to increase through the year 2005, due to increases in population and constant dollar Gross Texas Product. The forecasts are summarized in Tables 5, 6 and 7. Table 5 shows the projected expenditures in the state for highway and nonhighway passenger and freight modes in constant dollars. Actual expenditures will be higher, the degree of which will depend on the actual amount of inflation in the future. Table 6 presents projected current dollar expenditures which take into account the inflation forecasted by Plaut [3]. The trends in the relationship of the different modes to the transportation bill are summarized in Table 7. Freight transportation will continue the trend of 1979 through 1982 and constitute more than half the total bill in 1985, but will fall to less than half of the bill in the late 1980's. The passenger bill is expected to increase relative to the total transportation bill through 2005. Highway transportation will continue to dominate Texas transportation, growing from 85.3 percent of the transportation bill in 1985 to 88.3 percent in 2005.

Table 5. Forecast of the Constant Dollar Texas Transportation Bill
(In Millions of 1972 Dollars)

	1985	1990	1995	2000	2005
Passenger					
Highway	$ 13,724.4	$ 17,732.2	$ 22,507.6	$ 28,477.7	$ 35,692.6
Nonhighway	1,724.6	2,252.1	2,908.1	3,694.1	4,646.6
Total Passenger Bill	$ 15,449.0	$ 19,984.3	$ 25,415.7	$ 32.171.8	$ 40,339.2
Freight					
Highway	$ 12,704.7	$ 16,316.6	$ 20,652.2	$ 25,842.6	$ 32,107.2
Nonhighway	2,827.6	3,153.5	3,511.4	3,892.8	4,317.9
Total Freight Bill	$ 15,532.3	$ 19,470.1	$ 24,163.6	$ 29,735.4	$ 36,425.1
Total Transportation Bill	$ 30,981.3	$ 39,454.4	$ 49,579.3	$ 61,907.2	$ 76,764.3
Real Gross Texas Product (RGTP)	$ 124,254.9	$ 156,984.4	$ 197,805.8	$ 246,367.8	$ 305,933.8
Transportation Bill as a Percentage of RGTP	24.93	25.13	25.06	25.13	25.09

Table 6. Forecast of the Current Dollar Texas Transportation Bill
(In Millions of Current Dollars)

	1985	1990	1995	2000	2005
Passenger					
Highway	$ 37,056.0	$ 63,835.8	$ 108,036.3	$ 176,561.7	$ 289,109.6
Nonhighway	4,656.4	8,107.5	13,959.3	22,903.3	37,638.0
Total Passenger Bill	$ 41,712.4	$ 71,943.3	$ 121,995.6	$ 199,465.0	$ 326,747.6
Freight					
Highway	$ 34,302.7	$ 58,739.7	$ 99,130.4	$ 160,224.2	$ 260,068.4
Nonhighway	7,634.6	11,352.5	16,855.0	24,135.0	34,975.1
Total Freight Bill	$ 41,937.3	$ 70,092.2	$ 115,985.4	$ 184,359.2	$ 295,043.5
Total Transportation Bill	$ 83,649.7	$ 142,035.5	$ 237,981.0	$ 383,824.2	$ 621,791.1
Gross Texas Product (GTP)	$ 335,488.2	$ 565,143.8	$ 949,467.8	$1,527,480.4	$2,478,063.8
Transportation Bill as a Percentage of GTP	24.93	25.13	25.06 ·	25.13	25.09

Table 7. Distribution of the Transportation Dollar

	1970	1980	1990	2000
Passenger				
Highway	46.2¢	42.3¢	44.9¢	46.0¢
Nonhighway	4.3	5.9	5.7	6.0
Total	50.5¢	48.2¢	50.6¢	52.0¢
Freight				
Highway	36.0¢	40.7¢	41.4¢	41.7¢
Nonhighway	13.5	11.1	8.0	6.3
Total	49.5¢	51.8¢	49.4¢	48.0¢
Total	100.0¢	100.0¢	100.0¢	100.0¢

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APPENDIX A

This appendix details the procedures used to obtain historical data. Esti-
mates of the state's historical passenger and freight bills were obtained by
employing methodology similar to that used by the Transportation Association of
America (TAA) in their data collection for Transportation Facts and Trends [2].
Each transportation mode was examined separately to determine as accurately as
possible each mode's contribution to the total transportation expenditures in
Texas.

PASSENGER TRANSPORTATION

Private Auto

New and Used Cars

Automobile purchases are the sum of gross new and net used motor vehicle
sales obtained from the Revenue Estimating and Research Division of the Texas
Comptroller of Public Accounts [5].

Auto Repair

The auto repair category includes auto repair, parts, tires, batteries, and
accessories. The expenditures in 1977 came from the 1977 Census of Retail Trade.
Data for 1975 and 1976 were interpolated using the 1972 and the 1977 Census of
Retail Trade [6]. Expenditures in Texas after 1977 were assumed to increase at
the same rate as the United States. For these years, expenditures were calcu-
lated from the United States Personal Consumption Expenditures for "tires, tubes,
accessories, and other parts" and "repair, greasing, washing, parking, storage,
and rental" [7]. The sum of these figures was divided by .85 to put back in the
estimated expenditures for business use that were deducted by the Bureau of
Economic Analysis in preparing the tables.

Gasoline

Gasoline expenditures were calculated from Census data, gallons used, and the price per gallon. The 1977 data came from the 1977 Census of Retail Trade [6]; 1975 and 1976 data were interpolated. Post-1977 data were estimated by multiplying gasoline usage [8] by the average Texas price per gallon [9,10] to determine an intermediate estimate of expenditures. To provide consistent post-1977 data, the rate of change in the intermediate estimate was applied to the 1977 data.

Registration Fees

Registration fees are the sum of automobile, motorcycle, and noncommercial truck and trailer registration fees [8]. Noncommercial truck and trailer fees were estimated as 3.552 percent and 30.927 percent, respectively, of truck and trailer registration fees, based on the average ratio of noncommercial to total fees from 1973 through 1975.

Operators' Licenses

Expenditures for operators' licenses were estimated from the number of licenses issued [8]. A portion of the difference between estimated total license revenue and revenue collected (due to duplicate licenses) was allocated to operators' licenses based on the ratio of operators' licenses to total licenses issued.

Tolls

Toll expenditures are the sum of tolls collected by the state, county, and municipal governments [8]. The 1982 county and municipal tolls were estimated using the percentage change in vehicle-miles traveled in Texas.

Fines and Penalties

Fines and penalties are the total of fines and penalties collected by state, county, and municipal governments [8]. The 1981 county and municipal fines and

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penalties were estimated as a percentage of total receipts, based on the ratio of
fines and penalties to total receipts from 1975 to 1980. The 1982 county and
municipal collections were assumed to change at the same rate as state
collections.

Parking Meters

Parking meter expenditures are municipal revenues from parking facilities
[8]. The 1981 figure was estimated from total municipal revenue, based on the
ratio of parking revenue to total municipal revenue from 1975 to 1980.

Insurance

Automobile insurance expenditures are the net premiums paid in Texas for car
insurance [11]. The 1982 data was estimated from the percentage change in United
States Personal Consumption Expenditures for net insurance premiums [7].

Interest on Debt

Interest payments were estimated from the amount of automobile purchases,
the percentage of purchases financed, the average interest rate charged, and the
average maturity of loans made in each year [6,12,13]. Interest paid in any
given year consists of the first year's interest payment on that year's car
sales, the second year's interest payment on car sales made in the previous year,
and so forth.

Bus, Taxi, and Transit

The bus, taxi, and transit passenger bill estimation is similar to the bus
freight bill estimation procedure. The 1972 Texas revenue for intercity rural
highway and suburban transportation [14,15] was updated assuming Texas changed at
the same rate as the nation. The amount of this revenue attributable to freight
was estimated and subtracted from the total bus, taxi, and transit revenue to
arrive at the passenger revenue.

School Bus

Texas school transportation expenses were obtained from reports of the Texas Education Agency [16].

Air Passenger

The air passenger bill is the sum of the passenger revenues attributable to Texas operations for each airline serving the state [17,18,19]. Each airline's Texas revenue is its total passenger revenue times the ratio of Texas enplaned passengers to total enplaned passengers.

General Aviation

Expenditures for general aviation include private aircraft purchases and repair and gasoline and jet fuel sales. Private aircraft and repair revenue was obtained from the Comptroller of Public Accounts Office [5]. Gasoline and jet fuel sales were calculated by multiplying the fuel prices by the estimated fuel consumed [20]. Gallons of fuel used was determined by multiplying the number of general aviation aircraft in each of six categories by the average hours flown and the average amount of fuel consumed per hour [21]. Annual consumption was then summed for all gasoline and all jet fuel aircraft.

Rail Passenger

Rail passenger revenues were derived from Amtrak operating data and the number of passengers in Texas [22,23,24]. Amtrak revenue per passenger mile was determined for each year as operating revenue divided by passenger miles. The passenger miles in Texas after 1975 were assumed to increase at the same rate as the number of passenger miles multiplied by the Amtrak revenue per passenger mile.

FREIGHT TRANSPORTATION

Intercity Motor Freight

The intercity motor freight bill was estimated by multiplying the ratio of Texas to the United States special fuel consumption [8] by the nation's total intercity motor freight bill [2]. The majority of intercity motor freight is carried by trucks operating on special fuels.

Local Trucks

Texas local truck freight revenue was assumed to increase at the same rate as United States revenue. The United States' local truck revenue for 1975-1978 was obtained from TAA [2]; 1979-1982 was estimated from trucking operating revenue data published by the federal government [7] and urban truck mileage [8].

This methodology differs from the previous report because per-mile local truck operating costs data were not available on a consistent basis from 1975 through 1982. The vehicle sample from which the data was derived underwent a drastic change in 1976. The vehicle size classification of data also changed between 1975 and 1982.

Bus Freight

The Texas bus freight bill is a percentage of total revenue for intercity rural highway and local suburban transportation. The 1972 revenue for these categories was updated assuming Texas revenue increased at the same rate as the United States [17,7]. The estimated revenue for intercity rural highway and local suburban transportation is multiplied by the national ratio of freight to total bus, taxi, and transit revenue.

Rail Freight

The rail freight bill is the total of Class I and Class II railroads' freight revenue. National freight revenue and total operating revenue data were collected for all railroads operating in Texas [23,25]. Each year's ratio of freight to total operating revenue was multiplied by Texas railway operating revenue. Because Texas revenue data did not include Class II railways, the initial estimates of operating revenue were multiplied by 1.029724 to include Class II. From 1970 to 1975, Class II freight revenue averaged 2.9724 percent of Class I freight revenues.

Waterborne Commerce

The 1972 water freight revenue was updated to obtain 1975 through 1982 revenues. The ratio of current-year to base-year tonnage handled and the whole-sale (producer's) price index were used to update the revenue [14,15,26].

Oil Pipelines

The 1972 oil pipeline revenue was updated assuming that revenues increased at the same rate as did Texas oil pipeline wages [14,27]. The procedure from the previous report was not used because United States oil pipeline and wage revenue data was discontinued in 1978.

Air Freight

The air freight bill is the sum of the freight revenues attributable to Texas operations for each airline serving the state. Each airline's Texas revenue is calculated by multiplying the total freight revenue by the ratio of Texas enplaned freight tons to total enplaned freight tons [18,19].

Other Shipper Costs

The ratio of other shipper costs to the freight bill excluding other shipper costs was assumed to be the same in Texas as in the nation. The ratio of the United States' other freight costs to freight excluding other freight costs [2] was multiplied by the Texas freight bill excluding other freight costs.

APPENDIX B

This appendix details the sources of the independent variable forecasts used to forecast the transportation bill.

STATE ECONOMIC INDICATORS

The Gross Texas Product and the gross product deflator variables indicate the general health of the economy. The forecasts of these variables were obtained from the Bureau of Business Research [3].

POPULATION

The population projections used were the "medium" projections made by TTI in a separate report [4].

REAL GAS PRICE INDEX

The real gasoline price index forecast was derived by TTI from forecasts of the United States gasoline price index [28]. The Texas current dollar gasoline price was initially assumed to change at the same rate as the U.S. The five cent per gallon tax increase, effective August 1, 1984, was then added to the initial current dollar price per gallon. The price, including the tax, was converted to a current dollar gasoline price index and divided by the Consumer Price Index [28] to yield the real gasoline price index.