Economic Impacts of Transportation Fuel Consumption in the Dallas-Fort Worth Area

MICHAEL MORRIS, WILLIAM BARKER, and JULIE DUNBAR

ABSTRACT

A mechanism is demonstrated for evaluating the impacts of transportation fuel consumption and price on a local economy. The project was derived from the observation that economic impacts of transportation actions and policies are often desired by local decision makers. It is also observed that the effect of changes in local transportation fuel expenditures on a local urban economy is generally unknown in any quantifiable form. The overall objective of this investigation is to incorporate local economic considerations into the urban transportation planning and decision-making process.

This methodology proposes that the most useful way to approach an assessment of local economic impacts is by linking the concepts of household expenditures and interindustry economics. Urban transportation planners and policy analysts have recognized for a long time that the household is the basic decision-making unit where trade-offs are made among alternative transportation services (1). The household is also the focus of decision making about expenditures for transportation fuels versus other needs and desires of the household. Therefore, in this approach, transportation, energy, and the household economy were analyzed simultaneously.

What are the effects of these changing household expenditure patterns on the overall economy of an urban area? A widely used means of answering this question is the interindustry or input-output model (2). Interindustry analysis explains how each sector of an economy is linked with every other sector. An input-output model can show, for example, what happens to all industries in an area if households reduce their consumption of gasoline. Using this approach, it is possible to quantify the effects on an urban area through aggregate measures of economic performance such as employment and income (3-5). Recently a large number of studies have been conducted at the federal level, and to some extent at the state level, that link these economic performance measures with energy consumption (6,7).

Because economies and energy situations vary from locale to locale within the United States, it should be expected that changes in transportation energy efficiency and fuel prices would have unique impacts in each area. Thus, a procedure that reflects these local differences is needed to estimate these impacts. The results of this study were published in a planning manual for local and state officials. The procedures in the manual can be used to assess quantitatively the economic impact of changes in fuel price and consumption levels. The important components of three detailed reports written for the U.S. Department of Transportation and the U.S. Department of Energy (8-10) are highlighted in this paper. The third report in this series contains a step-by-step procedure to implement the proposed methodology.

The procedures developed in this project can be used to address a number of issues of interest to state and local policy makers. Such policy questions include

1. What are the economic consequences to a particular urban area of increased gasoline prices?
2. What are the economic benefits to a local community of an increase in fuel efficiency?
3. What are the long-term effects on the household and trucking sectors of an urban area of changing fuel prices and fuel efficiency levels?
4. What is the economic impact on a local community of sanctions on roadway construction funds by the U.S. Environmental Protection Agency?

To demonstrate this planning tool, these four questions were evaluated for the Dallas-Fort Worth area.

Changing energy prices and more efficient automobiles can be expected to cause changes in household expenditure patterns. As the price of gasoline goes up, for example, households may reduce their use of the private automobile to compensate for the price increase. They may switch to alternative forms of transportation, reduce their expenditures in other areas, purchase a more fuel-efficient automobile, or choose some combination of these and other options. In linking transportation energy and economic analysis, it seems appropriate to investigate the basic trade-offs the household is making, not only in the transportation area but also among transportation and other household expenditures. The procedures and results of these interrelationships are summarized in this paper.

The three remaining sections of paper contain an overview of the methodology, a review of important planning manual components, and the results of the application of the methodology to the Dallas-Fort Worth area.

OVERVIEW OF THE METHODOLOGY

The methodology is outlined in a series of 10 steps and addresses both the household and trucking-related sectors of the economy. The procedure examines the impact on the household and trucking sectors separately. This enhances the flexibility of the analysis by allowing the planner or engineer to evaluate only those sectors that are of the most concern. The results of this study indicate the importance of evaluating the trucking sector of a local economy.

The flexibility of the procedure is also demonstrated by its applicability to any planning region. A planning area at the local, regional, or state level can undertake this method of analysis by using the area-specific factors supplied by the manual (10). The only major piece of information the manual does not supply is an input-output model for the area of interest. If a locally derived input-output model is not available, it will be necessary to obtain estimates of household expenditures by economic sector, along with economic multipliers supplied by the Bureau of Economic Analysis (11).

For some time, input-output analyses have been applied to transportation problems at the local, state, and federal levels. Goldstein highlighted a variety of applications along these lines more than a decade ago (12). More recently, the National Cooperative Highway Research Program (NCHRP) is sponsoring two handbooks for state departments of transportation. These handbooks will provide techniques useful in applying input-output concepts to the analysis of transportation policy (13). Figure 1 shows an overview of the planning approach. Each of the key elements of the approach is described below.

Step 1: Alternative Local Transportation Policies

The local policies of interest in this step are those that affect the energy consumption of the transportation system. These actions might include traffic signalization programs, ridesharing programs, fuel price changes, and so forth. Because the impact of these policies varies among urban areas, it is necessary for the local analyst to quantify the changes in energy consumption that result from a particular action.

Step 2: External Events

The local price of transportation fuels and the efficiency with which they are used are determined mostly by events and forces outside the control of local policy makers. Events such as OPEC oil price changes and domestic oil deregulation have significant impacts on fuel prices and consumption levels. Likewise, federal laws pertaining to automotive fuel economy probably have a greater effect on transportation energy efficiency than do local transportation actions. Again, it is appropriate for the local planner to determine the nature of these external factors and their influence on the local transportation situation because these values change from time to time.

Step 3: Estimated Fuel Prices and Transportation Efficiencies

Taking into consideration the local and external factors discussed in Steps 2 and 3 that affect local transportation fuel prices and transportation efficiencies, the local planner establishes fuel price and efficiency scenarios for the analysis. Background information on projected fuel prices and energy efficiency values is presented in the manual series to assist the local analyst with this activity. The goal of the analysis is to determine the economic impact of a change in fuel price, efficiency, or a combination of the two. To do this, a base condition (commonly the current situation) must be established; then prices and efficiencies that differ from the base condition are quantified for present-year or future conditions.

Step 4: Sector Energy Consumption Model

The first of two major models in this procedure is the economic sector energy consumption model. This is the central model in the planning manual. The

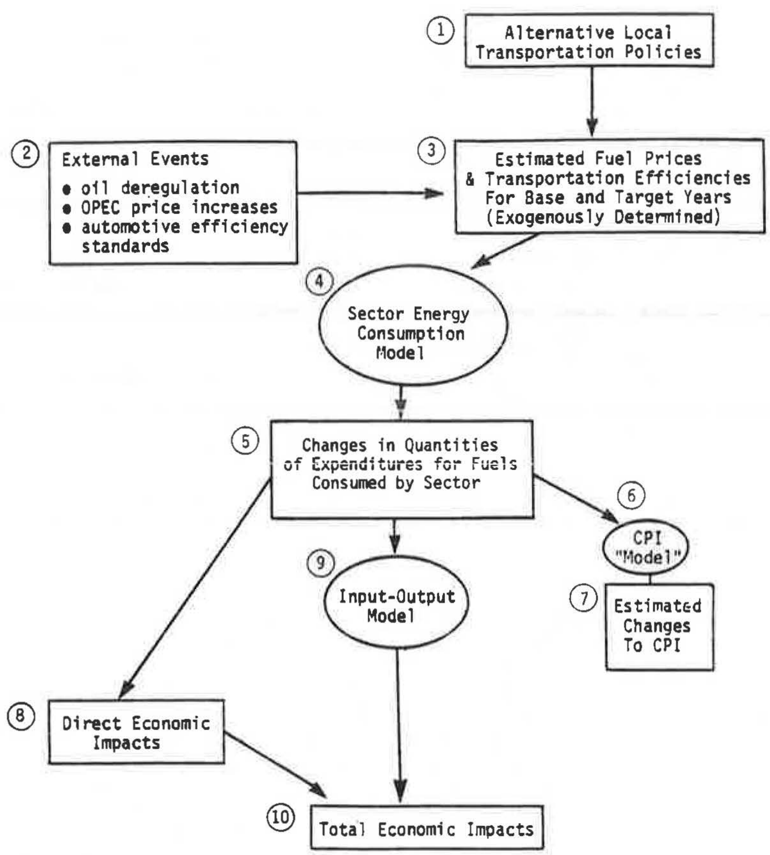

FIGURE 1 Overview of planning approach.

basic function of the model is to replicate the decisions a household makes about purchasing goods and services. When this has been accomplished, the conversion of transportation policies into economic choices can take place.

This model shows how household expenditure patterns would differ from the base condition if fuel prices or efficiencies should change as identified in Step 3. The model estimates changes in gasoline consumption, as well as other changes in household expenditures, caused by changes in gasoline purchasing patterns. The model coefficients used to simulate this change in household purchasing are based on data published by the Bureau of Labor Statistics (BLS) (14). The income/expenditure elasticity coefficients calibrated for this study were estimated by the following regression equation:

$$\ln C_{kj} = \ln a + b \ln Y_j$$

where

- ln = base of natural logarithms,
- C_{kj} = expenditures for industry sector k and jth income group,
- Y_j = income of households in the jth income group, and
- a,b = regression coefficients (b is the elasticity value for each income group and economic sector).

Household expenditure data (C_{kj}) were obtained from the BLS survey of 5,000 items aggregated into 24 household sectors. The original data contained 12 income classes, but they were aggregated into the 3 income classes (Y_j) used in this study. As a result, 72 household expenditure elasticity values were calibrated. This sensitivity to income class increases the accuracy of the study and permits the evaluation of equity concerns. The results of this model are discussed later in this paper.

Step 5: Changes in Quantities of, and Expenditures for, Fuels by Household Sector

Changes in the expenditure pattern for each sector are the output of the model. These estimates are used as input data to the steps that follow. An example of this process is presented later in this paper.

Step 6: CPI Model

The Consumer Price Index (CPI) is based on the current prices of a market basket of goods. The quantities of goods in this market basket are updated only infrequently. One of the purposes of this research is to examine the feasibility of using the CPI as a measure of transportation performance along with the more traditional measures such as volume-capacity ratio, number of accidents, emissions, and delay. By varying the prices and quantities of transportation fuels as if the market basket were updated, it is possible to estimate the impact of changes in transportation system efficiency on the CPI.

Step 7: Estimated Changes in the CPI

The output of the model would be an estimate of the change in the CPI resulting from the previous assumptions and estimates. This change in CPI is based on updated prices for a market basket of goods for the short run and updated prices and quantities for the long run. This distinction is consistent with the method currently used for estimating the CPI. Even though the incomes and benefits of some individuals are adjusted as a result of changes in the CPI (e.g., unions and some welfare programs), it is beyond the scope of this study to reintroduce revised income levels.

Step 8: Direct Economic Impacts

By aggregating the results of the sector energy consumption model, total expenditures by household sector of the economy can be estimated. Total expenditures by commercial sector are also estimated to determine the effects of price and fuel efficiency on truck travel. Changes in these initial expenditures represent the direct economic impacts.

Step 9: Input-Output Model

To determine the rippling effects of changes in household consumption patterns, an input-output model is used. This model estimates direct and total impacts. Direct impacts are defined as the initial changes in expenditures by various sectors of the economy that result from increases or decreases in fuel expenditures. Total impacts include both direct and indirect impacts and are the net effects as industries interact with each other. Indirect impacts result from an increase in demand for the output of one economic sector which indirectly increases the demand for the output of goods and services of other economic sectors that supply products to the first sector. This model is presented later in the analysis.

The altered sector expenditures are the input to the interindustry analysis. Further, the input-output analysis demonstrates any changes in employment and income. These measures are thought to represent best the vitality of the local economic climate. This method of analysis includes the indirect effects of changes in household and commercial sector expenditure.

Step 10: Total Economic Impacts

The changes in total employment and income include both direct and indirect effects. Combining the various economic impacts estimated throughout the steps in this process allows the planner or analyst to make an overall statement about the direction and magnitude of the economic impact of changes in fuel price and efficiency.

Through this analysis it is possible to determine changes in regional employment and income as a result of different transportation-related policy decisions. It is important to realize that this methodology is more accurate for the short term (i.e., less than 5 years) than the long term. To use this tool in long-term evaluations, adjustments are made to the economic multipliers because the coefficients cannot be assumed to be constant over time. Even though some of the scenarios presented for demonstration are for different years, it is suggested that the most accurate use of this methodology is to compare alternative policies for the same year. Therefore, it is recommended that the comparative versus absolute nature of the methodology be used.

A number of assumptions are included in the methodology. These assumptions (shown in Figure 2) help to identify the interrelationships among the various

	FUEL TAX		FUEL PRICE		FUEL EFFICIENCY	
NET CHANGE						
• Fuel Tax	↑	↓	-	-	-	-
• Fuel Price	-	-	↑	↓	-	-
• Fuel Efficiency	-	-	-	-	↑	↓
NET RESULT						
A) Household						
• Income	0	0	0	0	0	0
• Fuel Consumption	0(1)	0(1)	0(1)	0(1)	↓	↑
• Tax-Roadway Construction	↑	↓	0	0	0(3)	0(3)
• Purchases	↓	↑	↓	↑	↑	↓
B) Commercial/Trucking						
• Profit	0	0	0	0	0	0
• Fuel Consumption	0	0	0	0	↓	↑
• Tax-Roadway Construction	↑	↓	0	0	0(3)	0(3)
• Consumer Prices	↑	↓	↑	↓	↓	↑
C) Regional Economic Impact						
• Income/Profit	0	0	0	0	0	0
• Fuel Consumption	0(1)	0(1)	0(1)	0(1)	0(4)	0(4)
• Tax-Roadway Construction	↑(2)	↓	0	0	0(3)	0(3)
• Household Expenses	↓	↑	↓	↑	↑	↓

(1) Small change depending on elasticity
(2) Areawide policy, therefore increase in funding
(3) Localized efficiency - construction funds would not be altered
(4) Greatest impact would be to non-regional refineries

↑ represents an increase in value
↓ represents a decrease in value
0 represents no change

FIGURE 2 Major relationships and assumptions.

components of this procedure. The following is a specific example of how these assumptions are used in this approach.

If a fuel tax were increased, the following assumptions would apply to the household sector of the economy:

- Income would stay the same;
- Fuel consumption would decrease slightly depending on the fuel price elasticity, where fuel price elasticity represents the change in fuel consumption resulting from a change in fuel price;
- Fuel taxes and construction funding would increase; and
- Purchases of goods would decrease.

If a fuel tax were increased, the following assumptions would apply to the commercial trucking sectors of the economy:

- Profit would stay the same;
- Fuel consumption would remain unchanged;
- Tax and roadway construction funding would increase; and
- Costs would be passed through to the consumer in higher prices.

The net economic impact would be

- No change in income and profit would result;
- Fuel consumption would decrease slightly;
- Taxes and construction funding would increase; and
- Household expenses for goods and services would decrease because of higher user costs and higher consumer prices that would result from higher trucking costs.

Other assumptions in this methodology are

- Variable costs (i.e., gasoline, maintenance, and fuel taxes) are included in the analysis and fixed costs (e.g., insurance) are not addressed.
- Vehicle miles of travel (VMT) per household remain constant over time.
- Automobile fuel efficiency and fuel prices do not vary significantly among income groups.
- Fuel prices do not change as a result of energy efficiency improvements in the local transportation system.

REVIEW OF IMPORTANT PLANNING MANUAL COMPONENTS

To demonstrate some of the important mechanical procedures in this methodology, four steps in the process are presented in greater detail. Table 1

TABLE 1 Change in Income for Example Scenarios

	A	B	C[a]	D	E[b]	F[c]
Income Level ($)	Household Transportation Expenditures Before ($)	Household Transportation Expenditures After ($)	Change (%)	Average Income per Income Level ($)	Transportation Expenditures as a Fraction of Income	Change in Income (%)
5-Cent Increase in Fuel Tax in 1982						
Less than 10,000	977.35	997.11	+2.0	5,362.30	0.1823	-0.3645
10,000 to 19,999	1,963.37	2,000.57	+1.9	14,670.28	0.1338	-0.2543
20,000 and up	2,680.60	2,726.20	+1.7	31,023.13	0.0864	-0.1469
Longe-Range Fuel Use and Price Trends by 2000						
Less than 10,000	1,014.82	1,026.67	+1.2	5,362.30	0.1893	-0.2272
10,000 to 19,999	2,034.72	2,062.44	+1.4	14,670.28	0.1387	-0.1942
20,000 and up	2,769.99	2,814.29	+1.6	31,023.13	0.0893	-0.1429
10 Percent Reduction in Fuel Use by 1987						
Less than 10,000	943.63	896.27	-5.0	5,362.30	0.1760	+0.8799
10,000 to 19,999	1,900.52	1,807.96	-4.9	14,670.28	0.1296	+0.6348
20,000 and up	2,634.46	2,486.49	-5.6	31,023.13	0.0849	+0.4755

[a]Column C = (B - A)/A x 100.
[b]Column E = A/D.
[c]Column F = -C x E.

gives the procedure used to determine the percentage change in income that would result from various example scenarios. Notice that transportation expenditures as a fraction of income range between 8.5 percent and 18.9 percent, depending on the year and income group. This is consistent with the traditional averages for these values.

Table 2 gives the income elasticities used in the sector energy consumption model. These values are used to convert the percent change in income to change in expenditures by sector. It seems clear from a review of these values that the elasticity coefficients are reasonable when compared across income groups as well as among economic sectors. This process is demonstrated in Table 3 for a selected policy and income group. This table demonstrates the substitution decisions that a household makes when changes in its household budget are required.

Table 4 gives the results of the input-output model for the same example. The sector definitions have been altered so that they will be consistent with the national input-output model, because these technical coefficients were obtained from the Bureau of Economic Analysis for the Dallas-Fort Worth area. Adjustments are made to the employment multiplier to account for increases in real income for different years used in the analysis. The information given in Table 4 demonstrates the traditional use of an input-output model.

TABLE 2 Income Elasticities by Sector

		Income Level ($)		
Sector Number[a]	Sector Name	Less than 10,000	10,000 to 19,999	20,000 and up
29	Transportation and warehousing	0.137	0.415	1.121
30	Telephone and telegraph	0.489	0.308	0.318
31	TV, radio, and other communications	0.410	0.092	0.095
32	Gas services	0.230	0.131	0.438
33	Electric services	0.436	0.713	0.321
34	Water and sanitation services	0.364	0.543	0.356
40	Building materials, hardware, and equipment	0.315	1.002	0.438
41	Department and variety stores	0.820	0.841	0.752
42	Food stores	0.396	0.513	0.230
43	Automobile dealers and service stations	0.809	0.575	0.144
44	Apparel and accessories stores	0.724	0.728	0.521
45	Furniture and home equipment	0.725	0.659	0.589
46	Eating and drinking places	0.812	0.983	0.479
47	Other retail	0.527	0.994	0.421
48	Banking and credit agencies	1.492	1.388	0.515
49	Insurance carriers	0.677	0.556	0.234
50	Finance, insurance, and real estate	0.372	0.010	0.182
51	Legal, accounting, engineering, and professional services	0.367	3.213	0.507
52	Lodging services	1.312	1.666	1.058
53	Personal services	0.463	0.407	0.690
56	Miscellaneous repair services	0.629	1.300	0.680
57	Medical and other health services	0.411	0.662	0.336
58	Education services	1.008	1.402	0.604
59	Other services	0.560	1.181	1.007

[a]The sectors are those defined by the 1972 Dallas-Fort Worth input-output model.

RESULTS OF THE APPLICATION FOR THE DALLAS-FORT WORTH AREA

To demonstrate this procedure, the results of four examples are presented and evaluated. The first represents a change in fuel tax (i.e., fuel price), the second represents changes in fuel price and efficiency over the long term, the third represents an improvement in fuel efficiency, and the fourth evaluates the impact of sanctions on federal construction funds.

Table 5 gives background information pertaining to each example. Example 1 shows an evaluation where the base condition and alternative (i.e., 5-cent increase in fuel tax) are for the present year. This particular scenario was selected because of the possibility of an increase in state fuel taxes.

It should be recognized that increases in the pump price of gasoline can be brought about by petroleum price increases as well as taxes. The local economic impacts are different for these two types of price increases. In general, petroleum price increases will result in money being exported from the local economy, whereas tax increases may result in an increase in government expenditures in the local economy. The amount of government expenditures depends on which level of government executes

TABLE 3 Change in Group Expenditures Due to a 5-Cent-per-Gallon Tax Increase in 1982 (1977 dollars)

	A	B	C[a]	D	E[b]	F[c]	G	H[d]
Sector Number	Change in Income (%)	Income Elasticity	Change in Expenditures (%)	Fraction of Households	Change in Group Expenditures (%)	1972 Household Expenditures (000)	Population Multipliers	Change in Expenditures ($1977)
29	−0.3645	0.137	−0.049937	0.34	−0.0169786	304,966.37	1.239	−64,154.21
30	−0.3645	0.489	−0.178241	0.34	−0.0606019	125,975.61	1.239	−94,589.74
⋮								
42	−0.3645	0.396	−0.144342	0.34	−0.0490763	485,285.95	1.239	−295,080.72
⋮								
47	−0.3645	0.527	−0.192092	0.34	−0.0653113	356,455.01	1.239	−288,445.89
⋮								
59	−0.3645	0.560	−0.204120	0.34	−0.0694008	164,590.68	1.239	−141,527.56

Note: Income level is less than $10,000.

[a]Column C = A + B.
[b]Column E = C + D.
[c]Column F expenditures have been converted to 1977 dollars using values from the Dallas-Fort Worth consumer price index.
[d]Column H = (E/100) x F x G x 1,000.

TABLE 4 Results of a 5-Cent-per-Gallon Increase in 1982 (1972 dollars)

	A	B	C	D[a]	E	F[b]	G	H	I[c]
Sector Number	Change in Household Expenditures ($000)	Change in Trucking Expenditures ($000)	Final Demand Multiplier	Total Change in Expenditures ($000)	Income Multiplier	Change in Income or Revenue ($)	Employment Multiplier	Employment Adjustment	Change in Employment
1	—	−1,913.57	2.2111	−4,231.09	0.4552	−1,925,994.27	0.00011	0.84	−178
2	—	—	2.1987	0.00	0.5021	0.00	0.00011	0.84	0
3	—	—	2.2537	0.00	0.5438	0.00	0.00003	0.84	0
4	—	−25.61	1.9019	−48.71	0.2671	−13,009.82	0.00002	0.84	0
5	—	—	2.3798	0.00	0.5638	0.00	0.00005	0.84	0
6	—	−1,675.16	2.9223	−4,895.32	0.7271	−3,559,387.22	0.00008	0.84	−239
7	—	—	2.8962	0.00	0.8058	0.00	0.00009	0.84	0
8	—	−1,054.87	2.2181	−2,339.81	0.3918	−916,736.44	0.00004	0.84	−31
9	—	−247.68	2.1099	−522.58	0.4518	−236,101.66	0.00006	0.84	−12
10	—	—	2.3171	0.00	0.5329	0.00	0.00011	0.84	0
11	—	−388.06	2.3719	−920.44	0.5551	−510,935.97	0.00005	0.84	−21
12	—	—	2.7221	0.00	0.7108	0.00	0.00009	0.84	0
13	—	−805.95	2.4813	−1,999.80	0.4918	−983,503.48	0.00003	0.84	−25
14	—	—	2.3809	0.00	0.5481	0.00	0.00006	0.84	0
15	—	—	2.4207	0.00	0.5649	0.00	0.00008	0.84	0
16	—	—	2.7761	0.00	0.6398	0.00	0.00006	0.84	0
17	—	−453.31	2.2994	−1,042.34	0.5235	−545,665.52	0.00004	0.84	−18
18	—	−225.39	2.2934	−516.91	0.5127	−265,019.46	0.00005	0.84	−11
19	—	−357.98	2.4721	−884.96	0.5914	−523,366.74	0.00005	0.84	−22
20	—	−348.54	2.9584	−1,031.12	0.8005	−825,412.15	0.00008	0.84	−55
21	—	−1,803.55	2.0184	−3,640.29	0.3479	−1,266,455.26	0.00003	0.84	−32
22	—	—	3.0598	0.00	0.7926	0.00	0.00006	0.84	0
23	—	—	2.7451	0.00	0.7379	0.00	0.00008	0.84	0
24	—	—	2.6427	0.00	0.6363	0.00	0.00011	0.84	0
25	−279.55	−838.19	2.7697	−3,095.80	0.7486	−2,317,519.23	0.00006	0.84	−117
26	−458.72	—	2.2641	−1,038.59	0.5581	−579,635.94	0.00004	0.84	−19
27	−283.05	−573.13	2.2138	−1,895.41	0.3617	−685,570.26	0.00003	0.84	−17
28	—	−1,714.95	2.6366	−4,521.37	0.7256	−3,280,708.62	0.00007	0.84	−193
29	−2,990.28	−384.86	2.5959	−8,761.53	0.7326	−6,418,693.89	0.00011	0.84	−593
30	−961.99	—	2.7219	−2,618.44	0.6587	−1,724,766.81	0.00011	0.84	−159
31	−1,517.91	—	2.8677	−4,352.91	0.7041	−3,064,884.29	0.00007	0.84	−180
32	−391.74	—	3.6246	−1,419.90	1.0111	−1,435,661.70	0.00011	0.84	−133
33	−162.01	—	1.6184	−262.20	0.1747	−45,805.81	0.00002	0.84	−1
34	−332.46	—	2.7315	−908.11	0.6644	−603,351.27	0.00021	0.84	−106
35	−263.67	—	2.9928	−789.11	0.8601	−678,714.87	0.00011	0.84	−63
36	−331.25	—	2.7933	−925.28	0.7809	−722,551.64	0.00006	0.84	−36
37	−776.29	—	2.4738	−1,920.39	0.6332	−1,215,988.54	0.00007	0.84	−72
38	−1,450.99	—	2.7905	−4,048.41	0.7419	−3,003,513.30	0.00051	0.84	−1,287
39	—	—	2.4766	0.00	0.3676	0.00	0.00021	0.84	0
Total	−10,135.90	−12,810.70		−58,630.82		−37,348,954.17			−3,621

[a]Column D = (A + B) x C.
[b]Column F = D x E x 1,000.
[c]Column I = F x G x H.

TABLE 5 Four Selected Transportation Policies and Actions Evaluated for the Dallas-Fort Worth SMSA

	Variables Changed			
Type of Analysis	Energy Price	Energy Efficiency	Energy Price and Energy Efficiency	Construction Funding
Base year alternative	Example 1: Short-range impact of a 5-cent increase in state fuel tax in 1982.			Example 4: Short-range impact of Environmental Protection Agency sanctions on roadway construction.
Base year and future year projection			Example 2: Long-range price and efficiency impact between 1980 and 2000.	
Future alternative		Example 3: Medium-range 10 percent fuel efficiency improvement above anticipated 1987 levels.		

the tax. Two options are presented to demonstrate this point.

Example 2 evaluates the long-term effects of changes in fuel price and fuel efficiency over time. This scenario was selected because economic impact measures were needed to assist in formulating the year 2000 long-range plan for the Dallas-Fort Worth area. An important issue in this plan is the impact of the cost and availability of petroleum on future travel. Another key component of the plan is an estimate of the transportation revenue generated by users in 2000. Specific attention to the impact of projected fuel price increases on the trucking sector of the economy between now and 2000 is included in the long-range plan.

Example 3 evaluates the economic impact of fuel efficiency improvements. This scenario represents the maximum energy efficiency that would be obtained from the implementation of transportation control measures and transportation system management actions in the Dallas-Fort Worth area. This package of actions is being tested as a possible component of a revised State Implementation Plan for Air Quality.

Example 4 evaluates the economic impact of a sanction on federal roadway construction functions. This action may be imposed by the Environmental Protection Agency for regions where air quality standards are not being achieved.

As discussed previously, this approach is intended for use by local, regional, and state transportation planners and engineers for estimating economic impacts of transportation fuel consumption on both the household and trucking sectors of the economy. Of the 59,840,000 daily vehicle miles of travel (VMT) in the Dallas-Fort Worth Standard Metropolitan Statistical Area (SMSA) for 1977, household or personal travel composes 48,878,000 VMT per weekday (77.6 percent) and trucking travel composes 9,513,000 VMT per day (15.8 percent). The remaining 1,450,000 VMT (6.6 percent) is made up of other users consisting of public service vehicles, such as police cars and fire trucks, and business and rental cars. The methodology contained in this planning manual addresses 93.4 percent of all roadway travel. Essential services and business and rental car travel are not included in this analysis because of their relative insensitivity to fuel price and efficiency. This omission greatly reduces the number of calculations without affecting the results in any significant way.

Table 6 gives the economic impact of the example alternatives evaluated for the Dallas-Fort Worth area. Recalling that Example 1 represents a 5-cent-per-gallon state fuel tax increase, the results of this investigation show that approximately 500 jobs would be lost to the economy of the Dallas-Fort Worth SMSA. Traditionally, such tax increases are presented as an employment benefit. This information indicates that there is no improvement in employment in the Dallas-Fort Worth area if a state gasoline tax is implemented. It is estimated that the Dallas-Fort Worth area "donates" 55 percent of its fuel-tax-generated revenue to other parts of the state.

To demonstrate the economic impact of a policy that would increase local fuel taxes, a study was conducted of Example 1B. This example evaluates a policy of returning 90 percent of the revenue from fuel tax dollars to the Dallas-Fort Worth area and results in an increase of 2,700 jobs. This option is much more beneficial because of the greater return of construction funds to the local area.

Example 2 shows a loss of 34,000 jobs as a result of the long-term changes in fuel price and efficiency. This is 1.35 percent of the projected employment for the year 2000. Ninety-five percent of this employment loss is caused by increased costs being passed on to the consumer as a result of increased trucking fuel costs. The economic impact due to household travel is less than 5 percent of the total impact because the projected increase in fuel price is offset significantly by increased fuel efficiency. The 1982 Surface Transportation Assistance Act addresses some of the inefficiencies of

TABLE 6 Final Impact of Four Selected Examples in the Dallas-Fort Worth SMSA (1972 dollars)

	Change in Income or Revenue ($000)	Change in Employment	Change in Employment (%)	Change in CPI (%)
Example 1A: 5-cent increase in state fuel tax	9,700	−500	−0.03	0.25
Example 1B: 5-cent increase in state fuel tax with 90 percent return to local jurisdiction	56,700	2,700	+0.16	0.25
Example 2: Energy and efficiency changes between 1980 and 2000	−840,600	−34,100	−1.35	0.11
Example 3: 10 percent fuel efficiency improvement	172,100	13,500	+0.71	−0.39
Example 4: Construction sanctions	−175,300	−11,780	−0.71	0.00

truck travel; however, continued attention to this concern seems warranted.

Example 3 represents a 10 percent improvement in fuel efficiency over anticipated 1987 levels. This example demonstrates a local gain of approximately 13,500 jobs. Example 4 evaluates potential roadway funding sanctions of approximately $150 million per year. This example demonstrates an employment loss of almost 12,000. From the information presented for each example, it can be seen that the procedures, input data, and results used in this methodology are sensitive to policy concerns.

One benefit of this procedure is that specific sectors can be monitored throughout the methodology. Data in Table 7 indicate the economic sectors in the Dallas-Fort Worth most affected by changes in transportation user costs. This table presents those sectors that are positively and negatively affected as well as the cause of the impact, namely elective household reductions in consumption or higher prices due to increased trucking costs. This relationship is driven by the household elasticity values discussed earlier. Some sectors, like retail trade, are affected by both reduced household spending and increased prices brought on by higher trucking costs. If a scenario increased household expenditures (e.g., Example 3), the results in Table 7 would be reversed.

TABLE 7 Economic Sectors Affected by 5-Cent Increase in Fuel Tax

	Cause	
	Elective Reductions	Higher Trucking Costs
Negative		
General services to households	X	
Retail trade	X	X
Wholesale trade		X
Finance	X	
Agricultural products and services		X
Eating and drinking establishments	X	
Positive		
Construction		

In summary, the methodology established in the study is designed to be straightforward. The planning manual, on which this paper is based, is ready for use and is in a format that is flexible and comprehensive. It is hoped that this procedure can be easily applied to any geographic area in the nation, for any time frame, and across any combination of economic sectors.

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