



JOINT HIGHWAY RESEARCH PROJECT

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AMOUNT OF TRAVEL AND
FUEL SALES ATTRIBUTABLE
TO OUT-OF-STATE VEHICLES
ON INDIANA HIGHWAYS

Kumares C. Sinha



AMOUNT OF TRAVEL AND FUEL SALES ATTRIBUTABLE TO OUT-OF-STATE

VEHICLES ON INDIANA HIGHWAYS

TO: H. L. Michael, Director
Joint Highway Research Project

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FROM: K. C. Sinha, Research Engineer
Joint Highway Research Project

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The attached report entitled "Amount of Travel and Fuel Sales Attributable to Out-of-State Vehicles on Indiana Highways" presents the results of the study conducted to determine the vehicle-miles of travel on Indiana highways and associated fuel sales that can be attributed to out-of-state vehicles. This study was conducted in accordance with a request made by Mr. G. K. Hallock, Chief Engineer for the Indiana State Highway Commission.

The study results are based on a field survey conducted through the state. The field survey included vehicle counts on highways, interviews at service stations and truck weigh stations. Additional secondary data was also obtained from various other sources. The analysis was performed in terms of four regions, Northwest, Northeast, Southwest, and Southeast, and the highway sections sampled included Interstate, 4-Lane and 2-Lane routes in each of the four regions. The sampled data was expanded for statewide representation by using extrapolation factors developed in the study. Separate computations were done for automobiles, pick-ups and vans, and trucks.

The analysis indicated that in 1979 the total vehicle-miles of travel on Indiana highways would amount to $43,141 \times 10^6$ and the travel by out-of-state vehicles would amount to about 32%. The corresponding fuel sales to out-of-state vehicles would be 961.5×10^6 gallons representing 31% of total expected motor fuel sales in Indiana in 1979 for highway purpose.

Respectfully submitted,


Kumares C. Sinha/ms
Kumares C. Sinha
Research Engineer

KCS:ms

cc: A. G. Altschaeffl
W. L. Dolch
R. L. Eskew
G. D. Gibson
W. H. Goetz
M. J. Gutzwiller
G. K. Hallock

D. E. Hancher
K. R. Hoover
J. F. McLaughlin
R. F. Marsh
R. D. Miles
P. L. Owens
G. T. Satterly

C. F. Scholer
K. C. Sinha
C. A. Venable
L. E. Wood
E. J. Yoder
S. R. Yoder



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AMOUNT OF TRAVEL AND FUEL SALES ATTRIBUTABLE TO OUT-OF-STATE
VEHICLES ON INDIANA HIGHWAYS

BY

Kumares C. Sinha
Professor of Civil Engineering
and
Research Engineer

Joint Highway Research Project

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in cooperation with the
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The assistance was also received from Wayne Campbell of the Indiana State Highway Commission and Cindy Burr of the Energy Group, Indiana Department of Commerce.

The author is solely responsible for the results and opinions expressed in the report.

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ABSTRACT

This study was conducted to estimate the extent of travel and attendant fuel sales attributable to out-of-state vehicles on Indiana highways. This information would be useful in making decisions regarding the source of additional highway revenue by raising motor fuel taxes or using funds from the general revenue source; if the extent of out-of-state travel and fuel sales is significant, then the additional motor fuel taxes might be more equitable than the diversion of funds from the general revenue source which have come only from Indiana tax payers.

The data for the study was collected from a field survey conducted throughout the state. The field survey included highway vehicle counts, and survey of vehicles at service stations and truck weigh stations. Data from secondary sources was also used to supplement the field data. Appropriate data was collected in terms of four regions, Northwest, Northeast, Southwest, and Southeast, and the highway sections sampled included Interstate, 4-Lane and 2-Lane routes in each of the four regions.

The analysis was conducted by highway type and by the type of vehicle. The sample data was expanded for statewide representation by using extrapolation factors developed in the study. Separate computations were done for automobiles, pick-ups and vans, and trucks.

The analysis indicated that in 1979 the total vehicle-miles of travel on Indiana highways would amount to $43,141 \times 10^6$ and the total out-of-state travel would be $13,663 \times 10^6$ vehicle-miles or 32% of total travel. The corresponding fuel sales to out-of-state vehicles in Indiana would be 961.5×10^6 gallons representing about 31% of total expected motor fuel sales in Indiana in 1979 for highway purpose.

The results clearly establishes the significance of Indiana as a cross-roads state, and it is therefore recommended that any additional source of highway revenue should come from motor fuel taxes and not from general revenue.

INTRODUCTION

The cost of maintaining and rehabilitating the highway system of Indiana is rising rapidly due to rising costs of materials as well as a high inflation rate while highway revenues have not increased proportionately. The combined effect is to cause a continuing deterioration of the Indiana highway system. In order to meet the funds needed for highway maintenance and rehabilitation, additional funding must be allocated.

In this connection an important question is: "From where will these additional funds come?" Various debates within the Indiana General Assembly have focussed on whether to use monies from the General Fund or to levy additional Motor Fuel Taxes. It is simply a question of who should pay for the maintenance and periodic rebuilding of the Indiana highway system: the Indiana taxpayers or the direct users of the highways.

Because Indiana is a crossroads state due to its physical location as well as its relatively small size, it can be argued that it has a significant travel by out-of-state vehicles; there is a considerable number of interstate and primary highways through Indiana which commercial vehicles, in particular, must use in the movement of various kinds of freight. To make appropriate decisions regarding the source of additional highway revenue by raising motor fuel tax or using funds from the general revenue source, it is desirable to know the extent of travel by out-of-state vehicles and the attendant amount of fuel sales. If the extent of out-of-state travel and fuel sales is significant, then the additional motor fuel taxes might be more equitable than the diversion of funds from the general revenue source which have come only from Indiana taxpayers.

The present study was conducted by the Joint Highway Research Project of Purdue University and Indiana State Highway Commission in order to quantify the

amount of travel and fuel sales that can be attributed to out-of-state automobiles and trucks using Indiana highways. The data for the analysis was obtained primarily from a field study conducted during the months of June and July, 1979.

BACKGROUND INFORMATION

Indiana Highway Financing Problem

In the fiscal year 1978 the State of Indiana received \$266,798,290 in revenue from fuel taxes on highway users. This is a principal source of funds for highway maintenance and rehabilitation. The distribution of this revenue is as follows (4):

Motor Vehicle Highway Fund	74.58%
Primary Highway Fund	13.98%
Local Street and Roads Fund	11.44%

Tax liability is based on a flat rate per unit of consumption:

For gasoline	8¢ per gallon
For special fuels (diesel, heating oil, LP gas)	8¢ per gallon

Recent or emerging problems associated with this revenue method are:

- a. As the price of gasoline increases, a pattern of reduced auto travel might begin to emerge and thus the volume of fuel consumed may decline resulting in a reduced revenue base.
- b. Increased fuel economy in automobiles means that more miles are travelled for the same fuel consumption. This means that for a fixed tax rate per gallon, users pay less for highway use per vehicle-mile travelled.
- c. The cost of highway maintenance and rehabilitation is increasing at least at the rate of inflation and generally higher.

There are several options that are under discussion for raising additional highway revenues in Indiana.

1. Increase the per gallon tax rate by a fixed amount.
2. Tie the per gallon tax rate to the rate of inflation or other economic indicator.
3. Change the per unit tax to an ad valorem tax - a tax rate based on the value of the good. Thus, as the price of gasoline increased, the tax would increase accordingly.
4. Leave the motor fuel taxes as is and supplement highway revenue from general revenue, the source of which is primarily state sales and income taxes.

This study deals with the identification of the extent of out-of-state users of Indiana highways in order to provide information to the decision-makers as to the impacts of an increased user tax as opposed to the use of general revenue.

The Problem of Out-of-State Users

Figure 1 depicts the basic components of the Indiana highway financing system. Apart from toll roads, the method of vehicle use taxes is the most direct method for requiring the user to pay for benefits received. Vehicle use taxes take the form of fuel use taxes, sales tax on fuel and automotive accessories, tax on new vehicles, registration fees and motor vehicle excise tax, and travel permits. A summary of various motor fuel taxes is given in Appendix A.

A key issue for the state legislature in deciding whether to increase highway revenues through vehicle use taxes or through general revenue is the extent to which out-of-state users should be required to pay for the maintenance and rehabilitation of Indiana highways. The basic alternatives are:

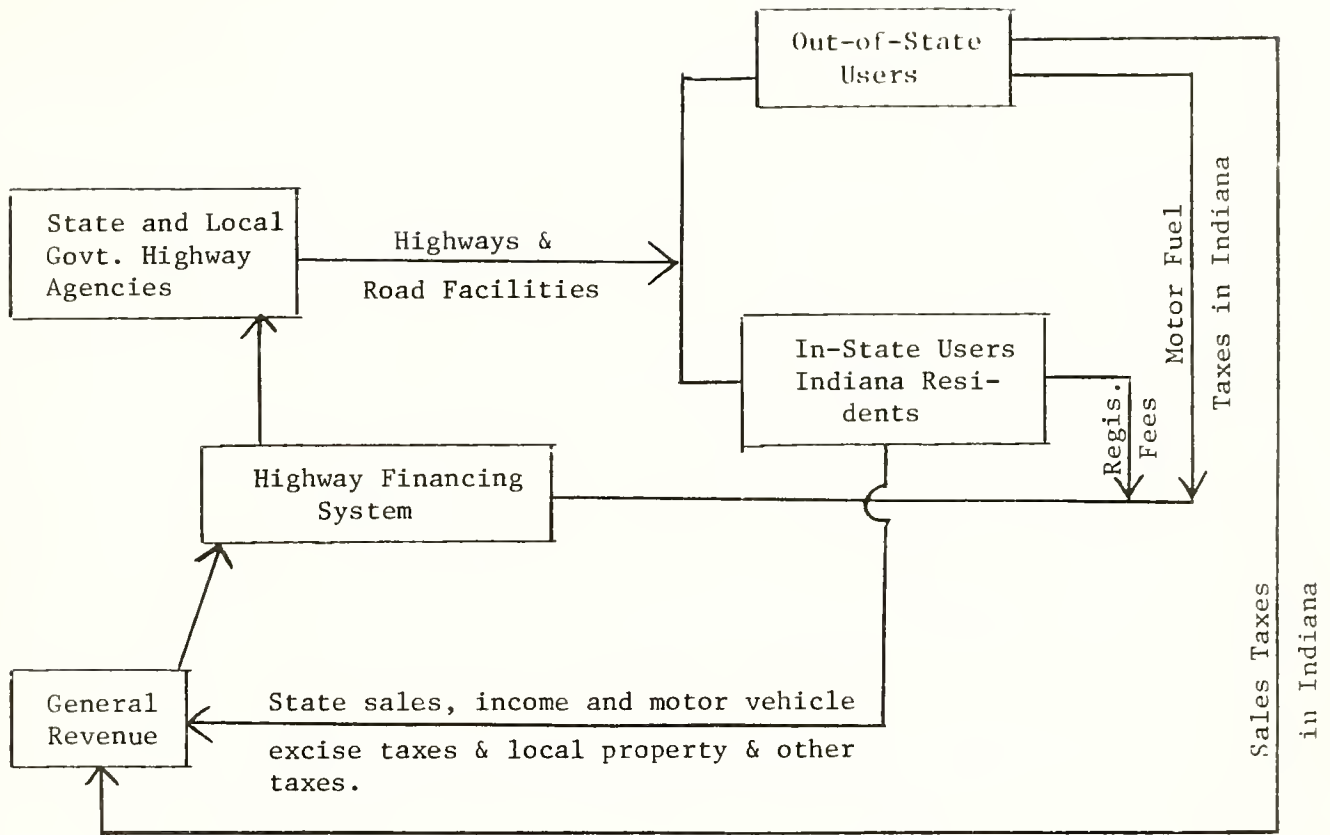


Figure 1. The Indiana Highway Financing System

- a. Increase highway revenue through general revenue: As shown in Figure 1, Indiana residents would bear the bulk of the burden through state sales and income taxes, although sojourners would pay sales taxes for any purchases made in transit.
- b. Increase vehicle use taxes in Indiana: The applicability of various vehicle use taxes with respect to out-of-state vehicles is presented in Table 1. It can be noted that fuel use taxes are the most appropriate method in order to capture the out-of-state user market. Taxes on vehicle parts and vehicle sales would not capture the through-state traffic. State registration and permits can be used to capture out-of-state truck traffic but not automobile traffic. In Appendix B is given a summary of state laws regarding through travel of inter-state trucks.

In order to make informed decisions the following information would be valuable to the legislature:

- a. The percentage of out-of-state vehicles using Indiana highways and the extent of out-of-state vehicle-miles of travel.
- b. The extent to which out-of-state vehicles purchase fuel in Indiana.
- c. The extent to which an increase in the price of gasoline in Indiana due to additional state fuel taxation will deter interstate travellers from purchasing fuel in Indiana.

This study elaborates on the first two items. The third item is not considered to be crucial because any small increment in state fuel tax is not expected to make any significant change in fuel purchase.

TABLE 1. VARIOUS VEHICLE USE TAXES WITH RESPECT TO
OUT-OF-STATE VEHICLE CONTRIBUTIONS

Specific Highway Revenue Sources	Contribution by Out-of- State Vehicles
1. Motor Fuel Tax (gasoline)	Yes, when purchased in Indiana
2. Motor Fuel Use Tax (diesel, home heating oils, LP gas)	Yes, when purchased in Indiana
3. Motor Carrier Fuel Tax	Yes, applies only to trucks
4. Tax on new trucks, buses and on their accessories	Not applicable
5. Vehicle registration fees	Not applicable
6. Motor Vehicle Excise Tax	Not applicable
7. Toll road fees	Yes, but sources are very limited
8. Sales Tax on fuel and automotive parts	Yes, when purchased in Indiana

DATA COLLECTION

No complete data source exists which disaggregates Indiana highways users according to home state of vehicle registration. Such information is not even available on interstate trucks; a report recently prepared for the Indiana Reciprocity Commission on proportional license plate registration for interstate carriers notes that there is no accurate count of non-Indiana trucks using Indiana highways either from the Bureau of Motor Vehicles or the Department of Revenue (7).

Because of limited time, manpower and financial resources, an attempt was made in the present study to obtain data from as many sources as possible, and then to synthesize the results with appropriate estimates.

Data sources employed were:

1. A field survey of vehicles on Indiana highways.
2. A limited survey of gasoline purchases at service stations.
3. A limited interview of truckers at official weigh stations.
4. Credit card data from Amoco Oil Company showing sales attributable to out-of-state card holders in Indiana. Other oil companies did not have data disaggregated sufficiently to be of use in this report.
5. A random sample of truck traffic data from weigh stations collected by the ISHC during June-July, 1979..
6. Data on statewide fuel consumption and vehicle-miles of travel in Indiana from different published documents.

Methodology of the Field Survey

The state of Indiana was divided into four regions, Northwest, Northeast, Southwest and Southeast, as shown in Figure 2. In each region a number of highway sections were selected representing Interstates, U.S. and State routes. The selection of highway sections was made considering the ADT values,

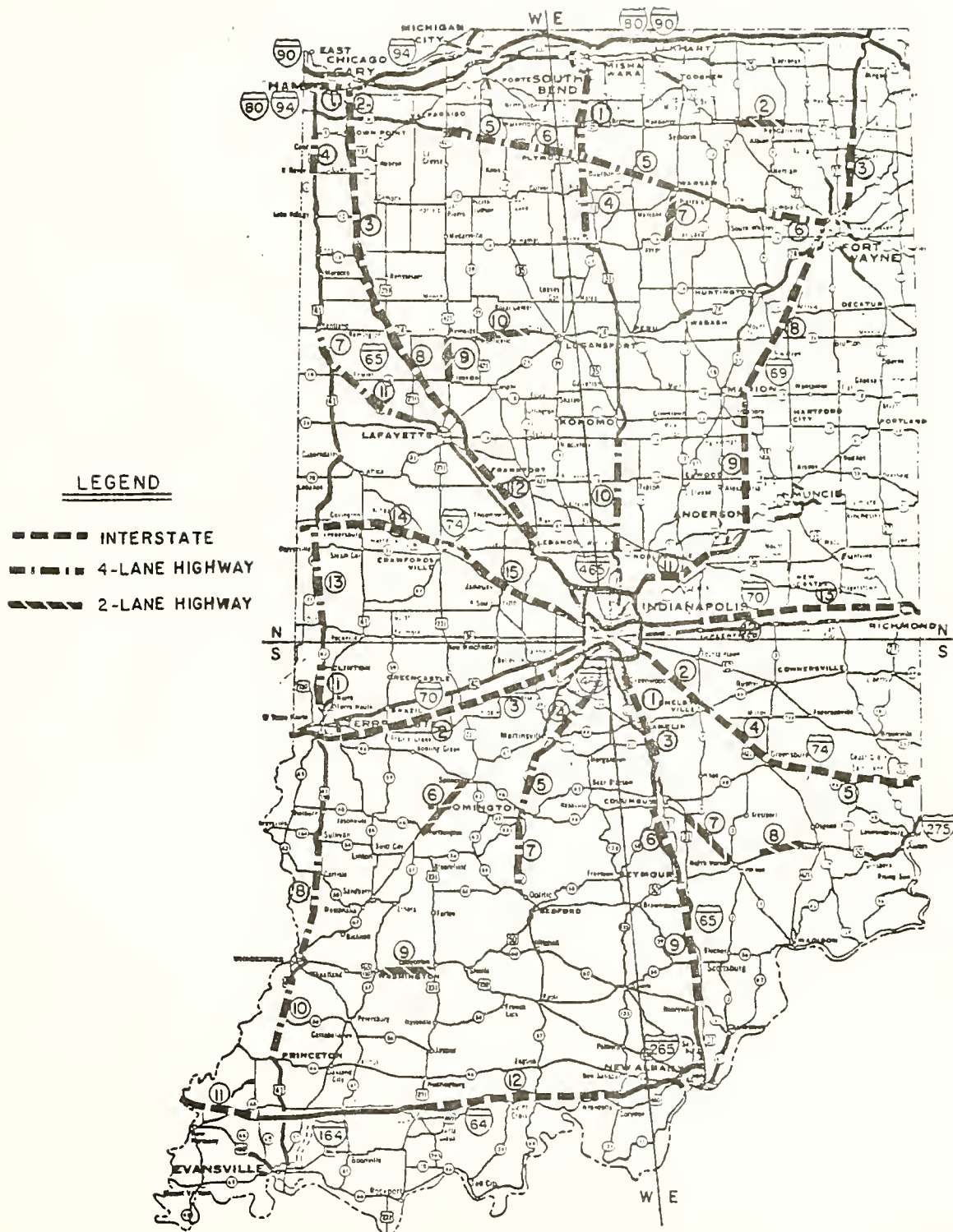


Figure 2. Map Showing Highway Sections for Field Survey

geographical location of the sections within the region as well as the number of lanes. A map indicating the 1975 ADT values along Interstate, U.S. and State routes was used in delineating the sample sections. The section lengths were determined according to the homogeneity of the ADT values. A total of 49 sections were chosen, 15 in Northwest, 13 in Northeast, 12 in southwest and 9 in southeast. No field survey was conducted on local routes. Figure 2 shows the sections included in the study.

The interstate routes included in the study were: I-64, I-65, I-69, I-70, I-74 and I-94. The U.S. routes were: U.S. 6, U.S. 24, U.S. 30, U.S. 31, U.S. 41, U.S. 50, U.S. 52 and U.S. 231, while the state routes included the following: S.R. 7, S.R. 15, S.R. 43, S.R. 37 and S.R. 63. For the data analysis, the sections were grouped in three different categories, Interstate, 4-lane routes, and 2-lane routes, for the following reasons.

1. The U.S. and the state routes are, unlike the Interstate routes, either 2 or 4 lane routes. Therefore this classification is better for a statistical comparison because there is usually less traffic on a 2-lane route than on a 4-lane route.
2. Indiana is a "pass through" state for East-West and North-South traffic; the out-of-state traveller's choice of route is more influenced by whether the route is a 4-lane or a 2-lane than its jurisdictional classification.

Field Operation

The field operation was divided in three parts: highway vehicle count, service station survey, and weigh station survey. Service stations and weigh stations were selected along the sampled sections in each region. Because of the interstate trucker disputes being experienced during the summer months of 1979, truck stops were not surveyed.

Because of the need to fully utilize data collection time, given the limited resources, vehicle counts and service station surveys were undertaken at different times of the day. It was not possible to do any field survey during the night.

The highway vehicle count consisted of recording the number of in-state automobiles and out-of-state automobiles on the basis of license plates, and the number of trucks passing at an observation point along a sampled section. Because of the difficulty in recognizing license plates of moving trucks, only total number of trucks could be recorded. Among the trucks on highways were included pick-ups and vans.

At the service stations, in addition to counting in-state and out-of-state vehicles, gallons of fuel purchase associated with individual vehicles were also recorded. If the traveller was out-of-state, questions were asked regarding the origin, destination and purpose of the trip.

The weigh station survey counted in-state and out-of-state trucks. In addition to the information on origin and destination, all truckers were asked how many gallons of fuel they expected to purchase in Indiana during the trip.

Other Data Sources

A random sample was selected directly from the raw truck data gathered from weigh stations throughout the state by the ISHC during June-July, 1979. This additional truck data was used to determine percentage of out-of-state trucks on Indiana highways. A 15% sample chosen randomly from two weigh stations for each of the four regions.

Other data sources also included information from Amoco Oil Company with respect to fuel sales on credit cards. Additional supporting data on annual vehicle-miles of travel and annual fuel consumption was obtained from the FHWA report, Highway Statistics (2). Some information was also furnished by the Indiana Departments of Commerce and Revenue.

Problems of the Field Survey

There were several problems associated with the data collected in the field survey. First, the field data was collected only during two months, June and July; out-of-state travellers probably tend to increase during the summer months. On the other hand, the gasoline shortage and the continuing gasoline price increase might have had some effects on out-of-state traffic. In addition, the strike by independent truckers during the summer months might have also affected the survey results. Also, the highway field survey counted pick-ups and vans in the truck category while pick-ups and vans are not included in weigh station data. In the process of data analysis appropriate assumptions have been made to minimize the effects of these data problems.

ANALYSIS OF DATA

Summary of Survey Information

Highway Survey

The data from highway vehicle count survey was first summarized by route type and district. The summarized data was then used to conduct a statistical analysis in order to determine the degree of variability in the percentage of out-of-state travel data. In Tables 2 through 5 are presented the number of in-state automobiles, out-of-state automobiles and trucks using the interstate routes, the 4-lane routes, and 2-lane routes, as summarized from the observed field data.

Service Station Survey

A total of 32 service stations were surveyed in the four districts. Most of these service stations were located along the interstate routes. The period of observations varied from station to station. In Table 6 is given a summary of the data from the service station survey. In total 326 automobiles were interviewed, while the number of trucks, pick-ups and vans was only 47. The percentage of out-of-state automobiles was 36.8% of all automobiles. The percent of out-of-state non-automobile vehicles was 55.3% of all such vehicles. The variation in the percent out-of-state purchase of fuel can be attributed to the location of the service stations visited, which greatly influence the number of out-of-state customers.

Weigh Station Survey

Because there was a considerable unrest in the trucking industry during the summer months of 1979, interview with truckers was limited mostly in weigh stations patrolled by state police. Consequently, only a sample of 99 truckers could be interviewed. A summary of the information is given in Table 7. The percentage of out-of-state trucks was 54.5% of all trucks in the weigh stations

Table 2. Summary of Field Observations: Northwest District

Section #	Interstate Routes			Trucks, Pick-ups & Vans			4 Lane Routes		Trucks, Pick-ups & Vans		2 Lane Routes		Trucks, Pick-ups & Vans
	In-state Autos	Out-of-state Autos		In-state Autos	Out-of-state Autos		In-state Autos	Out-of-state Autos	In-state Autos	Out-of-state Autos	In-state Autos	Out-of-state Autos	
1 (I-94)	247 (44.8) ¹	304 (55.2) ¹	138 (20.0) ²										
2 (I-65)	271 (56.6)	208 (43.4)	98 (17.00)										
3 (I-65)	218 (45.4)	262 (54.6)	152 (24.0)										
4 (U.S. 41)				201 (73.6)	72 (36.4)	100 (26.8)							
5 (U.S. 30)				202 (61.0)	129 (39.0)	84 (20.2)							
6 (U.S. 30)				204 (57.3)	152 (43.7)	108 (23.2)							
7 (U.S. 52)				141 (75.8)	45 (24.2)	142 (43.3)							
8 (I-65)	214 (32.9)	437 (67.1)	166 (20.3)										
9 (S.R. 43)													

115
(89.1)14
(10.9)40
(23.7)

Table 2 continued.

Section #	<u>Interstate routes</u>			<u>4 Lane Routes</u>			<u>2 Lane Routes</u>		
	In-state Autos	Out-of-state Autos	Trucks, Pick-ups & Vans	In-state Autos	Out-of-state Autos	Trucks, Pick-ups & Vans	In-state Autos	Out-of-state Autos	Trucks, Pick-ups & Vans
¹⁰ (U.S.24)							102 (86.4)	16 (13.6)	48 (28.9)
¹¹ (U.S.52)				240 (92.3)	20 (7.7)	105 (28.8)			
¹² (I-65)	236 (53.1)	208 (46.9)	240 (35.1)						
¹³ (S.R.63)				84 (68.8)	38 (31.2)	129 (51.4)			
¹⁴ (I-74)	52 (26.0)	148 (74.0)	145 (42.0)						
¹⁵ (I-74)	78 (35.2)	143 (64.8)	153 (40.9)						
Total	1316 (43.5)	1710 (56.5)	1092 (26.5)	1072 (70.2)	456 (29.8)	658 (30.1)	217 (87.9)	30 (12.1)	128 (34.1)

¹Percentage of total automobiles.²Percentage of all vehicles.

Table 3. Summary of Field Observations: Northeast District

Section #	<u>Interstate Routes</u>			<u>4 Lane Routes</u>			<u>2 Lane Routes</u>		
	In-state Autos	Out-of-state Autos	Trucks, Pick-Ups & Vans	In-state Autos	Out-of-state Autos	Trucks, Pick-Ups & Vans	In-state Autos	Out-of-state Autos	Trucks, Pick-Ups & Vans
1 (U.S.31)				233 (74.7) ¹	79 (25.3) ¹	69 (18.1) ³			
2 (U.S.6)							102 (82.9)	21 (17.1)	63 (33.8)
3 (I-69)	233 (53.8)	200 (46.2)	184 (29.8)						
4 (U.S.31)				204 (75.8)	65 (24.2)	81 (23.1)			
5 (U.S.30)				219 (61.0)	140 (39.0)	123 (25.5)			
6 (U.S.30)				209 (83.6)	41 (16.4)	99 (28.4)			
7 (S.R.15)							123 (91.1)	12 (8.9)	24 (15.1)
8 (I-69)	223 (69.5)	98 (30.5)	117 (26.7)						
9 (I-69)	240 (74.7)	81 (25.3)	130 (28.8)						

Table 3 continued.

Section #	<u>Interstate Routes</u>			<u>4 Lane Routes</u>			<u>2 Lane Routes</u>		
	In-state Autos	Out-of-state Autos	Trucks, Pick-Ups & Vans	In-state Autos	Out-of-state Autos	Trucks, Pick-Ups & Vans	In-state Autos	Out-of-state Autos	Trucks, Pick-Ups & Vans
¹⁰ (U.S.31)				219 (74.0)	77 (26.0)	59 (16.6)			
¹¹ (I-69)	343 (85.1)	60 (14.9)	202 (33.3)						
¹² (I-70)	78 (38.8)	123 (61.2)	161 (44.6)						
¹³ (I-70)	63 (30.2)	145 (69.8)	150 (41.9)						
Total	1180 (62.5)	707 (37.5)	944 (33.3)	1084 (72.9)	402 (27.1)	431 (22.5)	225 (87.2)	33 (12.8)	97 (27.3)

¹Percentage of total automobiles.²Percentage of all vehicles.

Table 4. Summary of Field Observations: Southeast District

Section #	<u>Interstate Routes</u>			<u>4 Lane Routes</u>			<u>2 Lane Routes</u>		
	In-State Autos	Out-of-State Autos	Trucks, Pick-Ups & Vans	In-State Autos	Out-of-State Autos	Trucks, Pick-Ups & Vans	In-State Autos	Out-of-State Autos	Trucks, Pick-Ups & Vans
1 (I-65)	420 (56.7) ¹	321 (43.3) ¹	407 (35.4) ²						
2 (I-74)	211 (66.6)	106 (33.4)	196 (38.2)						
3 (I-65)	248 (51.2)	236 (48.8)	304 (38.6)						
4 (I-74)	174 (57.0)	131 (43.0)	233 (43.3)						
5 (I-74)	161 (53.5)	140 (46.5)	187 (38.3)						
6 (I-65)	200 (66.0)	103 (34.0)	199 (39.6)						
7 (S.R.7)							117 (92.1)	10 (7.9)	60 (32.1)
8 (U.S.50)							96 (94.1)	6 (5.9)	60 (37.0)
9 (I-65)	143 (47.7)	157 (52.3)	190 (38.8)						
Total	1557 (56.6)	1194 (43.4)	1716 (38.4)				213 (93.0)	16 (7.0)	20 (34.4)

Table 4 continued.

¹Percentage of total automobiles.²Percentage of all vehicles.

Table 5. Summary of Field Observations: Southwest District

Section #	<u>Interstate Routes</u>			<u>4 Lane Routes</u>			<u>2 Lane Routes</u>		
	In-state Autos	Out-of-state Autos	Trucks, Pick-Ups & Vans	In-state Autos	Out-of-state Autos	Trucks, Pick-Ups & Vans	In-state Autos	Out-of-state Autos	Trucks, Pick-Ups & Vans
1 (S.R.63)				166 (80.2) ¹	41 (19.8) ¹	176 (46.0) ²			
2 (I-70)	172 (52.6)	155 (47.4)	287 (46.7)						
3 (I-70)	113 (52.6)	102 (47.4)	266 (55.3)						
4 (S.R.37)				199 (88.8)	25 (11.2)	124 (35.6)			
5 (S.R.37)				183 (89.3)	22 (10.7)	127 (38.2)			
6 (U.S.231)							92 (91.1)	9 (8.9)	52 (34.0)
7 (S.R.37)				229 (96.6)	8 (3.4)	119 (33.4)			
8 (U.S.41)				153 (71.2)	62 (28.8)	157 (42.2)			
9 (U.S.50)							103 (93.6)	7 (6.4)	100 (47.6)

Table 5 continued.

Section #	<u>Interstate Routes</u>			<u>4 Lane Routes</u>			<u>2 Lane Routes</u>		
	In-state Autos	Out-of-state Autos	Trucks Pick-Ups & Vans	In-state Autos	Out-of-state Autos	Trucks Pick-Ups & Vans	In-state Autos	Out-of-state Autos	Trucks Pick-Ups & Vans
¹⁰ (U.S.41)				154 (72.6)	58 (27.4)	159 (42.9)			
¹¹ (I-64)	38 (24.2)	119 (75.8)	184 (54.0)						
¹² (I-64)	47 (22.0)	167 (78.0)	165 (43.5)						
Total	378 (40.7)	543 (59.3)	902 (47.6)	1154 (84.2)	216 (15.6)	862 (38.6)	195 (92.4)	16 (7.6)	152 (41.8)

¹Percentage of all automobiles.²Percentage of all vehicles.

Table 6 : Survey of Automobile Data from Service Stations

District	<u>In-State Automobiles</u>				<u>Out-of-State Automobiles</u>				Percent Volume Purchased by
	# of Gas Stations	Fuel Volume (V1) (Gallons)	# of Autos	Average Purchase Per Auto (Gallons)	Fuel Volume (V2) (Gallons)	# of Autos	Average Purchase Per Auto (Gallons)	Out-of-State Automobiles V2 V1 + V2	
Northwest	14	983.0	97	10.13	619.9	44	14.08	38.67%	
Northeast	6	237.4	26	9.13	252.2	22	11.46	51.51%	
Southwest	4	239.4	29	8.25	300.9	28	10.75	55.69%	
Southeast	7	662.2	54	12.26	331.0	26	12.73	33.33%	
Statewide Data	31	2,122.0	206	10.30	1,504.0	120	12.53	41.48%	

Table 7 : Weigh Station Survey

	In-State Trucks	Out-of-State Trucks	Number of Out-of-State Trucks with No Purchase In Indiana	Estimated Volume of Fuel Purchase By All Trucks	Estimated Volume of Fuel Purchase By Out-of-State Trucks	Percent of Fuel Purchase By Out-of-State Trucks
Data From Personal Interview at Weigh Stations	45	54	28	3660 Gallons	1945 Gallons	53.1
Data from Random Sample from ISHC Weigh Station Survey	158	232	—	—	—	—

while the percent of expected fuel purchase by out-of-state truckers was 53.1%. In addition, the percent of out-of-state trucks indicating fuel purchase in Indiana was 48.15%.

To supplement the weigh station data collected in the study, additional truck field data was obtained from the Indiana State Highway Commission (ISHC). The ISHC gathered weigh station data during June 5-July 11, 1970; a 15% random sample was selected from two weigh stations in each district delineated in the present study to derive additional truck data from the ISHC file. The results of the data selected from the ISHC weigh station survey showed 50.42% of the trucks using the weigh stations during the period of June 5-July 11, 1979 was classified as out-of-state trucks and 40.51% was in-state. However, the data collected by the ISHC did not have any information on fuel purchase.

Credit Card Information

In order to get some information about fuel purchase by out-of-state travellers in Indiana six major oil companies were contacted; the information requested included the total fuel sales to credit card holders at the gasoline stations in Indiana and the percentage of these sales made to out-of-state credit card holders. Unfortunately, almost all of the oil companies could not provide the information except the Amoco Oil Company. In Table 8 is presented the data furnished by the Amoco Oil Company. Average purchase by out-of-state credit customers was 13.42 gallons and each out-of-state customer made an average of 1.4 purchases for a total of 18.79 gallons on credit during the three month period. This data reflects purchases made at central Indiana stations (within a 50-mile radius around Indianapolis). The pattern of gasoline purchase may be quite different in urban areas along the state borders. Furthermore, approximately 46 percent of motor fuel sales are made on credit at Amoco stations in Indiana. This ranges from 10 percent to 85 percent depending

Table 8 : Residence for Amoco Credit Card
Purchasers in Indiana
(May, June, July 1979)

<u>Description</u>	Resident State		Total
	Indiana	Other States	
	<u>%</u>	<u>%</u>	<u>%</u>
Total Indiana Station Credit Card Customers	77.3	22.7	100.0
Total Number of Credit Card Transactions	90.8	9.2	100.0
Total Dollar Volume of Credit Card Sales	88.9	11.1	100.0

Sample Sizes: 37,557 Customers

Source: Letter of D. G. Cowart, Marketing Research Department, Amoco Oil
Company, Chicago, Illinois, August 22nd, 1979.

on the type of station and location. As the data represents only one oil company information and involves only credit card holders who made a purchase in one specific area within Indiana no statewide extrapolation of out-of-state gasoline purchase can be made on the basis of this information. Nevertheless, this data provides some useful insight about the gasoline purchase on credit by out-of-state automobiles.

Estimation of Percentage of Out-of-State Vehicles and Fuel Purchase Rates

In this section an analysis is presented of the vehicle use and fuel purchase rates of out-of-state automobiles and trucks on Indiana highways. These rates will then be used to estimate the amount of travel and attendant fuel sales.

Automobile Data

A summary of in-state and out-of-state automobiles on Indiana highways is presented in Table 9. The data indicates that the overall percentage of out-of-state automobiles on Indiana highways excluding county and local roads is 34.65%. As it can be expected Interstate highways have the highest percentage of out-of-state automobiles (50.15%) while the corresponding percentages on 4-lane and 2-lane routes are 24.37 and 9.95, respectively. Considering the four regions, the percentage of out-of-state automobiles range between 30.43% to 40.84%. Statistically these percentages are not significantly different at 5% level of significance.

Survey data was collected during weekdays as well as weekends. However, the percentage of out-of-state autos was found to be not significantly different between the two periods, Monday through Thursday and Friday through Sunday.

It is interesting to note that the overall statewide percentage of out-of-state automobiles observed on highways (34.6%) agrees closely with the corresponding percentage observed at service station survey (36.8%). Because of

Table 9: Summary of Sample Data on In-State and
Out-of-State Automobiles on Indiana Highways
(Excluding Local Routes)

<u>By Route Type</u>	<u>In-State</u>	<u>Out-of-State</u>
Interstate	49.42%	50.15%
4-Lane	76.27%	24.37%
2-Lane	90.05%	9.95%
<hr/>		
<u>By Region</u>		
Northwest	59.22%	40.84%
Northeast	68.86%	31.13%
Southwest	69.56%	30.43%
Southeast	69.98%	35.01%
<hr/>		
Statewide (Excluding Local Routes)	65.37%	34.65%

the small sample in service station survey similar comparisons cannot be made by route type or by region.

It can be argued that there is a seasonal variation in travel with high out-of-state travel in summer months and therefore this percentage may be higher than what the yearly average would be. However, it is felt that there are several factors that tend to indicate that the actual yearly percentage of out-of-state automobile travel may not be too different from the figure estimated. These factors are listed below:

1. During the months of June and July in 1979 there was a severe fuel shortage nationwide which inhibited many long trips generally made during the summer months. Because out-of-state travellers are more likely to make long trips than the in-state travellers, there may be a possible undercount of out-of-state automobiles.
2. The field survey did not consider county and local roads which may account for some percentage of out-of-state travel, particularly in those areas which border the state boundaries.
3. The ultimate purpose of the study was to determine the extent of vehicle-miles of travel by out-of-state and in-state travellers and attendant fuel sales. In this process, the percentage of vehicle counts was applied directly to distribute the total vehicle-miles of travel and thus giving equal weights to the trip lengths of in-state and out-of-state automobiles. However, it is well established that the average trip length of in-state travellers is smaller than that of out-of-state travellers. Consequently, the results on vehicle miles of travel would in effect undercount the extent of out-of-state travel.

Considering the above factors associated with the procedure used in the study it was felt that the value of the percentage of out-of-state automobiles obtained from the field study conducted in June-July 1979 could be reasonably applied to the yearly travel data. It should be pointed out, however, that the procedure adopted in estimating yearly total vehicle-miles of travel included appropriate adjustments to extrapolate the data on vehicle-miles of travel from the observed months.

Truck Data

In the highway field survey trucks (including pick-ups and vans) were counted without distinction between in-state and out-of-state categories. In Table 10 is presented a summary of corresponding traffic rates by route and by region. The percentages by route type ranged from 31.52% on 2-lane to 36.50% on Interstate, and statistically these rates are not significantly different from each other at a level of significance of 5%. However, by location the truck traffic rates are significantly different, except the rates between Northwest and Northeast showed no significant difference at the same level of significance. Also, the average truck traffic percentage in weekdays was significantly higher than in weekends during the period of the highway vehicle count. The overall statewide truck traffic percentage (including pick-ups and vans) on highways was found to be 33.5%. However, this rate was highly influenced by the inclusion of pick-ups and vans in the truck category. The observed truck rates on non-Interstate routes were high because pick-ups and vans constitute a large part of non-automobile traffic on these routes.

As the split between in-state and out-of-state trucks could not be obtained from highway field data, information from weigh stations were used for this purpose. As mentioned earlier, the percentage of out-of-state trucks was 54.5% of all trucks counted in the weigh stations surveyed in the present

Table 10: Summary of Sample Data on Truck Traffic on
 Indiana Highways
 (Excluding Local Routes)

<u>By Route Type (All Regions)</u>	<u>Percent of Trucks (Including Pick-Ups and Vans)</u>
Interstate	36.50%
4-Lane	32.00%
2-Lane	31.52%
<hr/>	
<u>By Region (All Routes)</u>	
Northwest	29.71%
Northeast	28.12%
Southwest	43.28%
Southeast	37.92%
<hr/>	
Statewide (Excluding Local Routes)	33.50%

study. The data obtained from the weigh station survey conducted separately by the ISHC during June-July, 1979 indicated the percentage of out-of-state trucks to be 59.49%. In addition, the percentage of out-of-state trucks (including pick-ups and vans) in the service stations surveyed was 55.3%. As can be seen these percentages are in close agreement.

The reliability of the figures estimated in the study can be further checked by the results of a 1978 report prepared by the Indiana Department of Revenue (3) which indicated that of the carriers holding motor fuel permits including carriers operating farm trucks exclusively, 67% are classified as out-of-state, 19% are classified as Indiana based but involved in Interstate travel and 14% are classified as carriers whose travel is entirely limited to Indiana.

Because of the very small sample no truck fuel purchase rate was developed from service station data. Only information on truck fuel purchase was obtained through interviews at weigh stations. The percentage of the expected total volume of truck fuel to be purchased in Indiana as reported by the out-of-state truckers at weigh stations was 53.1%. Another important information was that about 51.8% of out-of-state truckers indicated no purchase of fuel in Indiana. As no truck fuel purchase data was collected in the weigh station survey by the ISHC, any comparison could not be made with the data collected in the present study. However, the sample size of the ISHC weigh station survey was much larger than that of the weigh station data collected directly in the present study and the ISHC survey was also more comprehensive in its geographical distribution. Consequently, it was felt that more confidence could be assigned to the out-of-state truck percentage value derived from the ISHC data.

ESTIMATION OF VMT AND FUEL PURCHASE BY OUT-OF-STATE VEHICLES

The procedure used to estimate the 1979 vehicle-miles of travel (VMT) and attendant fuel purchase by out-of-state automobiles and trucks using Indiana highways followed the steps outlined below.

1. Computation of VMT separately for in-state and out-of-state automobiles and for all trucks (including pick-ups and vans) on the sampled sections in each of the four regions.
2. Estimation of the 1979 VMT for the state of Indiana by functional classification of highways.
3. Extrapolation of the sectional VMT values to statewide VMT estimates for 1979 for in-state and out-of-state automobiles and trucks (including pick-ups and vans), by functional classification.
4. Estimation of total statewide VMT for in-state and out-of-state trucks and in-state and out-of-state pick-ups and vans.
5. Estimation of fuel purchase associated with out-of-state automobiles and other vehicles.

In Figure 3 is shown a schematic diagram of the procedure used in the study. In the following paragraphs the details of these steps are discussed.

VMT Estimation

The reported 1979 ADT values of sampled sections were multiplied by the section distances to compute the sectional VMT values, and the observed percentages of in-state autos, out-of-state autos and trucks (including pick-ups and vans) were applied to split sectional VMT values into these three categories, as shown below.

$$SECVMT_{ij} = ADT_i * 365 * DIST_i * PERCNT_j$$

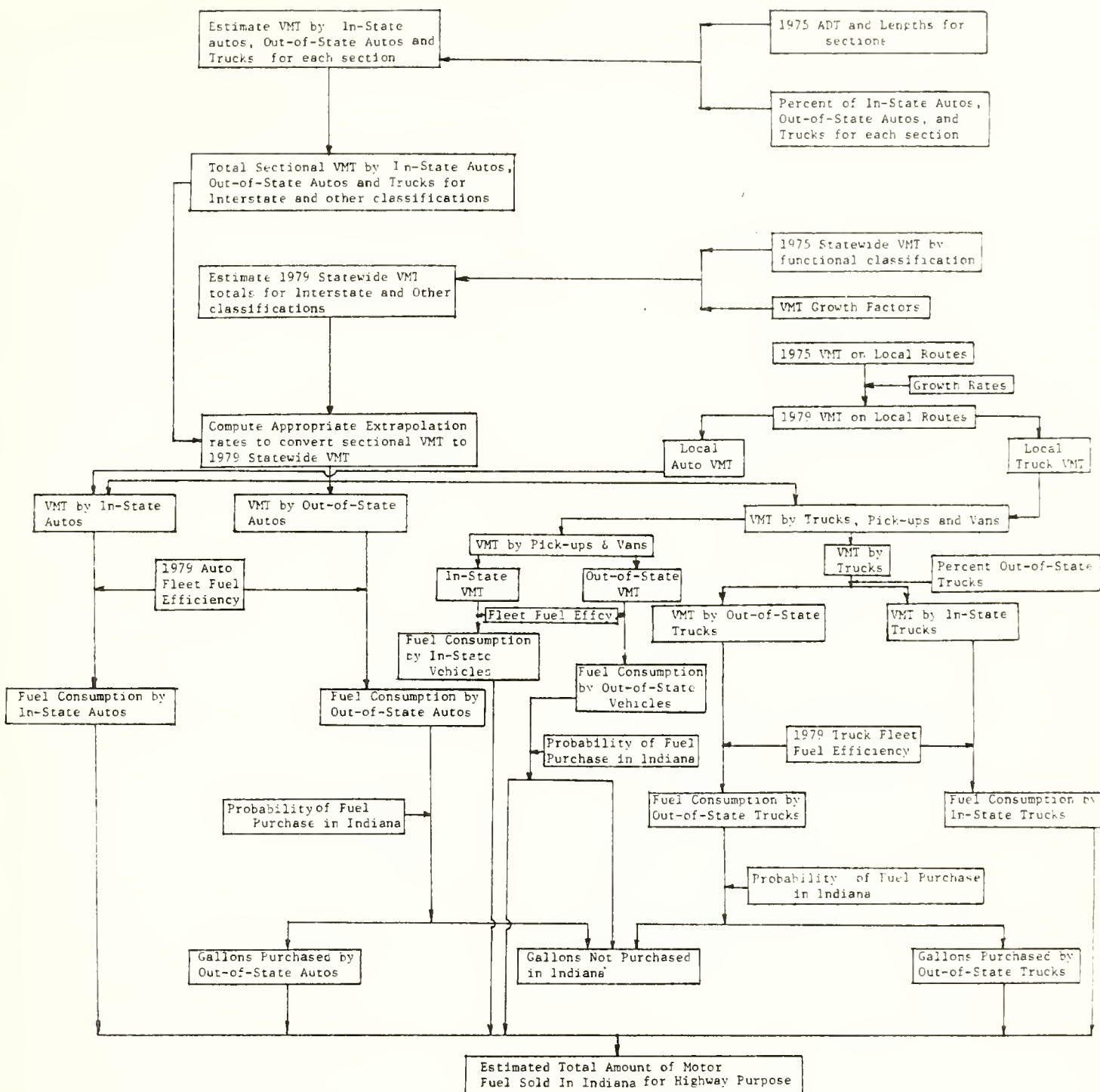


Figure 3: Schematic Diagram Showing the Estimation Procedure

where,

$SECVMT_{ij}$ = VMT of a particular section i in category j ;

ADT_i = 1975 ADT of section i ;

$DIST_i$ = distance of section i in miles;

$PERCNT_j$ = observed percentage of traffic in category j ;

i = section identification;

j = traffic categories (in-state autos, out-of-state autos, and trucks).

In Tables C1 through C4 of Appendix C are given the results of the sectional VMT computations. An important underlying assumption in this procedure is that the average trip length of both in-state and out-of-state vehicles is the same. In reality, however, the in-state travellers can be expected to make much shorter trips than out-of-state travellers. This assumption biases the VMT values in favor of in-state traffic.

Individual sectional VMT values were then aggregated to two groups, Interstate and other U.S. and State Routes (SVMTIS and SVMTOH). Because no observation was made on local roads, the non-Interstate category did not include local roads. A summary of these computations is presented in Table 11.

An adjustment rate was developed to estimate the statewide 1979 VMT values by traffic category on the basis of the sectional VMT values. To accomplish this, an estimate of the 1979 total statewide VMT by functional classification was made. The most recent VMT information available was for the year 1977; this data was adjusted to estimate the 1979 values according to an average growth rate computed from historical data on Indiana VMT. In Table 12 is given the historical data on VMT in Indiana as obtained from Highway Statistics (2). The average yearly rates of growth were computed from the historical data. These are 4.67% for Interstate, 5.67% for other U.S. and state routes, and -9.5% for local routes (excluding Federal Aid Urban System). Applying these average growth rates to the base year (1975) VMT values, the 1979 VMT values were estimated for each highway category as shown below.

Table 11: A Summary of Sectional VMT Computations
(on the basis of sample data)

	In-State Autos	Out-State Autos	Trucks (include Pick-Ups and Vans)
<u>Northwest</u>			
Interstate	364,578,624	446,698,223	311,927,427
Other U.S. and State Routes	179,774,382	84,037,667	104,119,602
Total	544,353,006	530,735,890	416,047,029
<u>Northeast</u>			
Interstate	366,427,045	239,973,340	318,499,619
Other U.S. and State Routes	369,273,714	130,396,495	140,798,203
Total	735,700,759	370,369,835	459,297,822
<u>Southwest</u>			
Interstate	122,905,481	126,408,926	255,611,988
Other U.S. and State Routes	238,418,518	46,082,113	188,293,102
Total	361,323,999	172,491,039	443,905,090
<u>Southeast</u>			
Interstate	291,224,480	236,708,066	278,272,151
Other U.S. and State Routes	30,295,211	2,414,945	16,356,792
Total	321,519,691	239,123,011	294,628,943
<u>Statewide</u>			
Interstate	1,145,135,630	1,049,788,555	1,164,311,185
Other U.S. and State Routes	817,761,825	262,931,220	449,567,699
Total	1,962,897,455	1,312,719,775	1,613,878,884

Table 12: Trends in VMT in Indiana

VMT x 10 ⁶					
	Interstate	Other US and State Routes (include Fed-Aid Urban)	Total IS and Other US and State Routes (include Fed-Aid Urban)	Local Routes (exclde Fed-Aid Urban)	State Total
1973	7,294	20,438	27,732	10,995	38,727
1974	7,221	19,494	26,715	10,278	36,993
1975	7,291	19,687	26,978	10,381	37,359
1976	6,750	23,535	30,285	9,601	39,886
1977	8,514	25,530	34,044	7,278	41,322

Note: All VMT values except for Interstate category were estimated from Highway Statistics (3). A significant portion of the Federal Aid Urban System is on local routes, however no breakdown of the VMT on Federal Aid Urban System by state and local routes was available for any of the years considered. Consequently, the VMT on Federal Aid Urban System was grouped with U. S. and State Routes. This grouping was satisfactory for the purpose of the study. In addition, for the years 1976 and 1977 the available data did not break down the VMT values on Federal Aid Secondary Rural by State and local routes. The available data for 1976 and 1977 also did not indicate the share of State routes for the VMT on non-Federal Aid highways. However, the 1973-75 data indicated that about 8% of the total VMT on Federal Aid System is on the local part of the Secondary system, while 2.9% of the total VMT on non-Federal Aid System is on State routes.

$$TVMT79 = TVMT75 (1 + RATE)^4$$

where

TVMT79 = estimated statewide VMT for 1979;

TVMT75 = reported statewide VMT for the same category in 1975;

RATE = average yearly VMT growth rate for the highway type under consideration.

The estimated 1979 statewide VMT values along with the aggregated sectional VMT values are presented in Table 13. The extrapolation factors were derived by dividing the statewide estimates by the sectional values and the resulting rates are also presented in Table 13.

The total statewide 1979 estimates of VMT for in-state automobiles, out-of-state automobiles and trucks (including pick-ups and vans) on Indiana highways were made by applying appropriate extrapolation factors to the sectional VMT values, as shown below.

$$\begin{aligned} VMT79_j = & (SVMTIS_j * \text{Extrapolation Factor for Interstate} + SVMTOH_j * \\ & \text{Extrapolation Factor for Other U.S. and State Routes}) \\ & + \text{appropriate share of VMT on Local Routes} \end{aligned}$$

where

$VMT79_j$ = total statewide VMT in traffic category j;

$SVMTIS_j$ = total sectional VMT for interstate highways in category j;

$SVMTOH_j$ = total sectional VMT for other U.S. and State Routes in category j;

j = traffic categories (in-state autos, out-of-state autos, and trucks).

The VMT values for pick-ups and vans were separated from the VMT values for trucks including pick-ups and vans. In the 1976 National Highway Inventory and Performance Study (NHIPS) (1) the truck traffic rates on Interstate, Primary and Secondary routes were found to be 30%, 6% and 4%, respectively. On the basis of traffic rates observed for non-automobile vehicles (Table 10), the rates for pick-ups and vans used in this study were 6.5% on Interstate and 25% on other

Table 13 : Estimation of Extrapolation Factors

	Estimated 1975 VMT on Study Sections x 10 ⁶	Estimated 1979 Statewide VMT x 10 ⁶	Extrapolation Factor
Interstate	3,359	8,749	2.6
Other US and State Routes	1,530	27,429 ^a	17.93
Total (Excluding Local Routes)	4,489	36,178 ^a	8.06
Local Routes	—	6,963 ^b	—
Total		43,141	

^a includes VMT on Federal Aid Urban System

^b excludes local share of the VMT on Federal Aid Urban System

U.S. and State routes. It was further assumed that 50% of the pick-ups and vans was out-of-state. This rate is higher than the automobile rate (35%), but lower than the truck rate (59.49%).

The 1979 VMT values for local routes were divided into automobile VMT and truck VMT by using a truck rate (including pick-ups and vans) of 8%. A truck rate (excluding pick-ups and vans) of 4% was reported for secondary roads in the National Highway Inventory and Performance Study (NHIPS) conducted by the FHWA in 1976 (1). All local automobile VMT was assumed to be in-state while the VMT for trucks and pick-ups and vans were divided into in-state and out-of-state categories. This assumption is consistent with the procedure adopted in the study.

The total truck VMT was divided into in-state and out-of-state groups by using the percentage of out-of-state trucks (59.49%) derived from the ISHC weigh station data.

The resulting 1979 VMT values are shown in Table 14. The total statewide VMT for 1979 is estimated to be $43,141 \times 10^6$ and this represents a small increase since 1977. These results conform to the recent trends in highway travel.

The total VMT by out-of-state vehicles would amount to 32% of all traffic in 1979. The assumptions were made in this study in such a way that the out-of-state travel computed would give conservative estimates; consequently, the actual percentages of out-of-state travel are most likely to be higher than the estimated rates.

Estimation of the Amount of Fuel Sales

The amount of fuel sales was estimated on the basis of the VMT values. Appropriate fleet fuel efficiency rates were applied to convert VMT values to gallons of motor fuel consumed. All fuel consumed by in-state traffic was assumed to have been purchased in Indiana. This assumption may not hold true in areas along the state borders; however, this assumption does not have much effect on the results of this study.

Table 14: Estimates of 1979 Statewide
 VMT by In-State and
 Out-of-State Vehicles

	<u>VMT x 10⁶</u>
In-State Automobiles	23,795.78
Out-of-State Automobiles	7,443.81
All Automobiles	31,239.59
 In-State Pick-Ups and Vans	 3,705.57
Out-of-State Pick-Ups and Vans	3,527.61
All Pick-Ups and Vans	7,233.18
 In-State Trucks	 1,976.32
Out-of-State Trucks	2,691.91
All Trucks	4,668.23
<hr/>	
State Total	43,141.00
Out-of-State Vehicles	13,663.33
Percent of VMT by Out-of-State Vehicles	32%

The steps involved in the estimation of fuel sales are shown diagrammatically in Figure 2 and the details are discussed below.

1. Estimate the 1979 average fleet fuel efficiency values for automobiles, pick-ups and vans, and trucks.
2. Convert out-of-state VMT values to out-of-state fuel consumption by type of vehicles.
3. Estimate probability of fuel purchase in Indiana by out-of-state travellers and estimate total fuel purchase by out-of-state automobiles, pick-ups and vans, and trucks.

Average Fleet Fuel Efficiency Rates

The average fleet fuel efficiency rates for 1979 for automobiles, single unit trucks and combination trucks were obtained from a recent report (5). The 1979 auto fleet fuel efficiency was 14.7 miles per gallon (mpg) while the corresponding rates for single unit trucks and combination trucks were 10.75 mpg and 6.04 mpg, respectively. The percentage of combination trucks in the truck fleet on Indiana highways has been estimated to be 53% (8). Therefore, a weighted average truck fleet fuel efficiency rate was estimated as shown below.

$$\begin{aligned} \text{Average Truck Fleet Fuel Efficiency (1979)} &= (\text{Percent SU Trucks} * \\ &1979 \text{ MPG for US}) + (\text{Percent Combination Trucks} * 1979 \text{ MPG for} \\ &\text{Combination}) = 0.47 * 10.74 + 0.53 * 6.04 = 8.25 \text{ mpg} \end{aligned}$$

This weighted average truck fleet fuel efficiency value was then applied in estimating fuel consumption by trucks. The average fleet fuel efficiency rate for pick-ups and vans was assumed to be 12.5 mpg.

Fuel Purchase by Out-of-State Vehicles

The VMT for out-of-state automobiles is estimated to be $7,443.81 \times 10^6$. Then the amount of fuel consumed by out-of-state travellers would be $(7,443.81 \times 10^6 \div 14.7)$ or 506.38×10^6 gallons. Similarly, the fuel consumption by out-of-

state pick-ups and vans would be $(3,527.61 \times 10^6 \div 12.5)$ or 282.21×10^6 gallons. The probability of fuel purchase in Indiana by out-of-state automobiles was taken to be 1.0, and it was assumed that the amount of fuel purchase would equal the amount of fuel consumed. This assumption is reasonable, because some automobiles would drive a part of the way in Indiana with fuel purchased out-of-state, while some others would purchase more fuel in Indiana than what would be necessary to travel the Indiana portion. On the average, it can be expected that the out-of-state automobiles purchase fuel in Indiana in equal proportion to the VMT. The same assumption was made for pick-ups and vans. However, this assumption cannot be made for trucks, because the trucks have much higher fuel tank capacity, and in some cases, it may be possible for out-of-state trucks to travel through Indiana without making any fuel purchase.

For trucks an estimate was made to determine the probability of fuel purchase in Indiana. This estimation was done on the basis of the weigh station survey data as shown below.

$$PRFP = PFPI * (POSTSH/POST)$$

where

PRFP = probability of fuel purchase in Indiana by out-of-state trucks;

PFPI = percentage of out-of-state trucks expected to make a fuel purchase in Indiana as estimated from the weigh station survey done in the present study;

POSTSH = percentage of out-of-state trucks as estimated from the data collected by the ISHC weigh station survey;

POST = percentage of out-of-state trucks as estimated from the weigh station data obtained in the present study.

The resulting probability value is $48.2 * (59.49/54.50)$ or 53%.

The expected amount of fuel purchase in Indiana by the out-of-state trucks can then be estimated to be $(2,691.91 \times 10^6 \div 8.25) * 0.53$ or 172.93×10^6 gallons.

The estimates of motor fuel purchase in Indiana during 1979 by different categories of traffic are summarized in Table 15. The percent of total motor fuel purchase by out-of-state vehicles amounted to 31%.

Comparison of Analysis Results with the Actual Fuel Consumption Data

In order to evaluate the overall reliability of the VMT and attendant fuel purchase figures obtained in the study, the resulting fuel consumption value was compared with the data on actual fuel consumption in Indiana in 1979.

The amounts of actual monthly deliveries of gasoline and diesel fuel in Indiana from January through October were obtained from the Energy Group of the Indiana Department of Revenue. For the months of November and December, the fuel availability figures were used. In general, the deliveries are the same or slightly lower than the available amounts. In Table 16 are given the monthly gasoline and diesel fuel figures for 1979. Assuming the amounts available to Indiana are actually delivered, the total consumption of gasoline and diesel in 1979 will be 3,350,242,004 gallons.

On the basis of the 1977 data, the percent of private and commercial highway use of motor fuel is 95.48% of the total fuel consumed. Assuming the same rate for 1979, the total motor fuel consumption for private and commercial

Table 15: Estimates of 1979 Fuel
Purchase by In-State
and Out-of-State
Vehicles

	<u>Gallons x 10⁶</u>
In-State Automobiles	1,618.76
Out-of-State Automobiles	506.38
All Automobiles	2,125.14
In-State Pick-Ups and Vans	296.45
Out-of-State Pick-Ups and Vans	282.21
All Pick-Ups and Vans	578.66
In-State Trucks	239.55
Out-of-State Trucks	172.93
All Trucks	412.48
<hr/>	
State Total	3,116.28
Out-of-State Vehicles	961.52
Percent of Fuel Sold to Out-of-State Vehicles	31%

Table 16: Motor Fuel Consumed In Indiana In 1979

	Gasoline	Diesel
<u>Actual Deliveries</u>		
January	244,028,400	36,031,800
February	223,255,200	40,584,600
March	254,742,600	39,505,200
April	240,874,200	38,526,600
May	268,711,800	53,898,600
June	235,510,800	38,283,000
July	230,853,000	33,348,000
August	260,971,200	30,109,800
September	228,170,964	30,563,148
October	248,079,090	46,090,632
<u>Available to the State</u>		
November	234,000,000	35,418,440
December	220,500,000	38,184,930

Source: Energy Group, Indiana Department of Commerce, Indianapolis, Indiana.

highway use will be 3.18×10^9 gallons. The corresponding figure generated by the study was 3.116×10^9 gallons indicating a difference of about 2%. Considering the limited amount of data available for the analysis and the complexity of the various assumptions made during the course of the study, this small level of difference is highly acceptable. However, there are several factors that can affect the fuel consumption values for different categories. First, the fleet fuel efficiency rates considered in the analysis to convert VMT estimates into fuel consumption can play a crucial role. Also, the value for the percentage of out-of-state trucks making fuel purchase in Indiana used in the study is based on a very small sample, and in reality this value is most likely to be higher than 53%.

Another set of comparisons was also made in terms of total sales of gasoline and non-gasoline motor fuel. Generally, most of the highway gasoline use is by automobiles, pick-ups and vans, while trucks primarily use diesel. Total fuel sales to automobiles, pick-ups and vans amounted to $2,703.80 \times 10^6$ gallons, while the volume of fuel sales to trucks was 412.48×10^6 gallons. The percentage of gasoline sales is then 86.76%, while the diesel sales is 13.24%. The corresponding values obtained from the expected fuel consumption data are 86.25% and 13.75%, respectively. This close agreement of study results with the fuel sales information indicates that the procedure adopted in the study was sound and the overall results obtained are reliable estimates.

CONCLUSIONS

The present study investigated the extent of use of Indiana highways by out-of-state vehicles and the attendant fuel sales. A field survey was conducted encompassing vehicle counts on highways, and personal interview at service stations and weigh stations. Data from secondary sources was also used to supplement the field data. The analysis indicated that in 1979 the total vehicle-miles of travel on Indiana highways would amount to $43,141 \times 10^6$ and the total out-of-state travel would be $13,663.33 \times 10^6$ vehicle-miles or 32% of total travel on Indiana highways in 1979. The corresponding fuel sales to out-of-state vehicles in Indiana would be 961.52×10^6 gallons representing about 31% of total expected motor fuel sales in Indiana in 1979 for highway purpose.

For any study of this nature, the data used often is not precise and the data in the present study also had several problems. First, observation from only two months in summer was used. In addition, there was a severe fuel shortage during the period accompanied by an unrest in trucking industry. Consequently, the truck data, particularly with respect to fuel purchase, was limited. Furthermore, due to the lack of information, average trip lengths for both in-state and out-of-state vehicles were considered to be the same. Also, pick-ups and vans were included in the truck category causing a large truck traffic percentage on non-Interstate routes. Appropriate assumptions and necessary adjustments were made in the analysis in order to minimize the effects of data imperfections. The overall validity of the analytical approach was established by comparing the total fuel consumption value generated by the study with the data on actual fuel consumption in Indiana in 1979. The study results indicated about 2% less fuel sales than the expected total motor fuel sales in 1979 for highway purpose. It is felt this small difference is highly acceptable and it establishes the overall

soundness of the procedure. Nevertheless, the study results should be reviewed as only approximate values and not as exact figures. The analysis procedure was such that the resulting in-state travel and associated fuel sales were probably over-estimated and thus under-estimating the out-of-state figures. The information on out-of-state travel and associated fuel sales therefore provides only a conservative estimate.

There are several implications of the study results. First, a 32% share of total vehicle-miles of travel and a 31% share of total motor fuel sales by the out-of-state vehicles establishes the significance of Indiana as a crossroads state. On the basis of these results it would appear that vehicle use taxes are more appropriate than general revenue fund for any additional source of highway revenue. As far as the vehicle use taxes are concerned, the taxes related to motor fuel are primarily relevant to out-of-state user market, and an appropriate increase in fuel taxes would be an equitable solution.

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APPENDIX A

Summary of Indiana Motor Fuel Taxes*

The Indiana Code has three fuel tax provisions administered by the Motor Fuel Tax Division of the Indiana Department of Revenue.

Motor Fuel Tax	1 C 6-6-1
Fuel Use Tax	1 C 6-6-2
Motor Carrier Fuel Tax	1 C 6-6-4

Motor Fuel Tax

This tax applies to the sale of gasoline for highway use. It is added to the selling price (at the rate of 8¢ per gallon) after it enters the state. Motor fuel distributors in Indiana are responsible for the tax collection and monthly payments to the Indiana Department of Revenue.

Fuel Use Tax

The Fuel Use Tax is the special fuels counterpart to the Motor Fuel Tax. Special fuels include diesel fuel, home heating oils, LP gas. Dealers and licensed users remit tax payments monthly. The fuel becomes taxable when it enters the tank of a vehicle at the rate of 8¢ per gallon.

Motor Carrier Fuel Tax

This small percentage of the fuel tax revenue consists of taxes levied on motor carriers who have imported fuel from another state in their supply tanks and used it in Indiana. Truck mileage in Indiana is the measure of liability. The levy is calculated from the mileage based on a rate of 8¢ per gallon.

*For further information refer Handbook of Taxes and Appropriations, Indiana Legislative Services Agency, November 1978.

Percent Revenues from Motor Fuel Taxes

The present revenues from motor fuel taxes for the calendar year 1977 had the following distribution:

Motor Fuel Tax	84%
Fuel Use Tax	14%
Motor Carrier Fuel Tax	2%

According to the 1979 Highway Statistics Report of the US Department of Transportation the percentages of taxable motor fuel consumption in 1977 in Indiana by type of fuel were:

due to gasoline: 85.92% of taxable motor fuel

due to special fuels: 14.08% of taxable motor fuel

Fuel Permits

The State of Indiana requires that all trucks (Indiana and non-Indiana) having more than 2 axles and all tractors must carry a fuel permit. This is issued annually or by trip.

APPENDIX B

Summary of State Laws Regarding
Through Travel of Interstate Trucks*

Special fuels tax provisions for highway use are directed primarily at truck traffic. States vary widely across the union with respect to special fuels and motor carrier tax laws.

In 1977 the North American Gasoline Tax Conference (NAGTC) classified state special fuel tax laws into three categories: supplier statutes, user-dealer statutes and user statutes. Indiana falls under the user-dealer category.

Supplier Statutes

In twenty states the distributor rather than the dealer or user is primarily liable for the payment of the special fuels tax. The tax is imposed on the distributor who, in turn, passes the cost on to the service station dealer.

"Carriers importing fuel into supplier law states in vehicle fuel tanks are commonly taxed on the use of that fuel within the state" (NAGTC Report, p. 1). This is generally done by periodic report of mileage travelled and fuel purchased in the state.

User-Dealer Statutes

Under this procedure covering 24 states, retail dealers and licensed bulk users receive special fuels ex-tax and are liable for tax payment. That is, the tax is collected by the dealer on the delivery of the special fuel into the fuel tank of the motor vehicle.

*For further information refer NAGTC's Five-Point Plan for the Taxation of Special Fuels, Federation of Tax Administrators, Washington, D. C., December 1977.

"Tax on fuel imported by interstate carriers in their fuel tanks is measured in user-dealer states by mileage" (NAGTC Report, p. 2).

User States

This type of statute is in effect in three states only. All licensed users are taxpayers. Special fuels are purchased tax free. User liability is based on mileage which is reported periodically.

In user statute states the issue of the amount of imported fuel is irrelevant since each motor carrier reports the total miles travelled as the basis of his tax liability.

Non Statute States

Four states do not tax carriers' use of special fuels. "Idaho, Oregon and Wyoming impose ton-mile taxes on carriers and Vermont has a system of registration fees graduated by weight" (NAGTC Report p. 2).

Summary

It has become common practice for states to tax motor carriers' use of highway through a special fuels tax. Alternative or additional revenue sources are taxes based on weight in relation to miles travelled, license plate registration fees and fuel permits.

Where special fuel tax is used, liability for collection and payment rests with either distributor, dealer or user. However in all cases the basis upon which liability is determined is vehicle-miles travelled. All but seven states impose taxes on fuel imported from other states in vehicle supply tanks by interstate carriers. Mileage within the state is the basis upon which liability is calculated with respect to imported fuel.

Only three states retain a requirement that the motor carrier make sufficient tax-paid purchases of fuel to cover operations within the state: Alabama, Mississippi and Wisconsin.

Appendix C: Sectional VMT Computations

Table C-1 : Computation of Section VMT:

Northwest Region

Section	Route	ADT (1975)	Distance (Miles)	In-State Auto-VMT	Out-State Auto-VMT	Truck VMT
1	I-94	93,150	5.0	60,859,552 (35.8%)	75,139,447 (44.2%)	33,999,750 (20.0%)
2	I-65	53,824	7.5	69,251,304 (47.0%)	53,043,552 (36.0%)	25,048,344 (17.0%)
3	I-65	12,638	60.0	95,486,409 (34.5%)	114,860,463 (41.5%)	66,425,328 (24.0%)
4	US-41	9,064	10.0	17,832,060 (53.9%)	6,385,134 (19.3%)	8,866,404 (26.8%)
5	US-30	14,082	18.0	45,056,626 (48.7%)	28,773,328 (31.1%)	18,688,785 (20.2%)
6	US-30	14,254	20.0	45,783,848 (44.0%)	34,025,723 (32.7%)	24,244,628 (23.3%)
7	US-52	4,108	10.0	6,557,506 (43.0%)	2,054,205 (13.7%)	6,492,488 (43.3%)
8	I-65	8,976	27.0	23,176,121 (26.2%)	47,325,286 (53.5%)	17,957,071 (20.3%)
9	SR-43	3,856	11.5	11,006,180 (68.0%)	1,343,401 (08.3%)	3,835,977 (23.7%)
10	US-24	3,908	14.0	12,261,506 (61.4%)	1,937,078 (09.7%)	5,771,295 (28.9%)
11	US-52	3,460	30.0	24,891,759 (65.7%)	2,083,785 (05.5%)	10,911,456 (28.8%)
12	I-65	19,152	32.0	77,174,899 (34.5%)	68,003,389 (30.4%)	78,517,071 (35.1%)
13	SR-63	5,396	25.0	16,494,897 (33.5%)	7,435,013 (15.1%)	25,308,589 (51.4%)
14	I-74	8,916	35.0	17,199,186 (15.1%)	48,863,915 (42.9%)	47,838,798 (42.0%)
15	I-74	9,106	31.0	21,431,153 (20.8%)	39,462,171 (38.3%)	42,141,065 (40.9%)

(VMT = ADT x DIST. x 365 x Appropriate Percentage)

Table C-2 : Computation of Section VMT:
Northeast Region

Section	Route	ADT (1975)	Distance (Miles)	In-State Auto-VMT	Out-State Auto-VMT	Truck VMT
1	US-31	14,896	23.0	76,406,723 (61.1%)	26,010,799 (20.8%)	22,634,397 (18.1%)
2	US-6	5,562	13.0	14,462,646 (54.8%)	3,008,652 (11.4%)	8,920,391 (33.8%)
3	I-69	14,178	24.0	48,735,419 (37.8%)	41,773,216 (32.4%)	38,421,044 (29.8%)
4	US-31	6,486	28.0	38,645,274 (58.3%)	12,329,367 (18.6%)	15,312,278 (23.1%)
5	US-30	14,196	30.0	70,572,574 (45.4%)	45,234,844 (29.1%)	39,638,781 (25.5%)
6	US-30	12,814	19.0	53,230,188 (59.9%)	10,397,215 (11.7%)	25,237,685 (28.4%)
7	SR-7	7,360	14.0	29,072,220 (77.3%)	2,858,329 (07.6%)	5,679,049 (15.1%)
8	I-69	12,550	48.0	111,916,884 (50.9%)	49,252,224 (22.4%)	58,706,892 (26.7%)
9	I-69	12,416	30.0	70,696,704 (53.2%)	24,471,936 (18.0%)	39,155,097 (28.8%)
10	US-31	12,860	30.0	86,884,089 (61.7%)	30,557,289 (21.7%)	23,375,622 (16.6%)
11	I-69	19,600	18.0	73,013,724 (56.7%)	12,877,200 (10.0%)	42,881,076 (33.3%)
12	I-70	16,550	21.0	27,273,986 (21.5%)	43,130,955 (34.0%)	56,450,808 (44.5%)
13	I-70	16,924	32.0	34,790,328 (17.6%)	80,057,289 (40.5%)	82,884,702 (41.9%)

(VMT = ADT x Distance x 365 x Appropriate Percentage.)

Table C-3 : Computation of Section VMT:
Southwest Region

Section	Route	ADT (1975)	Distance (Miles)	In-State Auto-VMT	Out-State Auto-VMT	Truck VMT
1	SR-63	7,406	13.0	15,216,256 (43.3%)	3,760,137 (10.7%)	16,165,076 (46.0%)
2	I-70	18,876	32.0	61,732,070 (28.0%)	55,779,335 (25.3%)	102,960,274 (46.7%)
3	I-70	21,434	30.0	55,155,040 (23.5%)	49,756,887 (21.2%)	129,790,371 (55.3%)
4	SR-37	10,594	16.0	35,389,045 (57.2%)	4,454,565 (07.2%)	22,025,349 (35.6%)
5	SR-37	11,816	17.0	40,398,372 (55.2%)	4,912,324 (06.7%)	28,007,582 (38.2%)
6	US-231	4,164	18.0	16,441,845 (60.1%)	1,614,091 (05.9%)	9,301,543 (34.0%)
7	SR-37	7,918	23.0	42,741,245 (64.3%)	1,528,847 (02.3%)	22,201,517 (33.4%)
8	US-41	7,108	33.0	35,188,118 (41.1%)	14,297,848 (16.7%)	36,129,892 (42.2%)
9	US-52	7,042	12.0	15,113,540 (49.0%)	1,048,694 (03.4%)	14,681,724 (47.6%)
10	US-41	10,162	25.0	37,930,097 (41.5%)	14,465,607 (15.6%)	39,780,419 (42.9%)
11	I-64	1,988	16.0	1,288,701 (11.1%)	4,051,862 (34.9%)	6,269,356 (54.0%)
12	I-64	1,900	55.0	4,729,670 (12.4%)	16,820,842 (44.1%)	16,591,987 (43.5%)

(VMT = ADT x Dist x 365 x Appropriate Percentage)

Table C-4 : Computation of Section VMT:
Southeast Region

Section	Route	ADT (1975)	Distance (Miles)	In-State Auto-VMT	Out-State Auto-VMT	Truck VMT
1	I-65	22,750	12.0	36,470,070 (36.6%)	27,900,600 (28.0%)	35,274,330 (35.4%)
2	I-74	16,600	12.0	29,737,572 (38.2%)	15,195,972 (20.9%)	27,774,456 (38.2%)
3	I-65	20,250	15.0	34,923,656 (31.5%)	33,149,756 (29.9%)	42,795,337 (38.6%)
4	I-74	12,425	20.0	29,296,907 (32.3%)	22,131,410 (24.4%)	39,274,182 (43.3%)
5	I-74	9,020	50.0	54,158,335 (32.9%)	47,409,120 (28.8%)	6,430,570 (38.3%)
6	I-65	19,300	16.0	44,859,376 (39.8%)	23,218,672 (20.6%)	44,633,952 (39.6%)
7	SR-7	5,585	18.0	22,970,099 (62.6%)	1,944,752 (05.3%)	11,778,597 (32.1%)
8	US-50	2,825	12.0	7,325,112 (59.2%)	470,193 (03.8%)	4,578,195 (37.0%)
9	I-65	17,565	33.0	61,778,564 (29.2%)	67,702,536 (32.0%)	82,089,324 (38.8%)

(VMT = ADT x Dist x 365 x Appropriate Percentage)

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