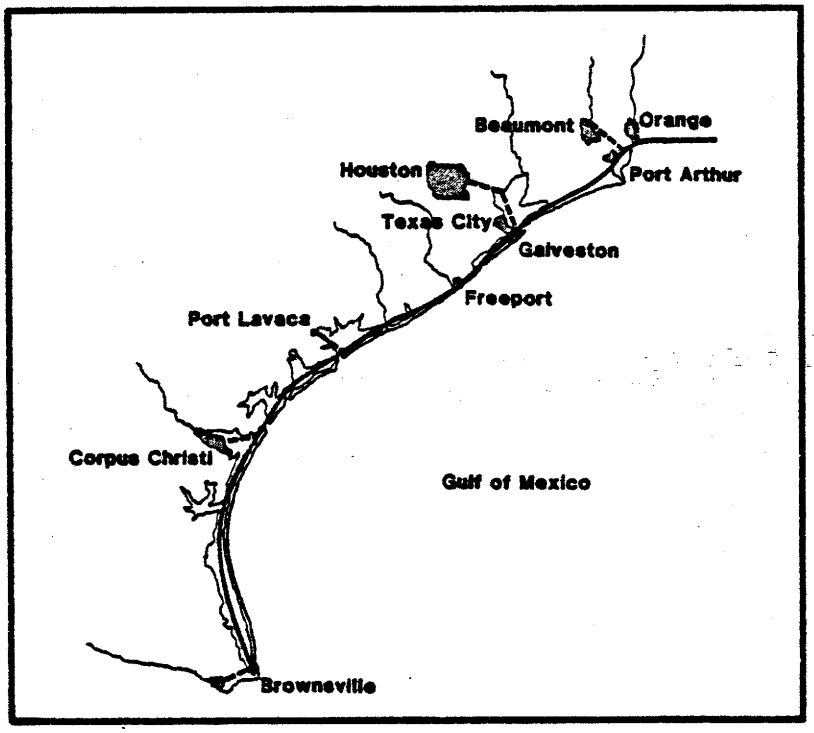
SOME ECONOMIC EFFECTS OF USER CHARGES ON TEXAS' COASTAL WATERWAYS

Research Report 1068-1F



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STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas

October 1982

SOME ECONOMIC EFFECTS OF USER CHARGES ON TEXAS' COASTAL WATERWAYS

by

Pamela Cosby
Emily Braswell
Dock Burke

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DISCLAIMER

The authors are wholly responsible for the views, interpretations, and analyses in this report. Any errors or omissions are also the responsibility of the authors.

PREFACE

The SDHPT and TTI initiated this study in response to the changes and impending changes in the financial support of and governmental responsibilities for the inland waterway network. The results reported here have already been published in summary form by the SDHPT in its biennial report prepared for the Sixty-Eighth Texas Legislature.

ACKNOWLEDGEMENTS

The authors thanks go to Messrs. Phillip Wilson, Jack Housworth, and B. C. Gersch of the SDHPT for their interest and cooperative support of this effort. At TTI, Ms. Susan Freedman typed and re-typed all the report drafts and completed the job in her professional way. Finally, the late Mr. Ralph Geho, SDHPT, deserves the special recognition he earned while serving as the waterways expert in SDHPT. Without his initial direction, this study would have lacked the focus it needed.

Ms. Cosby is no longer at TTI and is living in Starkville, MS. Ms. Braswell is presently the transportation planner, City of Victoria.

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BACKGROUND

Introduction

Now, more than ever, legislators are faced with decisions of how best to provide the funds for construction, operation, and maintenance of the nation's inland waterways. The U.S. Congress is currently "encouraging" states to play a more active role in defraying the costs of waterway transportation systems. Nationwide, policy analysts are recognizing the need to investigate new revenue sources capable of providing the necessary funds. The general intent of Congress is to shift the cost of waterway transportation from taxpayers in general to direct users of waterway systems. Legislators hope that the imposition of waterway user charges will reduce the tax liability of consumers. However, the extent to which expected benefits will be dissipated by higher consumer prices is of significant interest. Thus, governmental officials have an incentive to investigate the economic effects of various methods of financing the inland waterway systems.

The purpose of this study is to provide policy makers and other interested parties with information regarding one segment of the nation's inland waterway system - the Texas portion of the Gulf Intracoastal Waterway.

Inland Waterway User Charge History - A Brief Overview

Although the 1882 Rivers and Harbors Act proclaimed that the navigable waters of the United States should forever be toll free, every administration since the 1930's has examined the issue of a

user charge on inland waterways. It has been argued that the original law was designed to prohibit individual states from hindering interstate commerce and to protect the water transportation industry from competition from railroads; but protection from competition is no longer considered a legitimate basis for the federal government to pay the full cost of operating, maintaining, and constructing these waterways (1).

After years of debate, Congress passed the Inland Waterways Revenue Act in 1978 which imposed an escalating fuel tax on commercial users of certain shallow-draft inland waterways. The tax, which was implemented in October 1980, began at four cents per gallon and is scheduled to increase in two cent increments to a maximum of ten cents per gallon in 1985.

The present four cent per gallon fuel tax is to be collected by the Internal Revenue Service. The revenue, which is held in a trust fund, will be used for a new or rehabilitative navigation construction projects conducted by the U.S. Army Corps of Engineers. However, the ten cent fuel tax will still only cover a fraction of the costs involved.

Controversy over the user charge issue abounds. Proponents, such as the railroad industry, claim that the charge is necessary for equity in modal competition. Federal expenditures on waterways are said to amount to unfair subsidization of the water transportation industry. The water transportation industry counters pro-user charge statements with assertions that all major modes of transportation receive federal subsidies in one form or another, and that federal support of the nation's inland waterways should continue

for the good of the nation as a whole. It is pointed out that commercial users are not the only ones deriving benefits, both direct and indirect, from the waterways. Maintenance of many waterways is done to facilitate recreational use, flood control, electric power generation, irrigation, fish and wildlife enhancement, betterment of the environment, economic development of local areas and states, defense preparedness, and promotion of exports, in addition to commercial water transportation. Opponents of user charges claim it is very difficult to identify all of the users or beneficiaries of a given waterway and that the costs of keeping those waterways navigable should continue to be borne by the general public, particularly since at least some of the benefits accrue to the general public and not to specific groups.

The present political climate of federal budget cutting has given impetus to the push for recovery of these costs. In his February 18, 1981, message to Congress, President Reagan proposed a 30 cent per gallon fuel tax to begin in 1983 and increase eventually to 34 cents per gallon in 1986. The 30 cent per gallon tax was designed to recover the estimated 1983 Federal outlay of $325 million for operation and maintenance. These proposals have been postponed; however, different types of user charges aimed at recovering the same levels may very likely be approved in the near future.

Although President Reagan's full cost recovery proposal has not been accepted, there are presently other proposals before Congress to institute fuel taxes or other forms of user charges to recover more of the costs of operating, maintaining, and constructing the waterways

than are now being collected.[1]

In addition to the Corps of Engineers and the Coast Guard, many agencies have responsibilities for aspects of water transportation. The Federal Maritime Commission regulates commerce between the United States and foreign countries, and between non-contiguous ports of the United States. The Interstate Commerce Commission oversees rate charges, mergers, acquisitions, and consolidation of transport companies for carriers of certain regulated commodities.

The Maritime Administration, which is part of the U.S. Department of Commerce, administers federal programs to aid in developing, promoting, and operating the U.S. Merchant Marine. It also administers subsidies to U.S. ship builders and operators of U.S. merchant vessels. The Environmental Protection Agency, the Office of Management and Budget, and the Water Resources Council also monitor various water navigation projects and proposals.

The Texas Gulf Intracoastal Waterway

The entire Intracoastal Waterway extends over 1,100 miles from Florida to the Mexican border. The Texas portion is approximately 426 miles long extending the full length of the coast.

The Texas Gulf Intracoastal Waterway[2] was begun in the early 1900's

[1]The terms "user charge" and "tax" will be used synonomously in the remainder of this report.

There is also consideration of user charges to recover costs incurred by the U.S. Coast Guard in operations on inland waterways.

[2]For the remainder of the report, the Texas Gulf Intracoastal Waterway will be referred to as the Texas GIWW.

when canals and shallow channels connecting bays and ports were dredged to allow inland travel between ports. The federal government assumed control of the waterway in 1925, and in 1934, a section from New Orleans to Corpus Christi was completed. By 1941, the waterway extended to Brownsville. One of the first important roles of the waterway was to provide safe inland passage for the transport of goods and troops in World War II.

Water transportation, which provides the lowest cost method of moving many commodities, has been instrumental in the economic growth of Texas. For many years, over 60 million tons have been transported on the GIWW annually. The latest figures indicate 67.8 million tons were moved in 1979 compared to 66.2 million tons in the previous year (2). The primary products moved are petroleum products, chemicals, and crude petroleum. The 1977 Census of Transportation indicates that 22.2 percent of all goods manufactured in Texas are shipped by water on at least the first leg of the journey to the consumer. A further indication of the importance of marine transportation to Texas is that in 1977, foreign imports and exports at the 10 major Texas ports exceeded 132 million tons. For the same year, domestic shipments totaled more than 114 million tons, an increase of over 50% between 1967 and 1977.

Activity on the GIWW and in the ports translates into an economic plus for Texas and its citizens with benefits including increased employment and income, a larger tax base, and energy savings from an energy efficient method of transportation. As important as these benefits are, they are not the only function of the Texas GIWW.

Commercial fishing boats are also major users. Some navigable channels are maintained more for these users and the estimated 1.9 million recreational trips that are made every year than for other commercial traffic. As activities in Texas expand, the GIWW will continue to serve as an important recreational facility not only for the 55 per cent of Texas residents living within 200 miles of the coast, but for a substantial tourist trade as well.

In the past, much of the cost for construction, maintenance and operation of the GIWW has been borne by the federal government. The federal sponsor of the GIWW is the United States Army Corps of Engineers which is responsible for administering many federal water resource development programs. In addition to navigation, these programs include flood control, hydro-electric construction, and port development. While Texas ports have relied heavily on federal financing, there have been various fund raising programs conducted by port authorities, navigation districts, counties and other local entities to finance some ports partially.

In 1975, the Texas Coastal Waterway Act authorized the State of Texas to act as local nonfederal sponsor of the GIWW in Texas. The State designated the Department of Highways and Public Transportation to act as its agent in fulfilling these responsibilities.

The role of the State as nonfederal sponsor is complicated by a conflict between federal statutes and the Texas Constitution. As implemented by the Corps of Engineers, federal law requires the nonfederal sponsor to have full authority and capability to pay damages, if any, incurred by an improvement project. This requiremnt is said

to pledge the credit of the State, a violation of the Texas Constitution. Although the Corps of Engineers has withdrawn its interpretation until further study is conducted, the situation will be tenuous until a solution to the conflict is found. The nonfederal sponsor is also required to construct or pay for all levees, weirs, and drainage ditches required for the containment of dredged materials. The State of Texas does not have the authorized funds to do this; therefore, dredging, which is necessary for continued safe navigation, is still being done by the Corps.

Other issues cloud the future of the water navigation system in Texas. The initial Reagan proposals would have increased the current 4¢ per gallon fuel tax to 30¢ per gallon in July, 1981; but new proposals involve the use of license fees, lockage fees, segment tolls and fuel taxes to offset federal expenditures on inland waterways. The impacts of these are unknown, but they could be devastating to parts of the industry, particularly to the carriers of low value commodities that travel long distances. It would no longer be economically feasible to continue such movements. There is also discussion of reducing financing for or abandoning altogether the low volume portions of some waterways, such as the section of the GIWW from Brownsville to Corpus Christi.

The entire GIWW was dredged to 12-feet by 125-feet in 1949 and has been maintained at those dimensions. Technology in marine transportation has made these dimensions obsolete creating unsafe conditions and causing the GIWW to lag behind other waterways in the number of

barges that can be put in one tow. The shallow depth also limits how heavily barges can be loaded.

A growing problem on the GIWW and in the ports is congestion due to the steadily increasing flow of commodities, larger vessel sizes, and increased recreational use. The growth in tonnage has been transported safely in the past primarily due to technological improvements in vessels and equipment. It is the general consensus of those directly involved in the inland navigation industry that further advances in technology can no longer be depended upon to carry the brunt of increasing traffic. Further efficiencies in the marine transportation industry must come from improvements in port layouts and other facilities. Research must continue to look for solutions to the problems of the water transportation system of Texas, so they can best be managed and developed to maximize economic benefits while at the same time protecting the environment. Continued evaluation of the impact of user charges on the user as well as the local, regional, and state economies is an increasingly important aspect of the Texas waterways economic future.

USER CHARGE OPTIONS

To fully understand the potential effects of the current and proposed user charges, it is essential to have an understanding of the types of charges as well as the levels.

User charges are taxes imposed by government on individuals or groups that derive a direct benefit from a governmentally funded endeavour. Such charges are designed to recover governmental costs when the benefits do not accrue to the general public but rather to the specific individuals or groups taxed.

There are many examples of transportation user charges presently in existence:

1) Tolls paid by the operators of automobiles and trucks to use certain highways and bridges;

2) Fuel taxes and permit fees paid by motorists to help finance roadways; and

3) Fuel taxes, ticket taxes and loading fees paid by airlines to help cover federal costs.

The concept of user charges for transportation services is not new. However, extensive user charges on waterways are relatively new and their effects are unknown. One possible impact, commercial traffic loss, is of great concern to the users of the Texas GIWW. The extent of this impact will depend upon the market structure of the various users of the waterway and the competing modes of transportation available. The type of user charge is also a factor in the resulting impact since the consequences may vary from type to type. Following is a discussion of some of the user charges and some implications of each.

As indicated earlier, the user charge presently in effect is a fuel tax. This tax is collected from towing companies under Public Law 95-591, Inland Waterways Revenue Act of 1978. This tax was believed to be the easiest form of user charge to institute since it required little additional administrative or record keeping capacity for the government. It is the responsibility of the commercial haulers who use the fuel to report the amount of fuel consumed and pay the tax to the Internal Revenue Service.

The fuel tax represents a variable cost that increases as fuel consumption increases. The current tax is uniform across all designated waterway segments, i.e., the same tax is imposed on every gallon of fuel consumed regardless of the costs involved with the waterway segment used. This acts to cross-subsidize the high expenditure, low-traffic waterway segments.

Another factor to be considered is the variation in fuel use (gallons per ton-miles) by waterway segment. If it takes more fuel to travel the same distance on one waterway than on another (because of differences in physical characteristics such as current), the waterway with the higher fuel consumption will generate more tax revenue. This will be the case regardless of the costs involved in operating and maintaining the respective waterways. In other words, if the waterway with lower fuel consumption due to physical characteristics is also the more expensive to operate and maintain, the waterway with higher comsumption will subsidize the lower.

Data from the U.S. Army Corps of Engineers indicate that costs of maintenance and operation vary greatly among waterway segments

(Table 1). In 1977, per mile costs ranged from $54.50 per mile for the Lower Mississippi to $1.70 per mile for the Missouri River. The GIWW-West, which includes the Texas portion, had costs of $23.90 mile. Since higher ton-mileage generates more fuel consumption, users of higher volume segments of the waterway will generate more revenue. Using this argument, the GIWW-West with its high ton-mileage and medium range operation and maintenance costs is probably subsidizing the higher operation and maintenance costs of the Mississippi River System.

Table 1. Corps of Engineers Operation and Maintenance Expenditures Subject to Recovery and Costs per Mile for Selected Inland Waterways (in thousands of current dollars).

	YEAR		
	1977	1981	1982 (est.)
Upper Mississippi			
Total	$34,614.5	$34,352.6	$44,637.9
Per Mile	40.3	39.9	51.9
Lower Mississippi			
Total	53,268.8	69,823.5	69,500.4
Per Mile	54.5	71.5	71.1
GIWW - West			
Total	16,414.4	24,707.6	27,221.4
Per Mile	23.9	36.0	39.7
Red River			
Total	992.7	1,278.0	1,341.9
Per Mile	2.2	2.8	2.9
Missouri River			
Total	3,617.0	4,009.2	4,772.5
Per Mile	1.7	1.9	2.3

Source: U.S. Army Corps of Engineers, Office of Chief of Engineers (Unpublished tables reporduced by the National Waterways Conference Inc.)(16).

A fuel tax will probably have a great effect upon long-haul shipments of high volume commodities (3, p.53). Such a situation exists on the GIWW in shipments to and from the Brownsville area. Shipments on this section will be subject to higher overall fuel taxes than those going to and from less remote locations. Table 2 shows the five major segments of the GIWW and their lengths. It is easily seen than the Corpus Christi to Brownsville segment will be at a disadvantage due to its greater length and thus, due to the higher fuel taxes based on fuel consumption.

The majority of products carried on the Corpus Christi to Brownsville segment are petroleum products, chemicals, and crude petroleum (68%) (4). The market for transport of petroleum products and crude petroleum is susceptible to competition particulary from pipelines, and modal diversion may occur in the long-run if the fuel tax on water transportation creates an uneconomical situation for continued waterborne shipments.

Table 2. The Five Major Segments of the Texas Gulf Intracoastal Waterway

Segment	Length (miles)
Sabine River to Houston Ship Channel	61.4
Houston Ship Channel to Freeport Harbor Channel	44.9
Freeport Harbor Channel to Matagorda Ship Channel	76.8
Matagorda Ship Channel to Corpus Channel	63.0
Corpus Christi Channel to Brownsville Ship Channel	133.6

Source: State Department of Highways and Public Transportation.

Another specific example of a commodity movement that may be adversely affected by the fuel tax (or any form of tax on the waterway) is the shipment of relatively low-valued sand and gravel from Victoria. These shipments presently move to Houston by both barge and truck in a competitive situation. If water shipping rates are increased enough, a complete shift to truck could occur.

The presence of competition is an important factor in the ultimate effects upon a waterway from any form of user charge. The extent to which the charges can be passed on to shippers depends in large part on the available alternative forms of transportation and their rates. It has been stated that there is no room in the waterway industry to absorb the cost of a user charge and that the cost must all be passed on to the shippers (5). This may be impossible for some companies to do, depending upon the market structures they face.

There are two principal economic factors that determine the demand for transportation. These are: (1) the demand for the product being shipped and (2) the cost and quality of the transportation service (6). Because it is based upon the demand for the products being shipped, the demand for transportation is said to be a "derived demand". If quantity demanded of the product changes, there will be a resultant change in the quantity demanded of transportation services. The second factor mentioned above is related to the presence or absence of competition. Cost and quality of the service become much more crucial factors when there are competing modes available. When competition is present, the alternatives to the firms shipping their goods are extended from (1) shipping at the going rate on the lone

mode or (2) not shipping at all to (3) choosing the most efficient method of shipment. Following is a brief discussion of some hypothetical market structures and the effects of a user charge.

Theoretical Effects of a User Charge

A theoretical outcome of the imposition of transportation user charges can be shown using basic market supply and demand analysis. When a tax to be paid by the carriers is imposed, the first response of the carriers will be to supply less at each market price. This will result in an upward shift of the supply curve because the tax has made it more expensive to supply any given quantity. To get the carrier to supply any given quantity of transportation service, a higher price must now be paid.

Most demand curves slope downward from left to right indicating that larger quantities are bought only at lower prices. Not all demand curves have the same relative elasticity, however. They may vary from nearly horizontal lines to nearly vertical lines depending upon consumers' reactions to price changes for a particular commodity or service. A completely vertical demand curve represents a perfectly inelastic demand. Consumers purchase the same amount regardless of changes in price. An example of a commodity with an highly inelastic demand is insulin since people who use insulin need a certain amount regardless of its price because it is necessary to keep healthy and alive.

As shown in Figure 1, the equilibrium position changes from E to E' indicating the price has risen from P to P' and quantity has decreased from Q to Q'. This also indicates that some of the tax C

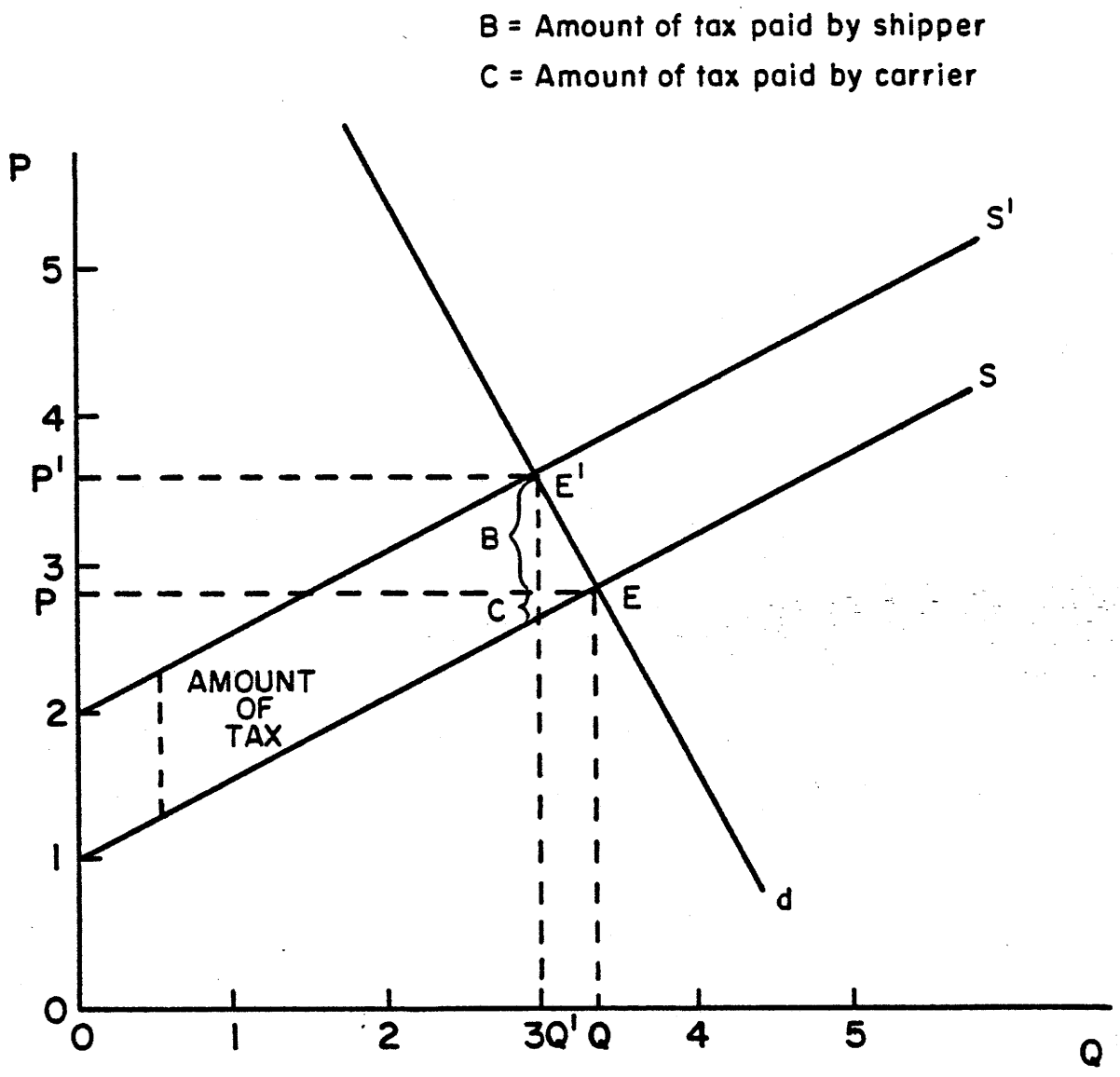

Figure 1. Effect of Per Unit User Charge with a Relatively Inelastic Demand Curve

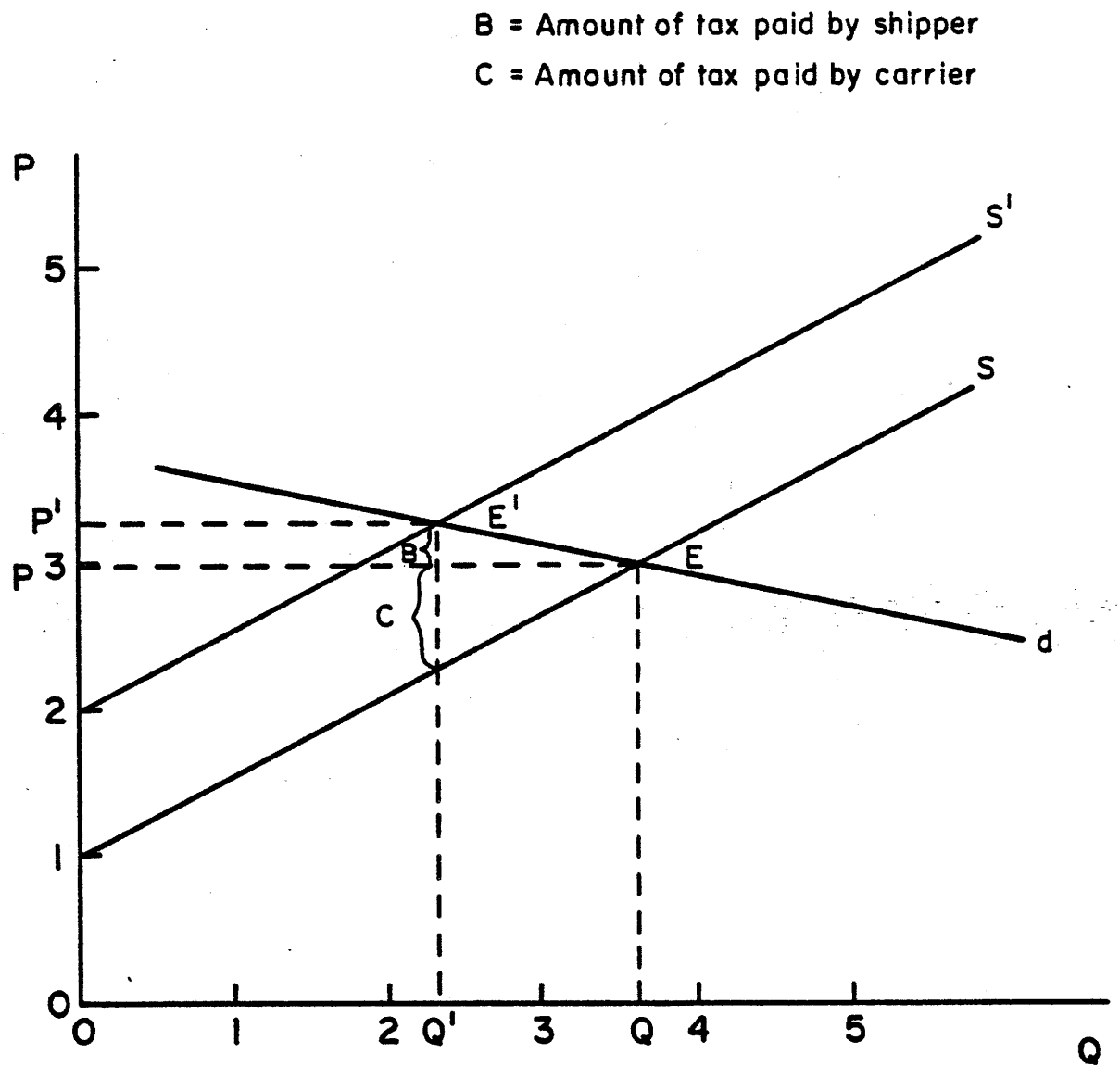

Figure 2. Effect of Per Unit User Charge with a Very Elastic Demand Curve

will be absorbed by the carrier and an amount B also will be passed on to shippers. The graph in Figure 1 indicates that shippers will pay a greater share of the tax than the carriers. The portions paid by each depends partly on the elasticity of the demand curve for the transportation service that is being taxed.

The concept of elasticity of demand is valuable because in the case of a transportation user tax, it suggests how total revenue for the carrier firm or industry would respond to changes in price such as those brought about by the introduction of a user charge.

Figures 1 and 2 depict demand curves of different relative elasticities. The graphs indicate that more of the tax will be passed on to shippers when the demand for the transportation service is more inelastic. In a situation such as the one depicted in Figure 2, where demand is very elastic, the carrier must absorb most of the tax.

There are many instances of water carriers who are involved in the shipment of more than one product. The losses incurred from shipping products that result in a very elastic demand for water transportation may be offset somewhat by charging higher prices to ship products with an inelastic demand. Higher prices may also be charged during peak periods for seasonal products to offset losses incurred at other times or with other products.

These highly simplified examples are offered only to illustrate the directional propensities of user taxes. Clearly, elasticities of substitution between waterborne and rail or truck transport affect empirical outcomes. Similarly, the degree of competition and profit-

ability within the industry will partly determine whether the incidence of a tax is potentially devastating to the industry and it's firms. And, most importantly, the condition of the Texas, U.S., and world economies is crucial to growth and health of the waterborne commerce industry. Under robust economic conditions, user charges will be easier to absorb.

One final theoretical aspect needs mentioning here. As shippers face higher transport rates (due to user taxes), their operating cost structures are affected also. The extent to which they can pass their portion of a user charge on to their own customers depends on the markets for products they serve. Consequently, the ultimate incidence of a user tax cannot be specified a priori and will usually be shared by carriers, shippers, and ultimately consumers.

Fuel Tax

The opposition of carriers to fuel taxes is clear--they will be adversely affected, whatever the level of user charge. There is one other aspect of fuel taxes that should be pointed out. Society, as a whole, should reap the benefit of fuel conservation as a result of the fuel tax. There should be an incentive for the creation of more fuel-efficient tows and for barges that create less resistance in the water. Keeping boats in good mechanical order to insure optimum fuel efficiency should become a higher priority of the waterway industry.

The fuel tax is not the only user charge option available. Segment tolls, equipment license fees, and lockage fees have all been

considered and are possibilities for future cost recovery schemes. Following is a discussion of these types with the exception of lockage fees which have no application in Texas because no locks are used on the GIWW except those at the mouth of Colorado River when the river is at high flood.

Segment Tolls

Segment tolls would tax the users of each waterway segment according to the amount of waterway maintenance and construction expenditures on that segment. With respect to Texas, the segment might be considered to be the entire Texas portion of the GIWW or it could be categorized down into additional segments. Separate expenditures have been calculated for the five portions of the Texas GIWW between the six major deep-draft channels where most traffic originates or terminates. Using these data and data indicating the number of ton-miles for each segment, it is readily apparent that this method of cost recovery could affect some areas to a much greater extent than others (Table 3). The Corpus Christi to Brownsville segment is characterized by high maintenance and construction costs (due partly to the much greater length of the segment) and low ton-miles. This results in a higher cost per ton-mile on this segment.

In addition to the petroleum and chemical products that make up a large part of the Corpus Christi to Brownsville traffic, almost one-fourth of the shipments are non-metallic minerals. These usually low-value shipments could be curtailed sharply if a segment toll were put into effect creating an unprofitable situation in this segment of the waterway.

The types of segment tolls most frequently talked about are a ton-mile tax or a fuel tax based on the costs for each segment. If either of these tolls was established, the types of effects on water carriers would be much the same as with the fuel tax discussed in the previous section. Obviously, those firms shipping on segments with the higher segment tolls would be affected more adversely.

Table 3. Length, Ton-Miles, and Estimated Costs for the Texas Gulf Intracoastal Waterway by Segment, 1977

	Length (Miles)	Ton-Miles (Millions)	Cost Per Ton-Mile[1]
Sabine River to Houston Ship Channel	61.4	2,023	$.00136
Houston Ship Channel to Freeport Harbor Channel	44.9	517	$.00362
Freeport Harbor Channel to Matagorda Ship Channel	76.8	771	$.00536
Matagorda Ship Channel to Corpus Christi Channel	63.0	462	$.0080
Corpus Christi Channel to Brownsville Ship Channel	133.6	239	$.02031

[1]Costs per ton-mile represent the amount needed to recover maintenance expenditures for 1977 plus one-fiftieth of the costs of the most probable improvements for the next 50 years.

Source: Texas State Department of Highways and Public Transportation.

License Fee

A License fee would apply a fixed operating charge on towboats and barges. Fees could be based upon a system-wide or segment specific cost recovery scheme. The fees could be charged by horsepower or

registered tonnage for towboats and cargo capacity for fully loaded draft barges.

A license fee would represent a fixed cost to the firm. Because the tax would not be based upon specific shipments (except when equipment is under contract to carry specific commodities), the burden of the license fee could be spread over various shipments according to what the market will bear. An example of how firms cover their costs differentially over the year is the case of spot grain rates. These rates fluctuate 100 to 300 percent between peak and slack shipping seasons in response to market conditions. To set a fixed yearly rate would result in too little traffic in slack periods and an excess in peak periods (3). A higher price is charged in peak periods that helps cover the increased cost of the license fee. Once again, the market conditions faced by the waterborne carriers' service will determine how much the tax carriers can pass along to the shipper and how much they will pay themselves.

One aspect of the license fee that sets it apart from the other forms of user charges is that the only way to avoid the tax in the short-run is to scrap or sell unprofitable equipment. With a fuel tax, or other tax that results in a variable cost, there is always the option to let equipment sit idle without incurring additional taxes. No shipments need move that can not pay their way. The cost remains the same with a license fee whether the equipment sits idle or not. Any activities that result in a greater than average idle time would be put at a disadvantage by a license fee.

For the carriers, a license fee on vessel size or horsepower might be more easily administered than some of the other forms of user charges. No records of fuel consumption or tonnages shipped must be kept. This could result in a savings to the firm in labor and bookkeeping cost. This type of charge might also be more easily assessed against out-of-state vessels using the Texas waterway if the fee is not nationwide. The license could be required for operation on the Texas portion in much the same manner that trucks pay fees to various states in which they operate. This would be much easier than trying to calculate fuel consumption for a vessel that has bought its fuel out-of-state.

Presently, the State of Louisiana levies an occupational license tax on those companies operating on the Louisiana portion of the GIWW. The tax is based on the revenue of the company but only on intrastate transactions. The tax ranges from $5 for a firm with less than $5,000 revenue annually to $480 for firms with more than $500,000 revenue. A self assessment system of collection requires operators to file a return indicating the amount of "taxable" revenue they earned on intra-state shipments.

One final aspect of the license fee is that the intra-industry competition may not be increased as much by this form of user charge. Since carriers with similiar equipment will pay similar fees, no one will have an advantage. This may not be the case with a fuel tax which gives more fuel efficient vessels an advantage (3).

User Charge Summary

There have been many proposals within the past few months as to the type of charge that should be put into effect and the percent of costs that should be recovered. It appears that the initial Reagan proposal to have a fuel tax great enough for full cost recovery has been set aside, at least temporarily. Some kind of segment specific charge may be more likely at this point. It has been agreed that uniform fuel taxes result in too much cross-subsidization. The Office of Management and Budget has since directed the Secretary of the Army to develop a proposal for a user charge plan for complete cost recovery of navigation operation and maintenance costs for shallow-draft waterways. The legislation will also recover construction costs, plus interest, amortized over 50 years. An additional bill, which will authorize the Secretary of Transportation to establish fees and charges for Coast Guard services, has been recommended (7).

LITERATURE REVIEW

Although many studies have been initiated in the last five years, there is much that is unknown about the effects of user charges on the water transportation industries or about impacts on the local and state economies in which they are located. It is not clear whether carriers will be able to pass along enough of the user charges to continue making a level of profit sufficient for them to continue operation or if some companies will be forced to go out of business. It is also not known for sure, but, it is likely, that carriers hauling certain commodities will be affected to a greater extent than those carrying other commodities.

Federal Studies

Since Congress passed the Inland Waterways Revenue Act in 1978, many questions concerning the impacts of waterway user charges have been addressed in studies at both national and local levels. Section 205 of the Waterways Act directs the Secretaries of Transportation and Commerce, with the Secretaries of Agriculture, Energy, the Army and the Treasury, and the Attorney General, the Chairman of the Water Resources Council, and the Director of the Office of Management and Budget to make a study of and to report findings and policy recommendations for the following areas of the waterway user charge issue:

1) The taxing mechanism;
2) The economic effects;
3) Feasibility of water improvement projects and the level of benefits from waterway expenditures;
4) Considerations of federal assistance;

5) Policy and future development; and
6) Definition of user taxes and charges.(8).

The report is being prepared by the Transportation Consulting Division of Booz-Allen and Hamilton, Inc., of Bethesda, Maryland. Booz-Allen and Hamilton have contracted to fulfill five tasks in evaluating the economic impacts of user charges:

1) To identify and collect data on rates and costs for thirteen commodities on the twenty inland waterways including rates for six types of waterways equipment and for competing rail and pipeline transportation;

2) To describe towing industry characteristics in terms of the industry's response to various forms and levels of user charges;

3) To describe shipper and receiver characteristics by identifying the modal decision process of shippers and receivers and by determining demand sensitivity to changes in barge rates;

4) To evaluate transportation carrier impacts of various levels and types of user charges on barge operators and competing modes;

5) To evaluate shipper and receiver impacts of changes in transporation rates and service modifications.(9).

The study will ultimately be used to develop regional impact models and evaluate regional impacts.

A more general study that pre-dates the congressional "Study of Inland Waterway User Taxes and Charges" was undertaken by the Corps of Engineers under Section 158 of the Water Resources Development Act of 1976. This study, the "National Waterways Study," is to develop answers about future policies for the waterways in the overall context of rail, highway, pipeline, and water transportation. Pursuant to this, the Corps of Engineers has assigned project management to the Institute of Water Resources in Fort Belvoir, Virginia. The Institute

has been charged with four tasks:

1) To project the nation's potential requirement for water transportation considering both complementary and competing modes;

2) To assess the capability of the existing waterways system to meet current and future needs;

3) To examine the relationship between the use of waterways for transportation and other purposes; and

4) To develop and evaluate alternative strategies to meet projected needs including operational, structural, managerial, institutional and regulatory changes.(10).

Based on the results of this study, the Secretary of the Army will recommend one or more alternatives in creating national policies for the inland waterways system.

As a part of this study, a review draft of the proposed plan has been released. According to an article in the June 18, 1981 American Waterways Organization Weekly Letter the plan

> "...recommended that congress adopt a national waterways plan and program, including inland and Great Lakes lock and channel development and rehabilitation, coastal port development, safety enhancement, and operations and maintenance.
>
> The plan also recommends that Congress adopt a strategic planning process involving alternative sets of future conditions, flexible schedule development, provision for funding appropriate to waterway requirements, and periodic plan reassessment.
>
> The study further recommends centralization of authority for national waterways programs by confirming and clarifying Federal jurisdiction over navigable waterways and 'creating a Presidentially appointed advisory body for national waterways development.'"(11).

State and Local Studies

In reaction to the federal study of inland waterway user taxes and charges that was authorized in Section 205 of Public Law 95-501, many states and local agencies have begun individual studies of their immediate inland waterway systems. For fear of federal policies overshadowing or even nullifying important local and regional considerations, studies have begun on the Alabama-Tennessee-Tombigbee River System, the Arkansas River System, and the Columbia-Snake River System. Studies have also begun on inland waterways in Illinois, Kentucky, Oklahoma, Pennsylvania, and Nebraska. Studies have been completed already in Minnesota, Tennessee and Iowa.

The Minnesota study was initiated by the State's Departments of Transportation, Agriculture, and Economic Development, the State Planning Agency, and the Water Planning Board (12). Because of their concern about the effectiveness and applicability of the federal study to small segments of the national waterway system, the Minnesotan's intend to use their regional study to aid them in monitoring the federal effort and to demonstrate the state and regional impacts of the various types and levels of tax proposals. The most significant finding of the study is that a waterway user charge in Minnesota will have a negative set of effects on that state because of the relatively high operations and maintenance costs due to natural geographic conditions and the State's stringent environmental standards. More specifically, the study revealed that a fuel tax would create inequities because of geographic and environmental disparities such as channel depth and the

number of locks which increase fuel usage per ton-mile and therefore increase the amount of tax per unit of goods moved. Other user fee alternatives create inequities with the greatest effects for every type of fee being suffered by Minnesota's agricultural industry.

Another state study, "Impacts of a Waterways User Charge on the Economy of Tennessee," was commissioned by the Tennessee Department of Transportation to analyze the expected effects of varying types and levels of waterway user charges on Tennessee's three river systems - the Mississippi, Tennessee, and Cumberland Rivers (13). Four types of user charges were identified:

1) fuel taxes
2) lockage fees
3) segment tolls
4) license fees

Each of these charges was studied at varying levels resulting in nine user charge options.

Although all four alternatives would result in some rate and cost increases and some amount of traffic loss, lockage fees create offsetting conditions by reducing congestion and delay times, and license fees have little short term effect. Of the nine user charge options, the least impact occurs with the four cent per gallon fuel tax which would result in a 5.16 percent decrease in waterway traffic. The greatest impacts in terms of towing industry operating costs, shipping rate increases, and potential loss of waterway traffic would result from a segment specific toll fee.

Secondary effects of user charges on Tennessee's economy include immediate and long term job losses in subsidiary industries; increased

energy production costs; and a general increase in consumer prices for the state and nation. Outside the towing industry, consumers of energy and agricultural products will experience the greatest impacts in the state of Tennessee.

A third regional study, "An Analysis of the Impact of the Loss of Navigation to the Sioux City Area, 1981," delineates several possible impacts of total and partial cost recovery waterway user charges on the Siouxland and area and for the Missouri Valley as a whole:

1) Fuel charges above 17 cents per gallon would drive all or nearly all grain traffic from the Missouri;

2) Loss of grain shipments would drive up rates for all other commodities because grain traffic makes up one-half of all commercial tonnage;

3) Loss of navigation would result in an approximate loss of $18.6 million on the Missouri River, $3.9 million of which would be in the Siouxland area;

4) Losses to river terminal and towing operations would amount to almost $2 million to Sioux City alone;

5) Rail would eventually dominate the Missouri Basin in the long haul transport market;

6) Secondary effects include loss of recreation possibilities and future plant expansion and investment; and

7) The greatest impacts would be in agriculture.(14).

The 1981 Siouxland analysis is an extension and expansion of an earlier study by the Siouxland Interstate Metropolitan Planning Council, "An Economic Analysis of the Impact of Waterway User Charges on Commercial Navigation to Sioux City, Iowa"(15). This earlier study, completed in 1978, determined the approximate shipping charges assessed

in transporting commodities by water and rail in order to compare the unit waterway savings. The costs of selected user charge proposals were ascertained and measured against the unit waterway savings. Although a fuel tax rather than a segment toll would minimize the effects, it appeared that imposition of any user charge would adversely affect navigation between Sioux City and Omaha.

Pittsburgh, Pennsylvania, has also begun a new waterway user charge impact study as a follow up to an earlier study completed in 1977 (16). The current study and the earlier study were conducted by Consad Research Corporation of Pittsburgh under the direction of the Pittsburgh Waterways Association. Findings of the 1977 study indicated three broad categories of effects of a four cent per gallon fuel tax:

1) Increases in local consumer costs;

2) Increases in Pittsburgh's production costs; and

3) Increases in transport costs for Pittsburgh.

These three effects would result in increased consumer costs and a further erosion in production for Pittsburgh's economy.

Other User Charge Studies

Various other studies of waterway user charges have been conducted by type and commodity. Once such study, "Impacts of Inland Waterway User Charges" was conducted by Michael S. Bronzini of CACI, Inc. with Arthur F. Hawn and Frank M. Sharp of the Department of Army (17). This study incorporated two types of user fees - a uniform systemwide fuel tax and a set of segment specific ton-mile fees. Their impacts

on the towing industry and the modal traffic share between waterway and rail for the Mississippi River and the entire GIWW were studied at two levels of cost recovery - 50 percent and 100 percent. The final analysis of the modal traffic share indicated a 5.5 percent decrease in ton-miles with a uniform systemwide fuel tax at a 50 percent cost recovery level, and a 7.1 percent decrease at the 100 percent cost recovery level. A comparable segment fee structure would reduce system ton-miles by 8.6 percent at a 50 percent cost recovery level and 9.1 percent at the 100 percent level. The segment fee structure would create varying degrees of traffic loss from segment to segment and varying percentages of cost increase.

It should be noted that traffic losses with 100 percent cost recovery fees for both types of fees are not double those with 50 percent recovery fees because of the high traffic loss incurred at the 50 percent recovery level. The remaining traffic tends to be long haul traffic which has a greater cost advantage over rail and can absorb the increase in cost due to the user fees.

A second study, reported in Transportation Research Board 704, was prepared by Robert W. Meyer of National Marine Service, Inc., in St. Louis. Meyer's study, "Time-Based Multicriteria Evaluation Model of User Charges" (18). The purpose of this study was to demonstrate the utility of objectifying the user charge evaluation process by applying a sound modeling format to this controversial issue. Two user charges were chosen -- fuel taxes and segment tolls at cost recovery levels of 50 and 100 percent for operations, maintenance

and rehabilitation costs. Of the four alternatives analyzed for the case study area, the 50 percent cost recovery level for a systemwide fuel tax was the most desirable in terms of national environmental and energy policies and local interests such as regional employment and market share.

From a different perspective, Binkley and Shabman focus their study, "Implications of Recent User Charge Legislation for Barge Transportation of Agricultural Commodities," on the particular impacts that the current user charge of four cents per gallon will have on three agricultural commodities -- wheat, soybeans, and corn (19). The model results suggest that the barge industry's share of total grain movements will not be significantly affected by the current fee, although diversions from the Missouri and Arkansas Rivers may occur. Related phenomena which may work to offset any increases in barge rates include the possibility of rail rates increasing in response to barge rates, and the mitigating affects of changes going on in the barge industry. Some larger barge firms now substitute inputs in their production process to reduce average shipment costs, and many smaller firms are now expanding or merging to take advantage of economies of size.

A more complete listing of articles and studies on waterways user charges can be found in the working bibliography of this report, but the articles reviewed here reveal many of the areas of understanding as well as the wide gaps of knowledge that presently make up the waterway user charge issue. Utilization of the existing knowledge and close

attention to further research is imperative if a clear, coherent and equitable national transportation policy is to be created and implemented.

EFFECTS OF USER CHARGES

Assessment of the impact of user charges requires an understanding of the nature of waterways freight rates, competing modes, the type and value of the commodities moved, and the conditions supply and demand for water transportation of those commodities. Unfortunately, much of the statistical data required to further that understanding is unavailable. In fact, only fifteen percent of all inland waterways freight is subject to regulation by the Interstate Commerce Commission. Each company is essentially free to negotiate its rates with its customers, and each one may have a different pricing procedure for determining rate increases resulting from newly imposed user charges (4). Consequently, rate data from the industry is scarce.

Also, since commodities carried by firms using the GIWW vary from high value petroleum products and chemicals to relatively low value bulk commodities, a wide range of market structures exists. Thus, demand and cost structures for the industry are difficult to identify. A further spur to diversity in reactions to user charges is the wide variation in form, structure, and size of operations ranging from one-boat-one-commodity operations to some of the nation's largest marine service corporations. There is, however, some information available that can be used to further an understanding of the waterway user charge industry.

Commodities on the GIWW

In terms of volume, the primary commodities moved on the Texas portion of the GIWW in 1977 were fuels, chemicals, and crude petroleum, in that order. These three primary commodities were followed by general

mining shipments, and primary iron and steel (see Table 4). In terms of value, the three main commodities remain the same, but in slightly different order - chemicals, fuels, and crude petroleum followed by fabricated metals, and primary iron and steel. Grain and coal which are dominant on other inland waterways constitute less than one per cent each, both in tonnage and value of total commodities shipped (See Table 4). It would seem inevitable then that the greatest effects on the Texas economy would result through the effects that user charges have on the high volume-high value shipments of fuels, chemicals, and crude petroleum which make up over eighty percent of volume and value shipped on the GIWW. It is expected that the potential increases in shipping rates (initiated by increased user charges) could lead to traffic loss on the GIWW and higher energy costs for the general consumer.

Segment Specific Effects

Further negative effects might include a slowing of new industry moving into the Texas coastal area accompanied by the attendant loss of employment and other economic opportunities. Although the greatest overall impact would probably result from the effects of the user charge on the three high volume-high value commodities, the effect on high volume-low value shipments could be devastating for certain waterway segments. Further, the effect on lower volume-lower value commodity movements might remove certain firms from competition. All of these segment and firm specific effects could also affect rates and prices for shipping other commodities as carriers try to shift the burden of rate increases to less rate-sensitive commodity movements. Of the five segments that make up the Texas GIWW, the most sensitive to changes in the shipping

Table 4. Estimates of Tonnage and Value for Selected Commodities Moved on the Texas GIWW in 1977 (in 1000's)

Group	1977 Tonnage	% of Total Tonnage	1977 Total Value	% of Total Value
Fuels	24,533	39.8	$3,152,914	29.4
Chemicals	13,571	22.0	5,052,686	47.1
Crude Petroleum	13,115	21.3	1,335,898	12.5
Mining (NEC)	6,483	10.5	150,013	1.4
Primary Iron and Steel	1,015	1.6	221,350	2.1
Grains	353	0.6	33,039	0.3
Durables (NEC)	308	0.5	171,799	1.6
Coal	236	0.4	7,957	0.1
All Others	1,786	2.9	590,337	5.5

Source: Tonnage data from Texas SDHPT waterway network model output. Value data based on commodity prices from Domestic Waterbone Shipping Market Analysis, A. D. Little, Report COM-74-10418; and price index data from Statistical Abstract, U.S. Department of Commerce.

market is the section from Corpus Christi to Brownsville because of its relatively low ton-mileage and relatively high maintenance and construction costs. This segment of the Texas GIWW would be especially affected by a segment toll at any cost recovery level.

In Table 5, the total maintenance and construction cost, total ton miles and the cost per ton mile for varying levels of cost recovery are presented for the five segments of the Texas GIWW. The lowest per ton mile cost for all levels of cost recovery exists on the segment from the Sabine River to the Houston Ship Channel, which is also the segment with the greatest volume of shipping. The segment from the Houston Ship Channel to the Freeport Harbor has the next lowest cost per ton mile, although the section from Freeport Harbor to the Matagorda Ship Channel has a higher shipping volume. The long segment from Corpus Christi to Brownsville is clearly the high cost segment on the Texas GIWW. On this segment, the ton-mile costs are almost 15 times greater than on the lowest cost segment. Any user charge structure based on segment taxes would jeopardize the continued viability of the GIWW segment from Corpus Christi to Brownsville. If segment tolls are avoided, the segments will be better able to make the adjustments necessary to spread the burden of user charge effects and minimize them on the low volume-low value movements.

Survey Procedure

To determine the range and tenor of waterway user responses to possible user charge impositions, questionnaires were utilized to survey the different types of users on the GIWW. Two series of questionnaires were prepared based on information gathered from calculating the revenue that would be raised by seven levels of fuel tax and comparable levels

Table 5. Estimated Construction and Maintenance Costs Per Ton-Mile for Five Segments of the Texas GIWW (based on 1977 data).

	Sabine to Houston S.C. Segment (1)	Houston to Freeport Segment (2)	Freeport to Matagorda Segment (3)	Matagorda to Corpus Christi Segment (4)	Corpus Christi to Brownsville Segment (5)
Ton-Miles (1000)	2,023,201	517,882	771,675	462,013	239,517
1977 Cost (1000)	$ 2,757	$ 1,876	$ 4,134	$ 3,697	$ 4,864
Cents Per Ton-Mile;					
100%-100%*	0.136	0.362	0.536	0.800	2.031
100%-50%*	0.089	0.240	0.366	0.585	1.382
50%-50%*	0.068	0.181	1.268	0.400	1.015

* The first percentage refers to per cent of maintenance costs; the second refers to per cent of construction cost.

of ton-mile and license fees. The first step was to estimate the number of gallons of fuel used on the GIWW. Assuming an average fuel efficiency of 220 ton-miles per gallon, and 5.1 billion ton miles traveled on the entire Texas GIWW in 1977, there would be approximately 23 million gallons of fuel consumed. Multiplying this estimate of fuel consumption by each of the seven selected tax levels resulted in the amount of revenue raised by each tax level. Table 6 summarizes these results as well as the equivalent levels of license fees and ton-mile tax that would be necessary to generate the same amounts of revenue. The ton-mile rates represent the tax levels necessary to generate the equivalent revenues for the entire Texas portion of the GIWW.

The license fee estimates were made using data from SDHPT on average horsepower for towing vessels and average barge capacities. Additional data from the Navigation Analysis Center was obtained to determine the number and type of vessels operating on the Texas GIWW. Finally, data from D. L. Anderson et al. (3) were used to estimate the "split" between towboats and barges.

When the two questionnaires were prepared, the assumption was made that one of several cost recovery schemes might be chosen. The beginning point was the current four cent per gallon fuel tax which is scheduled to rise in two cent increments to ten cents per gallon by 1986. Twenty, thirty, forty, fifty and seventy-five cents per gallon were also chosen because they bracket all other cost recovery schemes (including the Domenici Amendment to Senate Bill 810 which called for varying levels of maintenance and construction cost recovery and President Reagan's thirty cent per gallon across the board fuel tax).

Table 6. Estimated Tax Levels for Equivalent Fuel, License, and Ton-Mile Tax Structure on Texas GIWW, Annual (based on 1977 data)

Fuel Tax Level ($per gallon)	Fuel Tax Revenue ($1,000)	Equivalent License Fee		Equivalent Ton-Mile Tax (¢ ton mile)
		towboat ($per hp)	barges ($per ton)	
$ .04	$ 920	$ 0.16	$ 0.08	0.018¢
.06	1,380	0.24	0.12	0.027
.08	1,840	0.32	0.16	0.036
.10	2,300	0.40	0.20	0.045
.20	4,600	0.80	0.40	0.090
.30	6,900	1.20	0.60	0.135
.40	9,200	1.60	0.80	0.180
.50	11,500	2.00	1.00	0.225
.75	17,250	3.00	1.50	0.338

Source: Calculated from data supplied by SDHPT, Navigation Analysis Center, and Anderson, D. L. et al. Modal Impacts of Waterway User Charges: Vol I (Ref. 3).

The first series of questionnaires was sent to four groups:

1) Carriers
2) Shippers
3) Port Authorities
4) Competing Modes

This in-depth questionnaire (see Appendix A) consisted of from fifteen to twenty-seven questions (depending on the group) ranging from from simple answer questions about type and quantities of commodities shipped to questions involving the equity and form of user charges on the water transportation industry. Of twenty questionnaires mailed out, nine were returned, three partially completed and six completed.

The second series of questionnaires was a briefer document sent principally to a group of carriers and shippers in the petroleum and petrochemical industries. Each question required only a check-the-blank response regarding the effects of various user charge levels on shipping rates and amounts of tonnage shipped. In this follow-up fifty-two questionnaires were mailed to carriers ranging from one-boat operators to major interstate firms. Of the fifty-two, twenty-seven were not returned, fourteen were returned undelivered, four were returned unanswered, and seven were returned answered. With such a small return from both questionnaires it was impossible to develop statistically reliable results. But, it was possible in light of the cost recovery levels calculated earlier, to analyze the limited data available and draw some tentative conclusions about the waterway user charge issue.

Table 7 summarizes the response to the two series of questionnaires that were used to gauge the expectations of shippers, carriers, and port authorities regarding the expected changes in rates and tonnage

resulting from varying levels of user charges.

Table 7. Expected Changes in Shipping Rates and Volumes on the Texas GIWW as a Result of Varying Fuel Tax Levels.

Fuel Tax Rate (per gal.)	Volume Changes (%)	Rate Changes (%)
$0.04	-0.3%	+3.2%
0.10	-2.3	+6.5
0.50	-9.2	+26.2
0.75	-18.6	+35.6

Responses from all users were fairly uniform at all points on estimated rate and tonnage increases. Attitudes about the various types of user charges and the appropriateness of imposing charges of any kind on the waterway users were also uniform.

User Reactions

In response to the question, "By what per cent would your rates have to increase before competitors begin taking away some of your business?" the participants' replies yielded a mean break point of approximately 25 per cent. According to Table 7, this is slightly below the 26.2 per cent rate increase expected from a $0.50 per gallon fuel tax. The impact of the Reagan proposal for a thirty cent per gallon fuel tax can be extrapolated from the responses of the three classes of inland waterways users. Such extrapolation produces a rate increase of approximately fifteen per cent and a tonnage decrease of approximately five per cent could be expected with a thirty cent per gallon fuel tax.

Using 1977 estimates from the Texas SDHPT it was possible to estimate that for 100 per cent recovery of maintenance and construction costs a fuel tax rate of $0.75 per gallon would have to be initiated. A 100 per cent maintenance and 50 per cent construction cost recovery would require a $0.51 per gallon fuel tax, and a 50 per cent maintenance and construction cost recovery scheme would require a $0.38 per gallon fuel tax.

According to the waterway users participating in the first questionnaire, the effects of user taxes other than fuel would vary from firm to firm and segment to segment, as well as by level and type of tax implemented. Since the only locks on the Texas GIWW are flood locks on the Colorado River, lockage fees were not considered in this study. The least detrimental tax is believed to be a low-level across the board fuel tax. Of the two remaining types of fees - segment and license - license fees were felt to be less detrimental than segment tolls. Although the data collected are insufficient to establish definitive guidelines for future policy implementation, it does give some indication of the effects that the people most involved in the waterway expect, and it is possible to make some tentative forecasts about the possible market structures given certain user responses. It also gives an indication of the wide gaps in existing information on the waterway user charge issue and the general lack of accessible data in this field.

The overall reaction of the questionnaire participants reflects the expected reactions to the three types of user charges as discussed earlier in this report. The present four cent per gallon tax has the

least effect while segment taxes are expected to have the most detrimental effect overall due to the severe effects on certain segments. License fees are generally viewed as somewhat less detrimental than segment tolls.

Although there is a great deal of controversy surrounding the question of whether any user charge should be implemented on the waterways, the response from the participants in this survey was that the waterway industry should bear some portion of the operating, maintenance, and construction costs of the waterways. The chief controversies center around fair treatment of each transportation mode in terms of government subsidy, the problems of cost allocation between navigation and non-navigation functions, the appropriate level of cost recovery in relation to other modes, and the cost allocation procedure.

Further Research

This report synthesizes existing information regarding the potential effects of varying levels and types of user charges on the Texas Gulf Intracoastal Waterway, and gives some insights into the potential impact of these on the waterway users. Many questions remain to be answered in regard to Texas and the nation as a whole.

One of the most urgent needs in this area is for a thorough data collection system and an accessible, convenient information storage and retrieval system. In addition to the collection and storage of data, an annotated bibliography of user charge and inland waterway literature would be a useful source of information for policy makers, legislators, and others interested in this issue. Other

historical research might include comparative studies of government subsidies and policies among the transportation modes. There is also a need for research in cost accounting and allocation procedures for tracking navigation and non-navigation costs on the nation's inland waterways, as well as for new administrative models and management plans for user tax collection, both intrastate and interstate, including coordination of multiple agency responsibility.

All of the above research needs presuppose the existence of adequate analytic forecasting techniques; but for the most part they do not exist. Better surveying techniques, more applicable modelling frameworks, and other tools for more accurate forecasting of commodity flows and other pertinent information are essential for the development of more realistic alternative scenarios for short and long rang planning on the inland waterways.

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