ANNEX VIII

EFFECTS OF INCREASES IN TOLLS RATES ON PANAMA CANAL TRAFFIC

ISTHMIAN CANAL PLANS - 1960

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EFFECTS OF INCREASES IN TOLLS RATES ON PANAMA CANAL TRAFFIC

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Section I

INTRODUCTION

The Panama Canal Company is studying several plans for providing facilities that would be adequate to handle future canal traffic. In this connection the Company asked Stanford Research Institute to analyze the outlook for commercial freight traffic through the Panama Canal during the remainder of the century. Such an analysis was accomplished, and the results were reported to the Company in March 1958.[1] Projections of future commercial freight traffic contained in that report are based on the assumption that future canal tolls will be no more restrictive than present tolls on traffic development.

Purpose

In studying the financial aspects of the various canal improvement plans the Panama Canal Company wishes to consider the implications of possible increases in the tolls rates. To provide data on this subject, the Company asked Stanford Research Institute to study the probable effects of increases in the tolls rates on the traffic volume projected for the future. An exploratory study was authorized to determine the extent to which the effects of various tolls increases could be estimated. This report presents the findings of that study.

Limitations

The present research was conducted without disclosing its subject outside the Institute and the Company. This served to limit the data sources which could be used and required that the analysis be kept in rather general terms. However, the nature of the analytical problems involved was thoroughly examined, and it was possible to establish some significant magnitudes that will be useful in connection with canal improvement plans.

Usefulness

History of Tolls

Reduction in 1938

Panama Canal tolls rates have, for practical purposes, not been changed since the canal was opened in 1914. Changes in the rules for measuring vessels in 1938 actually resulted in a slight reduction in charges. Thus, there is no historical experience on the effects of a tolls increase, and there is no chance to observe past responses of traffic to significant changes in the rates. Since 1914 the general level

1/ *An Analysis of Future Commercial Freight Traffic through the Panama Canal*, 2 volumes, March 1958.

of money prices has risen a great deal. In terms of other goods and services, the real cost of a Panama Canal transit has therefore been declining.

Complex lines of reasoning are necessary to trace the probable effects of increased tolls on the decisions of shippers and vessel operators to use the canal, to use an alternative route, or to abandon trade between areas now served by the canal. Quantitative data that can support these lines of reasoning are meager outside the business organizations contributing to canal traffic. The methods of analysis used in this study and the conclusions reached are indicated in the section immediately following. Detailed discussions of the many aspects of the tolls impact problem are given in Sections III and IV.

Members of the Institute staff participating in this study are Robert K. Arnold, Sherman H. Clark, Carl A. Trexel, Jr., and Dr. Neil T. Houston, project manager.

Note: SRI considers only a single toll for all commodities. Nevertheless it concludes that an increase somewhat above 100% could be adopted.

Section II

SUMMARY AND CONCLUSIONS

General Effects of Tolls Increases

Study of the relation between Panama Canal tolls and the volume of canal traffic revealed that tolls can affect in many ways the decisions of buyers, sellers, and vessel operators responsible for the commodity movements and vessel routings that produce canal traffic. It was found that there are no simple generalities that can explain the effects of tolls increases, and it is not possible to measure with precision the probable effects of a variety of increases that might be made in the future. This study identifies the traffic components that would be most sensitive to tolls increases, and it gives in some detail the methods of analysis that are necessary in tracing the impact of tolls on the volume of traffic.

Complexity of problem

Sensitivity

Although rather general in nature, the conclusions presented here represent the maximum detail which it is feasible to attempt in a limited study without access to new data from industry. More intensive study of specific traffic components with the cooperation of the industries concerned could probably produce more refined estimates than have been possible here. However, the required research would be quite extensive--a factor that should be weighed in relation to the possible usefulness of such estimates to the Panama Canal Company.

Cost and length of further studies

Owing to variations in conditions affecting the decisions of individual shippers and vessel operators, large numbers of them would not be expected to react to increasing tolls in the same way. These uncertainties make it impossible to trace the effects of successive small increments in possible tolls increases. The traffic was therefore studied in relation to a tolls increase that would result in sufficient individual reactions to make a discrete* difference in the number of canal transits.

Methodology

No case was found in the study in which identifiable effects could be traced from an increase in tolls up to 20 percent above present rates; in other words, a 20 percent increase in tolls rates would probably have no significant effect on canal transits. However, conditions found in the study indicate that an increase of 100 percent in tolls would probably affect enough decisions to cause a discrete difference in the number of canal transits. In Sections III and IV various components of canal traffic are discussed with reference to a possible increase of 100 percent in tolls.

20% increase

100%

* Discrete: without intermediate values, i.e. 1 or 2 transits but not 1.5 transits.

Effects on General Cargo Liner Traffic

If tolls are increased, the responses of general cargo liner traffic will be governed by factors that are different from those affecting the responses of vessels moving shiploads of a single commodity between two points. For the general cargo liner to change its route involves consideration of alternative distances and sailing conditions between more than one pair of ports, effects on the sequence of ports of call, opportunities to call at wayports, frequency of service, established relations with shippers, and other factors. The combination of factors on an existing route of a general cargo liner operator is likely to seem to him clearly superior to possible combinations on other paths that could be taken between his trading areas. General cargo liner operators using the Panama Canal are therefore likely to be willing to pay considerably higher tolls before avoiding the canal. This probability is reinforced by the high unit value of much of the general cargo carried, which means that higher tolls could be passed on, through higher freight rates, without seriously affecting liner load factors. With the exception of United States intercoastal traffic, it appears that a 100 percent increase in tolls would have no significant effect on general cargo liner transits.

not sensitive to 100% increase

→ which means that increases higher than 100% could be sustained!

Effects on Shipload Commodity Movements

The probable responses to increased tolls by vessels engaged in shipload movements of commodities were analyzed in three categories: (1) those resulting in diversion of the vessel to an alternative route not using the Panama Canal, (2) those stemming from reduced volume of shipments owing to higher commodity costs associated with the higher tolls, and (3) those causing cessation of traffic owing to geographical reorientation of markets and supply sources as a result of higher transportation costs. These categories are discussed at length in Sections III and IV.

Reactions by Vessels

It was found that only three significant commodity movements appear to have a possibility of diverting to an alternative route in response to an increase in tolls in the order of 100 percent. The most important of these is the movement of sugar and chrome ore from the Philippines to the East Coast of the United States. If Suez Canal tolls remain unchanged, this movement would be readily diverted to the Suez route. An estimate of the transits involved is included below in the summary of effects on transits associated with a doubling of tolls rates.

Subjected to alternative routes by 100% increase

→ sugar and other "quota" products could be diverted to an alternative route but are unlikely to be substituted by a new source of supply.

The second movement with an alternative route possibility is that of refrigerated foods from New Zealand to the United Kingdom. This involves the Strait of Magellan via the 50th parallel, a route that probably has disadvantages in weather and fueling conditions. This route could not be satisfactorily evaluated without assistance from the vessel operators, and this case is not included in the summary of transits. The third alternative route possibility is that for Chile nitrate shipped to Europe. This again involves the Strait of Magellan and could not be fully evaluated. In any case, the number of transits lost would be small, and no estimate of them is included.

Possibilities for reduced volumes of shipments resulting from higher commodity costs caused by increased Panama Canal tolls were considered for the following items: coal, iron and steel scrap, sugar (West Indies to Japan), nitrate, wheat, soybeans, and bananas. It was found that these commodities appear relatively insensitive to tolls increases and that transits based on these items would probably not be significantly reduced as a result of doubling the tolls rates.

The foregoing conclusion rests largely on three factors. First, the increase in tolls would constitute only a very small part of the delivered price of the commodity, meaning that even if there were a market response to the price change it would not be a very large response. Second, alternative sources of supply at closely competing prices are generally not available to the markets concerned, which tends to minimize responses to price changes. Third, in recent years the ocean freight rates for these movements have varied over a range much greater than a doubling of tolls would entail, and the volume of traffic has shown no reaction that could be traced to the resulting changes in delivered costs.

The following commodity movements were considered with respect to possible geographical reorientations of markets and supply sources, which would be the most likely type of response to a major tolls increase: phosphate rock, iron ore, and petroleum and petroleum products. Reasons were found for believing that traffic in all of these might be substantially reduced as a result of a tolls increase in the order of 100 percent. Alternative sources of supply, from which shipments would not pass through the Panama Canal en route to the markets concerned, are available in all three cases. For iron ore and crude petroleum the canal toll is a substantial part of total transportation costs, and unit costs are closely watched by the shippers and buyers of these large-volume bulk items. However, uncertainties concerning responses to higher tolls are created by ownership patterns and market strategies involved. Possible losses of transits based on these commodities are included in the summary that appears below.

Effects on Intercoastal Traffic

The United States intercoastal trade requires special analysis because the major possible response to higher tolls is a shift of traffic from water carriers to overland carriers. It was concluded that if rail rates do not increase in response to an increase in water rates, shipments of canned goods could be greatly reduced as a result of doubling canal tolls. This would so impair the economics of the whole general cargo service that substantially all the general cargo transits could be lost. Such a loss is included in the summary of transits below. Lumber shipments would also be fairly sensitive to increased water transportation costs, but these are closely related to less sensitive steel shipments in the opposite direction. The possibility appears to exist for distributing increased costs of a round voyage between these two commodities in a manner that would permit both to continue to move after a doubling of canal tolls. The large proportion of proprietary cargo in these movements makes exact determinations difficult.

Total Effect on Panama Canal Transits

The impact on canal transits of the restrictions on commodity movements that could be associated with a 100 percent increase in tolls, as described in the preceding paragraphs, can be estimated on the basis of the commodity projections and associated transits contained in the earlier Stanford Research Institute report An Analysis of Future Commercial Freight Traffic through the Panama Canal. The 1975 projections are used here.

The sugar and chrome ore shipments from the Philippines to the East Coast of the United States are partly in general cargo liners that would not be affected by the tolls increase; diversion of the shipload movements to the Suez route would probably involve about 50 transits. Loss of the intercoastal traffic in canned goods and general cargo would mean a loss of about 200 transits. If higher tolls should reduce the phosphate rock tonnage to, say, half its projected volume, a further loss of about 75 transits would result. This indicates a total of about 325 transits in the general dry cargo vessel category.

If the higher tolls serve to prevent further growth in iron ore shipments, tonnage would be about 8,000,000 below the projected level, which would remove about 500 ore carrier transits, or an equivalent combination of ore carriers and the general cargo vessels that are projected as carrying iron ore. If tolls serve to prevent crude petroleum shipments from Venezuela to the West Coast of the United States, tanker transits in 1975 would be about 140 less than the projected number.

It can be seen from the foregoing paragraphs that about 900 to 1,000 transits are involved with the commodity movements that would probably be prevented by doubling canal tolls. This is less than 10 percent of the projected total transits for 1975, but it does contain a substantial proportion of the large tanker and ore carrier transits.

If transits were to decline less than 10 percent in response to a 100 percent increase in tolls, it is obvious that the total tolls revenue of the Panama Canal Company could be greatly increased by raising tolls. It is not considered feasible to estimate specific losses of transits that would result from successive tolls increments above the 100 percent increase that has been discussed here. Additional components of the traffic would be affected at different levels that cannot be closely identified. As a general estimate, it appears that total tolls revenue could be increased further by tolls increases somewhat beyond 100 percent. Revenue is, of course, not the only consideration in fixing tolls, since the resulting volume of traffic also affects the facilities required to handle the traffic and other matters not covered by this study.

Influence of Changing Price Levels

The foregoing analysis is in terms of increasing tolls under conditions of costs and prices expressed in 1958 constant dollars. In other words, it is in terms of increases in the "real cost" of tolls to shippers and vessel operators, as distinguished from the money costs which may prevail in the future. To express the analysis in terms of actual prices that may prevail in the future, changes in the general price level must be taken into consideration. If the general level of prices of other goods and services changes in the future the Panama Canal tolls increases, in money terms, that would produce the effects described above would be changed in approximately the same proportion. Thus, if the general level of prices were to rise, say, 30 percent by 1975, an increase in the money rate of Panama Canal tolls of 130 percent would be expected to have the same impact as the 100 percent increase that has been discussed here.

Section III

DIVERSION OF TRAFFIC TO ALTERNATIVE ROUTES

Vessels use the Panama Canal because the distance between ports being served is shorter via the canal than via other possible routes. The saving in distance makes it possible for the vessels to pay canal tolls and still accomplish their voyages more economically than would be possible on alternative routes. In studying a possible increase in canal tolls it is important to remember that alternative routes do exist and to consider how much it is worth to a ship to avoid taking a longer path to its destination.

Value of Time Saved by Using the Canal

At first glance it appears a simple matter to compare the desirability of using a short route with that of using a longer route. There is obviously a cost saving in reducing the number of miles steamed, and costs can be estimated for various kinds of vessels. However, on closer analysis it can be seen that direct cost savings are not the appropriate expression of the economic advantages of the shorter route.

The real advantage of the shorter route lies in saving time, and the value of saving a day's time en route on a voyage is not, strictly speaking, represented by the daily operating cost of the vessel. Rather, it is represented by the value of getting increased utilization of the vessel in earning profit for its owners. By saving time, the vessel is able to make more voyages in a period of time and thus to perform more revenue-producing service.

The costs of a vessel during a year are practically the same whether it makes four voyages, for example, the long way around or makes five voyages on a time-saving route. The advantage in making the five voyages obviously comes from the additional revenue collected on the fifth trip. A detailed calculation would necessarily allow for the additional port charges, cargo costs, etc., but it is nevertheless clear that it is the revenue aspect that gives incentive to improve the turn-around time and get better utilization of the vessel. Except for possible instances in tramp operation discussed below, it is not direct cost saving from reducing the voyage time that is of primary importance. It is the increase in the ship's net revenue-earning ability that must be estimated. If a ship arrives in port a day early, its costs are not suspended for the following day (except for underway fuel consumption). It is therefore necessary to approach the value of time saved through the revenue that can be earned.

Liner operators, who plan fixed schedules for their ships for long periods in advance, would probably treat the ship utilization problem analytically in a fairly uniform manner, although the actual revenues and costs involved will vary with the vessel type and with the trade route being served. Time saved by using the canal allows more voyages to be made than is otherwise possible and the liner operator's schedules are arranged to keep his ships employed making such additional voyages and presumably carrying revenue cargo that he would not otherwise lift. In addition, the time-saving shorter route has a competitive advantage over the longer route in attracting cargo and probably makes possible greater revenue per voyage than could be obtained on the longer route. When several operators are competing on a route with many sailings this simple explanation is probably close to the actual facts.

The routing decisions for irregular vessels and proprietary carriers, on the other hand, may have no single simple explanation. The irregular service or proprietary vessel may have no additional revenue-earning voyage booked to commence immediately on completion of a voyage involving possible use of the canal. Possibly her next employment is several days or more in the future. In this case, the revenue-earning ability of the vessel is not increased by an early arrival followed by idle time in port, and the only advantage in using the canal is the direct cost-saving from reduced underway fuel consumption. It is, of course, quite possible to have an opposite situation in which the ship can immediately pick up its next revenue cargo and in which early arrival is necessary even to secure the booking. In the latter case the value of time saved by using the canal could be quite great.

A case which illustrates very well the concept of vessel utilization was encountered during the present study. A company recently operated its bulk carriers at reduced speed in a period when the tonnage of available cargo had declined. This afforded a considerable saving in fuel but lengthened the time en route by nearly 40 percent. This practice was more economical for the company than speedy completion of voyages followed by idle time. It is obvious that under conditions such as these it is worth much less to the company to shorten a voyage by using the canal than it would be worth in times when cargo is plentiful and time saved can be converted into more cargo revenue. The case shows also that the value of canal service can vary from time to time for an individual operator, as well as vary among operators who work under different conditions.

Voyages by vessels using the Panama Canal could fall into any of the broad categories of situations just described, and even within these categories a wide range of conditions could obviously occur. This means that the value of a vessel-day saved by use of the Panama Canal must vary over a quite wide range. However, to evaluate the effect of increased tolls on the routing decisions of vessel operators some finite values must be employed. To estimate actual values on the basis of detailed analysis would require case-by-case study of individual operators. The difficulties in obtaining voyage revenue data, adjusting for cargo-handling costs and other variable costs, and covering enough situations to describe canal traffic adequately would be quite formidable. An approach through such detailed analysis was not possible in the present study.

In lieu of study on a case-by-case basis it is possible to use a more general analysis that can still provide useful bench marks on the possible diversion of vessels to alternative routes as a result of increasing Panama Canal tolls. This analysis involves using average daily total costs for vessels as an indication of the value of a vessel-day and using a wide range of estimates, in order to cover the possible variations in the value of a day owing to factors discussed earlier. Conclusions that are consistent with all the values within a wide range should be consistent with most of the actual cases that are likely to develop and should therefore be reliable indications of the effects of tolls increases.

Some rationale can be offered for using vessel costs instead of the logically required net voyage revenue in considering the value of a vessel-day. Over the long term, average voyage revenues must be at least as great as the vessel costs, plus sufficient profit to induce the operator to stay in business. This general principle obviously allows a multitude of short-term deviations that could affect routing decisions. For the tramp operator in particular, routing decisions probably tend to be made on a short-term basis. For the liner operator the necessity to continue on the route to protect a competitive position, even in bad times, probably gives such decisions a much longer-term character. There is no way to test these ideas against actual practice in the present study, but the use of a range of values in the analysis affords protection against the uncertainties involved.

Cost data themselves are not readily available and vary greatly with vessel characteristics and flag of registry. However, some bench marks can be obtained. The Panama Canal Company has collected estimates of daily costs, including a 10 percent profit, of a variety of vessels while standing by for transit through the canal. For the Liberty ship and the C-3 type these cost estimates were taken as a basis for examples worked out in later pages. Data on underway fuel consumption were obtained, and additional costs were computed for underway conditions, assuming fuel at $3 per barrel. This gives daily underway cost estimates of $3,358 for the Liberty and $4,764 for the C-3 under United States flag conditions.

In the voyage examples computed, an assumed value of a vessel-day somewhat higher than the foregoing is shown. The other assumed values range downward from the basic cost estimates to allow for possible conditions in which the earning power of the vessel is depressed. In all, a wide range of assumed values for a vessel-day is provided for each ship type. The underway fuel costs become a substantial portion of the assumed values at the lower end of the range and serve to indicate reasonable minimum values worth considering.

Values for a vessel-day using a new 18-knot ship of the U.S. Maritime Administration "Seafarer" design were developed using basic data from voyage pro forma operating statements available from a West Coast operator.

The Liberty, C-3, and Seafarer are believed to represent the general characteristics of vessels presently engaged or likely to be engaged in the future in the trades for which the examples are worked out. Smaller vessels would have somewhat lower costs, but their canal tolls would also be less. The three types worked out therefore probably cover the relevant range of conditions as they affect routing decisions.

Comparison of Routing Decisions by Type of Service

In the study of routing decisions it is much simpler to consider traffic that moves from a single port of origin to a single port of discharge than it is to analyze service between a range of ports in one area and a range of ports in another area. Where the object of a voyage is simply to get from one port to another by the most economical route, the alternatives to be compared are clear cut. The distances over the possible routes can be measured and converted to steaming time required. Values can be associated with differences in time as discussed in foregoing paragraphs, and these values can be related to canal tolls and other relevant costs peculiar to particular routes. This kind of traffic is common in moving bulk commodities, which are handled in shipload lots on a point-to-point basis. It is characteristic of the operations of tankers, ore carriers, and the various irregular service vessels engaged in tramp operations.

For general cargo liner services operating between groups of ports, possibly also with calls at wayports en route, consideration of alternative routes is much more complex in principle. The route affording the shortest distance between two of the ports concerned may not be the shortest between another pair of ports served. For example, on the trade route from the East Coast of the United States to the Far East, it is shorter from New York to Hong Kong via Panama than via any other route, but it is shorter from Boston to Manila and from Baltimore to Saigon via Suez. The sequence of calls at various ports must be arranged with consideration of the volume and types of cargo offered and of competitive conditions affecting the booking of these cargoes. This can affect the choice of routes. For competitive reasons New York is commonly the first port of call and the last port of departure on the United States North Atlantic range, even though other ports may be closer to the foreign area being served.

Opportunities to call at intermediate ports are also important in liner routing. Many vessels en route from the East Coast of the United States to the Far East call in California, since only a small deviation from the direct route is required. From Australasia to the United Kingdom via Panama it is possible to call at Caribbean and East Coast United States ports with little extra mileage, while on the Suez route it is possible to call at various ports along the way. Similar examples can be found on other important trade routes.

In view of the factors mentioned above, it is necessary for the operator considering a change in route to compare not only distances and costs involved but also the effects on the competitive quality of his service and the possible need for significant changes in the ports and customers served. These factors suggest that general cargo liner routes are much less subject to change as a result of increases in canal tolls than are the routes of shipload movements of bulk commodities. It was not possible to discuss this subject with vessel operators during the present study, but the logic of the situation seems clear.

The major general cargo liner routes and the major commodity movements through the Panama Canal were studied in relation to the routing factors just described and in relation to increased voyage costs that would result from increased canal tolls. Illustrative computations were made for those commodities that move in significant volume in shipload lots, in order to compare the desirability of the Panama route with that of alternative routes that could be taken. These computations are shown in the following pages in Tables 1 to 9. These shipload movements occur between ports that are also on the major general cargo liner routes using the canal, and they may be viewed as generally representative of the situation for those routes. No attempt was made to give more detailed treatment of the more complex factors discussed earlier as affecting liner routing. This would not be feasible without direct contact with operators. Also, it does not seem necessary for present purposes, because for the reasons just described liners would be less subject to route changes than the shipload movements for which the examples are worked out.

Illustrative Examples of Possible Alternative Routes

The following tables are worked out in terms of major commodity movements in present and projected future Panama Canal traffic. These items move in volume in shipload lots and thus present the simplest routing problems. The factors considered in making the computations are the differences in underway steaming time on the routes and the relevant canal tolls at present tolls rates. With one small exception, the Panama Canal route has an economic advantage, at present tolls rates, in all cases shown. This is, of course, to be expected, since the traffic is presently moving through the canal. The tables show the extent of the present Panama Canal economic advantage over possible alternative routes. This advantage is shown both in dollars and as a percent of the present Panama Canal tolls for a laden transit. The percent columns thus indicate the approximate percentage increase that could occur in Panama Canal tolls before the other routes become equally advantageous.

At least two other factors that would affect an economic comparison of routes but which have not been included in the computations shown in the tables should be mentioned. These are fuel and weather. Bunker fuel is not uniformly priced round the world. Routes differ in both the frequency of bunkering opportunities and in the prices at which fuel can be purchased. Operators can bunker for a long voyage at the expense of deadweight capacity available for cargo, or they can bunker more frequently and gain cargo-lifting capacity at the expense of extra time spent fueling. Depending on fuel prices, freight rates, and the availability of cargo, one route may be more attractive in terms of bunkering than another. Since these factors vary from time to time and from one operating situation to another, it was not feasible to incorporate them in the present analysis. Details on these matters would necessarily have to be obtained for specific situations from vessel operators. The possibility that the economic advantages shown in the tables would be modified in actual practice by bunkering considerations should be recognized. This is not believed likely to affect significantly the orders of magnitude shown, but serves to illustrate another barrier to precise measurement of factors affecting routing.

Some routes are more attractive than others in terms of the weather usually encountered. Of the routes concerned here, the ones through the Strait of Magellan are known to be adversely affected in this respect. Heavy weather can require steaming at reduced speed, and it entails both risk and wear and tear that are not involved in calmer waters. To evaluate in economic terms the effects of weather on the willingness of operators to use the Strait of Magellan would also require direct consultation with the operators and could not be undertaken in the present study. Possible modifications of the data in the tables to allow for this factor should also be recognized.

The tables show examples for three basic ship types, as described earlier. Canal tolls vary from vessel to vessel in these general size categories, but for purposes of these examples tolls for laden vessels are assumed to be the same for both the Panama and Suez Canals and to be $5,000 for Liberty ships and $6,000 for the larger C-3 and Seafarer types. The use of the Suez route is based throughout on tolls at these levels. Any future change in Suez Canal tolls would, of course, alter the relative advantages of Suez and Panama routes.

In the tables, the wide range of values that might be attached to a vessel-day was selected as described earlier to cover a variety of situations that might represent the bases for actual routing decisions. The following nine routing situations are illustrated:

1. New Zealand to the United Kingdom
2. Philippines to East Coast United States
3. West Coast South America to Europe
4. East Coast United States to Japan
5. West Coast South America to East Coast United States
6. West Coast Canada to Europe
7. United States Gulf Ports to Japan
8. Florida to Japan
9. Cuba to Japan

These routes involve substantial tonnages of 11 commodities that are important in Panama Canal traffic. In addition, the special cases of tanker traffic and the United States intercoastal trade are discussed later in this section. This serves to cover all possibilities for rerouting important parts of the present and projected future traffic.

Examination of Tables 1 to 9 shows that in only three of the cases is there an alternative route that might become more economical than the Panama Canal route if there were a moderate increase in canal tolls. In the other six cases tolls increases of well over 200 percent would be required to shift the advantage away from the Panama route. The three cases that appear in the tables as most susceptible of rerouting are New Zealand to the United Kingdom, Philippines to East Coast United States, and a portion of the West Coast South America to Europe trade. These are shown in Tables 1, 2, and 3, respectively, and are discussed briefly below.

The data in Table 1 indicate that on movements from New Zealand to the United Kingdom there are certain situations in which the extreme southerly route via the 50th Parallel and the Strait of Magellan appears to be more economical than the Panama Canal route, even with tolls at the present level. Nevertheless, meats and dairy products are moving through the canal in refrigerator ships in substantial volume. This would indicate either that the value of a vessel-day is higher than shown in the examples that favor the Strait of Magellan or that there are factors not included in these data, such as weather and/or bunkers, that throw the advantage in practice to the Panama Canal route under present conditions. For values of a vessel-day in the higher part of the ranges shown in the table, the time that can be saved by using the Panama Canal clearly offsets the present tolls and makes the canal route advantageous, aside from possible weather and bunker advantages.

If a vessel en route from New Zealand to the United Kingdom follows the 30th Parallel track to the Strait of Magellan to secure better weather conditions than are likely to be found on the 50th Parallel, the added distance makes this track less attractive than the Panama Canal route for all vessel-day values shown in Table 1. A similar relation exists for both the Cape of Good Hope and Suez Canal routes.

To evaluate the 50th Parallel route more precisely as an alternative to using the Panama Canal would require consultation with vessel operators, which was not possible in the present study. It seems probable that the present advantage of the Panama Canal is greater than Table 1 indicates. For this reason, an increase of 100 percent in canal tolls might not divert the traffic to the Strait of Magellan, and no allowance for loss of this traffic is included in the summary of the effects of doubling tolls.

It can be observed in Table 1, and in the other tables as well, that the advantage of the Panama Canal route over the possible alternatives increases as the value of a vessel-day increases. This merely reflects the value of saving time on the shorter route, but it is important to recognize as a basic principle in estimating the effects of tolls increases. It is obvious from the discussion in earlier paragraphs that the value of a vessel-day will vary widely from ship to ship and situation to situation. Thus, different operators would be expected to reach rerouting decisions at different levels of Panama Canal tolls, even on a single trade route. The table simply indicates this with numerical examples. The significance of this fact lies in showing that there is no single critical level of tolls below which all operators on a route would use the canal and above which they would all cease using the canal. This is one reason why it is not possible to trace in detail the effects on traffic of successive small increments in tolls rates.

Table 2 compares the economic advantages of the Panama Canal route and the Suez Canal and Cape of Good Hope routes for shipments from the Philippines to the East Coast of the United States. Sugar and chrome ore are the shipload commodities concerned. The data are based on the average of the distance from Manila to New York and from Manila to Philadelphia. From Philippine outports to specific United States destinations the figures would be slightly different. A good deal of sugar is shipped for optional discharge at one or more of several East Coast ports, final selection not being made until shortly before the vessel arrives. Routing therefore must allow for a range of possibilities.

[illegible] are not included. Considerations of weather and bunkering opportunities are probably less important in choosing between these two routes than in considering the Strait of Magellan route discussed earlier. It therefore seems clear that a 100 percent increase in tolls would divert this traffic to Suez.

Table 3 illustrates shipments from the West Coast of South America to Europe, where iron ore and nitrate move by shiploads in substantial volumes. From the northern ports in South America the Panama Canal has a much greater advantage than it has from the southern ports that are closer to the Strait of Magellan. Thus, very substantial increases in tolls would be required to divert traffic originating in Callao, Peru, to the Strait of Magellan route. Smaller increases in tolls would serve to shift the advantage to the Strait of Magellan in the case of the nitrate traffic from Chile; tolls increases of less than 100 percent would cause such a shift when the value of a vessel-day is low. However, when weather and fueling considerations are allowed for, the advantages of the Panama Canal route are probably greater than these data indicate, so that a 100 percent increase in tolls would not cause the nitrate traffic to be diverted.

Table 1

ECONOMIC ADVANTAGES OF PANAMA CANAL ROUTE VERSUS ALTERNATIVE ROUTES NEW ZEALAND TO THE UNITED KINGDOM 1/

Value of a Vessel-Day	Advantage of Panama Canal vs Suez Canal		Advantage of Panama Canal vs Strait of Magellan via 50th Parallel		Advantage of Panama Canal vs Strait of Magellan via 30th Parallel		Advantage of Panama Canal vs Cape of Good Hope	
	Dollars	Percent of Panama Canal Tolls	Dollars	Percent of Panama Canal Tolls	Dollars	Percent of Panama Canal Tolls	Dollars	Percent of Panama Canal Tolls
10-Knot Vessel								
$ 800	$ 4,147	83%	2/		$ 1,557	31%	$ 4,427	89%
1,000	5,183	104	2/		3,446	69	6,783	136
1,200	6,220	124	2/		5,335	107	9,140	183
1,400	7,256	145	2/		7,224	144	11,497	230
1,600	8,293	166	$ 67	1%	9,113	182	13,853	277
$2,800	$14,513	290%	$3,837	77%	$20,448	409%	$27,993	560%
3,000	15,550	311	4,500	90	22,337	447	30,350	607
3,200	16,587	332	5,133	103	24,227	485	32,707	654
3,400	17,623	352	5,767	115	26,116	522	35,063	701
3,600	18,660	373	6,400	128	28,005	560	37,420	748
16.5-Knot Vessel								
$1,600	$ 5,026	84%	2/		$ 3,160	53%	$ 5,428	90%
1,800	5,655	94	2/		4,305	72	6,855	114
2,000	6,283	105	2/		5,449	91	8,283	138
2,200	6,911	115	2/		6,595	110	9,711	162
2,400	7,539	126	2/		7,740	129	11,139	186
$4,200	$13,194	220%	$2,061	34%	$18,048	301%	$23,994	400%
4,400	13,822	230	2,444	41	19,190	320	25,422	424
4,600	14,450	241	2,828	47	20,335	339	26,851	448
4,800	15,079	251	3,212	54	21,480	358	28,279	471
5,000	15,707	262	3,595	60	22,625	377	29,707	495
18-Knot Vessel								
$2,400	$ 6,911	115%	2/		$ 6,594	110%	$ 9,711	162%
2,700	7,775	130	2/		8,169	136	11,675	195
3,000	8,638	144	2/		9,743	162	13,639	227
3,300	9,503	158	2/		11,317	189	15,603	260
3,600	10,367	173	$ 335	6%	12,892	215	17,567	293
$4,900	$14,110	235%	$2,620	44%	$19,713	329%	$26,077	435%
5,300	15,262	254	3,324	55	21,813	364	28,695	478
5,700	16,414	274	4,028	67	23,912	399	31,313	522
6,100	17,566	293	4,731	79	26,011	433	33,932	566
6,500	18,718	312	5,435	91	28,110	468	36,551	609

Note: The Liberty ship, C3, and U.S. Maritime Administration "Seafarer" design are assumed to represent the 10-knot, 16.5-knot, and 18-knot vessel categories, respectively. Panama and Suez Canal tolls are assumed to be $5,000 for the Liberty and $6,000 for the larger types.

1/ Based on distance from Wellington to Bishop Rock. Shipload commodity is refrigerated foods.
2/ Strait of Magellan via 50th Parallel more advantageous than Panama Canal for these values of a vessel-day.

Table 2

ECONOMIC ADVANTAGES OF PANAMA CANAL ROUTE VERSUS ALTERNATIVE ROUTES PHILIPPINES TO EAST COAST UNITED STATES[1/]

Value of a Vessel-Day	Advantage of Panama Canal vs Suez Canal		Advantage of Panama Canal vs Cape of Good Hope	
	Dollars	Percent of Panama Canal Tolls	Dollars	Percent of Panama Canal Tolls
10-Knot Vessel				
$ 800	$ 667	13%	$ 2,333	46%
1,000	833	17	4,166	83
1,200	1,000	20	6,000	120
1,400	1,167	23	7,830	156
1,600	1,333	27	9,670	193
$2,800	$2,324	46%	$20,670	413%
3,000	2,490	50	22,500	450
3,200	2,656	53	24,330	487
3,400	2,822	56	26,170	523
3,600	2,988	60	28,000	560
16.5-Knot Vessel				
$1,600	$ 808	13%	$ 2,889	48%
1,800	909	15	4,000	67
2,000	1,010	17	5,110	85
2,200	1,111	19	6,220	103
2,400	1,212	20	7,330	122
$4,200	$2,121	35%	$17,330	289%
4,400	2,222	37	18,440	307
4,600	2,323	39	19,560	326
4,800	2,424	40	20,670	344
5,000	2,525	42	21,780	363
18-Knot Vessel				
$2,400	$1,111	19%	$ 6,222	104%
2,700	1,250	21	7,749	129
3,000	1,389	23	9,278	155
3,300	1,528	25	10,810	180
3,600	1,667	28	12,330	205
$4,900	$2,268	38%	$18,950	316%
5,300	2,453	41	20,950	350
5,700	2,639	44	23,030	384
6,100	2,824	47	25,060	418
6,500	3,009	50	27,100	452

Note: The Liberty ship, C3, and U.S. Maritime Administration "Seafarer" design are assumed to represent the 10-Knot, 16.5-knot, and 18-knot vessel categories, respectively. Panama and Suez Canal tolls are assumed to be $5,000 for the Liberty and $6,000 for the larger types.

1/ Based on distances from Manila to New York and Philadelphia (average). Shipload commodities affected are sugar and chrome ore.

Table 3

ECONOMIC ADVANTAGES OF PANAMA CANAL ROUTE VERSUS ALTERNATIVE ROUTES
WEST COAST SOUTH AMERICA TO EUROPE

Value of a Vessel-Day	Advantage of Panama Canal vs Strait of Magellan			
	Antofagasta to Lisbon 1/		Callao to Bishop Rock 2/	
	Dollars	Percent of Panama Canal Tolls	Dollars	Percent of Panama Canal Tolls
10-Knot Vessel				
$ 800	$ 1,667	33%	$ 8,173	163%
1,000	3,333	66	11,467	229
1,200	5,000	100	14,760	295
1,400	6,670	133	18,053	361
1,600	8,330	167	21,347	427
$2,800	$18,240	365%	$41,107	822%
3,000	19,900	398	44,400	888
3,200	21,560	431	47,693	954
3,400	23,220	464	50,987	1,020
3,600	24,880	498	54,280	1,090
16.5-Knot Vessel				
$1,600	$ 2,080	35%	$ 9,968	166%
1,800	3,090	52	11,964	199
2,000	4,100	68	13,960	232
2,200	5,110	85	15,955	266
2,400	6,120	102	17,952	299
$4,200	$15,210	253%	$35,915	599%
4,400	16,220	270	37,911	632
4,600	17,230	287	39,907	665
4,800	18,240	304	41,903	698
5,000	19,250	321	43,899	732
18-Knot Vessel				
$2,400	$ 5,110	85%	$15,956	266%
2,700	6,500	108	18,700	312
3,000	7,890	132	21,444	357
3,300	9,280	155	24,189	403
3,600	10,670	178	27,933	466
$4,900	$16,680	278%	$38,826	647%
5,300	18,530	309	42,485	708
5,700	20,390	340	46,144	769
6,100	22,240	371	49,804	830
6,500	24,090	402	53,463	891

Note: The Liberty ship, C3, and U.S. Maritime Administration "Seafarer" design are assumed to represent the 10-knot, 16.5 knot, and 18-knot vessel categories, respectively. Panama and Suez Canal tolls are assumed to be $5,000 for the Liberty and $6,000 for the larger types.

1/ Represents shipload movements of Chile nitrate.
2/ Represents shipload movements or iron ore.

Table 4

ECONOMIC ADVANTAGES OF PANAMA CANAL ROUTE VERSUS ALTERNATIVE ROUTES EAST COAST UNITED STATES TO JAPAN 1/

Value of a Vessel-Day	Advantage of Panama Canal vs Suez Canal		Advantage of Panama Canal vs Cape of Good Hope	
	Dollars	Percent of Panama Canal Tolls	Dollars	Percent of Panama Canal Tolls
10-Knot Vessel				
$ 800	$12,330	247%	$18,670	373%
1,000	15,420	308	23,330	467
1,200	18,500	370	28,000	560
1,400	21,580	432	32,670	653
1,600	24,670	493	37,330	747
$2,800	$43,170	863%	$65,330	1,310%
3,000	46,250	925	70,000	1,400
3,200	49,330	987	74,670	1,490
3,400	52,420	1,050	79,330	1,590
3,600	55,500	1,110	84,000	1,680
16.5-Knot Vessel				
$1,600	$14,950	249%	$16,630	277%
1,800	16,820	280	19,450	324
2,000	18,690	312	22,280	371
2,200	20,560	343	25,110	418
2,400	22,420	374	27,940	466
$4,200	$39,240	654%	$53,390	890%
4,400	41,110	685	56,220	940
4,600	42,980	716	59,050	980
4,800	44,850	747	61,880	1,030
5,000	46,720	779	64,710	1,080
18-Knot Vessel				
$2,400	$20,560	343%	$25,110	419%
2,700	23,130	385	29,000	483
3,000	25,690	428	32,890	548
3,300	28,260	471	36,780	613
3,600	30,830	514	40,670	678
$4,900	$41,970	700%	$57,520	959%
5,300	45,390	756	62,700	1,040
5,700	48,820	814	67,880	1,130
6,100	52,240	871	73,070	1,220
6,500	55,670	928	78,260	1,300

Note: The Liberty ship, C3, and U.S. Maritime Administration "Seafarer" design are assumed to represent the 10-knot, 16.5-knot, and 18-knot vessel categories, respectively. Panura and Suez Canal tolls are assumed to be $5,000 for the Liberty and $6,000 for the larger types.

1/ Based on distances from Norfolk to Yokohama. Coal is the principal shipload commodity, but those examples will serve also for shipments of scrap iron from east coast ports to Japan.

Table 5

ECONOMIC ADVANTAGES OF PANAMA CANAL ROUTE VERSUS ALTERNATIVE ROUTES
WEST COAST SOUTH AMERICA TO EAST COAST UNITED STATES

Value of a Vessel-Day	Advantage of Panama Canal vs Strait of Magellan			
	Antofagasta to Savannah[1/]		Callao to Philadelphia[2/]	
	Dollars	Percent of Panama Canal Tolls	Dollars	Percent of Panama Canal Tolls
10-Knot Vessel				
$ 800	$12,000	240%	$16,033	320%
1,000	16,250	325	21,291	426
1,200	20,500	410	26,550	531
1,400	24,750	495	31,808	636
1,600	29,000	580	37,067	741
$2,800	$54,500	1,090%	$68,617	1,370%
3,000	58,750	1,180	73,875	1,480
3,200	63,000	1,260	79,133	1,580
3,400	67,250	1,340	84,392	1,690
3,600	71,500	1,430	89,650	1,790
16.5-Knot Vessel				
$1,600	$14,610	244%	$19,495	325%
1,800	17,180	286	22,682	378
2,000	19,760	329	25,869	431
2,200	22,330	372	29,056	484
2,400	24,910	415	32,242	537
$4,200	$48,090	802%	$60,924	1,020%
4,400	50,670	845	64,111	1,070
4,600	53,240	887	67,297	1,120
4,800	55,820	930	70,485	1,170
5,000	58,390	973	73,672	1,230
18-Knot Vessel				
$2,400	$22,330	372%	$29,055	484%
2,700	25,870	443	33,437	557
3,000	29,420	448	37,819	630
3,300	32,960	549	42,201	703
3,600	36,500	608	46,583	776
$4,900	$51,850	864%	$65,572	1,090%
5,300	56,570	943	71,414	1,190
5,700	61,290	1,020	77,257	1,290
6,100	66,013	1,100	83,100	1,380
6,500	70,740	1,180	88,942	1,480

Note: The Liberty ship, C3, and U.S. Maritime Administration "Seafarer" design are assumed to represent the 10-knot, 16.5-knot, and 18-knot vessel categories, respectively. Panama and Suez Canal tolls are assumed to be $5,000 for the Liberty and $6,000 for the larger types.

1/ Represents shipload movements of Chile nitrate.
2/ Represents shipload movements of iron ore.

Table 6

ECONOMIC ADVANTAGES OF PANAMA CANAL ROUTE VERSUS ALTERNATIVE ROUTE WEST COAST CANADA TO EUROPE[1/]

Value of a Vessel-Day	Advantage of Panama Canal vs Strait of Magellan	
	Dollars	Percent of Panama Canal Tolls
10-Knot Vessel		
$ 800	$18,670	373%
1,000	23,330	467
1,200	28,000	560
1,400	32,670	653
1,600	37,330	747
$2,800	$65,330	1,310%
3,000	70,000	1,400
3,200	74,670	1,490
3,400	79,330	1,590
3,600	84,000	1,680
16.5-Knot Vessel		
$1,600	$16,630	277%
1,800	19,450	324
2,000	22,282	371
2,200	25,110	418
2,400	27,940	466
$4,200	$53,390	890%
4,400	56,220	940
4,600	59,050	980
4,800	61,880	1,030
5,000	64,710	1,080
18-Knot Vessel		
$2,400	$25,110	418%
2,700	29,000	483
3,000	32,890	548
3,300	36,780	613
3,600	40,670	678
$4,900	$57,520	959%
5,300	62,700	1,040
5,700	67,890	1,130
6,100	73,070	1,220
6,500	78,260	1,300

Note: The Liberty ship, C3, and U.S. Maritime Administration "Seafarer" design are assumed to represent the 10-knot, 16.5-knot, and 18-knot vessel categories, respectively. Panama and Suez Canal tolls are assumed to be $5,000 for the Liberty and $6,000 for the larger types.

1/ Based on distances from Vancouver, B.C. to Bishop Rock. Shipload commodities affected are grain and lumber.

Table 7

ECONOMIC ADVANTAGES OF PANAMA CANAL ROUTE VERSUS ALTERNATIVE ROUTES UNITED STATES GULF PORTS TO JAPAN[1/]

Value of a Vessel-Day	Advantage of Panama Canal vs Suez Canal		Advantage of Panama Canal vs Cape of Good Hope	
	Dollars	Percent of Panama Canal Tolls	Dollars	Percent of Panama Canal Tolls
10-Knot Vessel				
$ 800	$17,670	353%	$16,330	327%
1,000	22,080	442	21,670	433
1,200	26,500	530	27,000	540
1,400	30,920	618	32,330	647
1,600	35,330	707	37,670	753
$2,800	$61,830	1,240%	$69,670	1,390%
3,000	66,250	1,330	75,000	1,500
3,200	70,670	1,410	80,330	1,610
3,400	75,080	1,500	85,670	1,713
3,600	79,500	1,590	91,000	1,820
16.5-Knot Vessel				
$1,600	$21,410	357%	$19,860	331%
1,800	24,090	401	23,090	385
2,000	26,770	446	26,320	439
2,200	29,440	491	29,560	493
2,400	32,120	535	32,790	547
$4,200	$56,210	937%	$62,580	1,040%
4,400	58,890	981	65,110	1,090
4,600	61,560	1,030	68,340	1,140
4,800	64,240	1,070	71,560	1,190
5,000	66,920	1,120	74,810	1,250
18-Knot Vessel				
$2,400	$29,440	490%	$28,440	474%
2,700	33,120	552	32,750	546
3,000	36,810	613	37,060	618
3,300	40,490	675	41,360	689
3,600	44,170	736	45,670	761
$4,900	$60,120	1,000%	$64,220	1,070%
5,300	65,020	1,080	70,060	1,170
5,700	69,930	1,170	75,810	1,260
6,100	74,840	1,250	81,560	1,360
6,500	79,750	1,330	87,290	1,450

Note: The Liberty ship, C3, and U.S. Maritime Administration "Seafarer" design are assumed to represent the 10-knot, 16.5-knot, and 18-knot vessel categories, respectively. Panama and Suez Canal tolls are assumed to be $5,000 for the Liberty and $6,000 for the larger types.

1/ Based on distances from New Orleans to Yokohama. Shipload commodity is soybeans.

Table 8

ECONOMIC ADVANTAGES OF PANAMA CANAL ROUTE VERSUS ALTERNATIVE ROUTES TAMPA, FLORIDA, TO JAPAN 1/

Value of a Vessel-Day	Advantage of Panama Canal vs Suez Canal		Advantage of Panama Canal vs Cape of Good Hope	
	Dollars	Percent of Panama Canal Tolls	Dollars	Percent of Panama Canal Tolls
10-Knot Vessel				
$ 800	$17,330	347%	$16,330	327%
1,000	21,670	433	21,670	433
1,200	26,000	520	27,000	540
1,400	30,330	607	32,330	647
1,600	34,670	693	37,670	753
$2,800	$60,670	1,210%	$69,670	1,390%
3,000	65,000	1,300	75,000	1,500
3,200	69,330	1,390	80,330	1,610
3,400	73,670	1,470	85,670	1,713
3,600	78,000	1,560	91,000	1,820
16.5-Knot Vessel				
$1,600	$21,010	350%	$19,860	331%
1,800	23,640	394	23,090	385
2,000	26,260	438	26,320	439
2,200	28,890	482	29,560	493
2,400	31,520	525	32,790	547
$4,200	$55,130	919%	$62,880	1,050%
4,400	57,760	963	65,110	1,090
4,600	60,400	1,010	68,340	1,140
4,800	63,030	1,050	71,580	1,190
5,000	65,660	1,090	74,810	1,250
18-Knot Vessel				
$2,400	$28,890	482%	$28,440	474%
2,700	32,500	542	32,750	546
3,000	36,110	602	37,080	618
3,300	39,720	662	41,360	689
3,600	43,330	722	45,670	761
$4,900	$58,990	983%	$64,330	1,070%
5,300	63,800	1,060	70,080	1,170
5,700	68,610	1,140	76,810	1,280
6,100	73,430	1,220	81,560	1,360
6,500	78,240	1,300	87,290	1,450

Note: The Liberty ship, C3, and U.S. Maritime Administration "Seafarer" design are assumed to represent the 10-knot, 16.5-knot, and 18-knot vessel categories, respectively. Panama and Suez Canal tolls are assumed to be $5,000 for the Liberty and $6,000 for the larger types.

1/ Based on distance to Yokohama. Phosphate rock is the shipload commodity on this route.

Table 9

ECONOMIC ADVANTAGES OF PANAMA CANAL ROUTE VERSUS ALTERNATIVE ROUTES CUBA TO JAPAN[1/]

Value of a Vessel-Day	Advantage of Panama Canal vs Suez Canal		Advantage of Panama Canal vs Cape of Good Hope	
	Dollars	Percent of Panama Canal Tolls	Dollars	Percent of Panama Canal Tolls
10-Knot Vessel				
$ 800	$17,670	353%	$15,670	313%
1,000	22,080	442	20,830	417
1,200	26,500	530	26,000	520
1,400	30,920	618	31,170	623
1,600	35,330	707	36,330	727
$2,800	$61,830	1,240%	$67,560	1,350%
3,000	66,250	1,330	72,500	1,450
3,200	70,670	1,410	77,670	1,550
3,400	75,080	1,500	82,830	1,660
3,600	79,500	1,590	88,000	1,760
16.5-Knot Vessel				
$1,600	$21,410	357%	$19,030	317%
1,800	24,090	401	22,180	370
2,000	26,770	446	25,310	422
2,200	29,440	491	28,440	474
2,400	32,120	535	31,560	526
$4,200	$56,210	937%	$59,760	996%
4,400	58,890	981	62,890	1,050
4,600	61,560	1,030	66,020	1,100
4,800	64,240	1,070	69,150	1,150
5,000	66,920	1,120	72,280	1,200
18-Knot Vessel				
$2,400	$29,440	490%	$28,440	474%
2,700	33,120	552	32,750	546
3,000	36,810	613	37,060	618
3,300	40,490	675	41,360	689
3,600	44,170	736	45,670	761
$4,900	$60,120	1,000%	$64,320	1,070%
5,300	65,020	1,080	70,030	1,170
5,700	69,930	1,170	75,810	1,260
6,100	74,840	1,250	81,550	1,360
6,500	79,750	1,330	87,290	1,450

Note: The Liberty ship, C3, and U.S. Maritime Administration "Seafarer" design are assumed to represent the 10-knot, 16.5-knot, and 18-knot vessel categories, respectively. Panama and Suez Canal tolls are assumed to be $5,000 for the Liberty and $6,000 for the larger types.

1/ Based on distance from Havana and Santiago (average) to Yokohama. The shipload commodity in this case is sugar.

Special Cases of Possible Alternative Routing

In addition to the examples given in Tables 1 to 9 there are two other situations in which the factors affecting the choice of an alternative route are more complex. These are the tanker traffic from the Caribbean area to Pacific destinations and the United States intercoastal traffic. A fuller discussion of these situations is desirable and follows immediately.

Tanker Traffic

The principal shipments of petroleum and petroleum products through the Panama Canal at present, and also those projected for the future, are from ports in Venezuela and the Caribbean to the West Coasts of the United States, Mexico, Central America, and South America. On these routes the distance saved by using the Panama Canal is very great. For example, from Maracaibo to San Francisco the saving is more than 8,000 miles, and from Curaçao to Valparaiso it is about 4,000 miles. For a 15-knot tanker these distances represent savings in steaming times of about 22 days and 11 days, not allowing for possible delays caused by weather in the Strait of Magellan.

The value of a tanker-day has fluctuated in the past over a considerable range. These fluctuations are owing to changes in the demand for shipping space in relation to tanker tonnage available. However, estimates of average daily vessel costs can provide some general indications of the average range in which vessel-day values could be expected to fall over the long term. An extensive study of tanker costs for transporting crude petroleum was made by Ebasco Services Incorporated as part of a study of Suez Canal traffic.[1/] Data in that study indicate that, in round numbers, the average daily cost of tankers of various size is as follows:[2/]

1/ Economic Survey to Determine the Volume and Characteristics of Traffic through the Suez Canal through 1972, Ebasco Services Incorporated, New York, January 1957.

2/ The principal assumptions on which the tanker cost estimates are based are: mid-1956 price levels, built in European yards, manned by European crews, annual fixed charges on initial investment including depreciation averaging 12.5 percent over a 20-year life of vessel.

Tanker Size (deadweight tons)	Average Daily Cost
16,000	$3,000
25,000	4,000
40,000	5,300
60,000	7,000
90,000	9,400

Panama Canal tolls now average about $0.48 per long ton of cargo for laden tanker transits. By estimating tolls for the large tankers on this basis and relating the tolls to daily costs as shown in the foregoing table it is possible to estimate the extent of tolls increases that would offset the value of time saved by using the canal. The following table shows such estimates for tankers of various size. No allowance has been made for weather and bunkering factors.

APPROXIMATE PANAMA CANAL TOLLS INCREASES THAT WOULD OFFSET VALUE OF TIME SAVED BY TANKERS

Tanker Size (deadweight tons)	Percent Tolls Increase	
	For 11 Days Saved 1/	For 22 Days Saved 2/
16,000	370	840
25,000	270	630
40,000	200	500
60,000	170	440
90,000	140	380

1/ Represents one-way voyage from Curaçao to Valparaiso at 15 knots.
2/ Represents one-way voyage from Maracaibo to San Francisco at 15 knots.

It can be seen that the only cases in which tankers might be diverted from the Panama Canal to the Strait of Magellan route without very large increases in tolls are those of the largest tankers operating where the time saved by the canal is least. Owing to the difficulties of handling very large deliveries in the small markets afforded by ports on the West Coast of South America, the largest tankers may not serve these ports. Further, the time that can be saved by using the Panama Canal increases rapidly as destinations north of Valparaiso are considered. Therefore, tolls increases of even 300 percent are not likely to divert a significant portion of the tanker traffic to the Strait of Magellan route. Tolls increases would affect the tanker traffic in other ways, however; these are discussed in Section IV.

In the foregoing comparisons it was assumed that tankers of all sizes could use the canal. With the canal at its present depth, the largest tankers that can transit fully loaded are those of about 40,000 to 45,000 deadweight. The question arises, What tolls could ships of this size pay and still be more economical using the canal than larger ships using the Strait of Magellan? Data useful in answering this question are available in the Suez Canal study by Ebasco Services Incorporated that was mentioned earlier. These data are shown in Table 10. The one-way distance of 11,873 miles approximates that from Maracaibo to San Francisco via the Strait of Magellan. The distance between these ports via the Panama Canal is 3,888 miles, which falls between those represented by the last two columns of Table 10.

Reference to Table 10 indicates that it costs about $7.78 per ton of cargo to ship from Maracaibo to San Francisco via the Strait of Magellan in a 90,000-ton tanker, while the comparable cost, less canal tolls, for shipping in a 40,000-ton tanker via the Panama Canal falls between $4.74 and $3.31 per ton of cargo. Thus the 40,000-ton vessel could pay canal tolls in the order of $3.50 per ton of cargo and still be more economical between these ports. Present tolls average about $0.85 per ton of cargo when the return voyage is made in ballast. Round-trip tolls must be considered here because the data on costs per ton of cargo are based on continuous use of the vessels on the routes concerned.

The 8,430-mile distance shown in Table 10 approximates that from Curaçao to Callao via the Strait of Magellan. The distance between these ports via the Panama Canal is only 2,092 miles, which is shorter than any shown in the table. However, a rough comparison can still be made. On the 8,430-mile distance it costs $5.75 per ton of cargo to ship crude petroleum in a 90,000-ton tanker. In a 40,000-ton tanker the cost is $3.31 over a 3,160-mile distance and would be less if only 2,092 miles were involved. Thus, the 40,000-ton tanker could pay more than $2.44 per

Table 10

ANNUAL COSTS PER TON OF CARGO
FOR TRANSPORTING CRUDE PETROLEUM IN TANKERS

Tanker Size (deadweight tons)	Distance One Way			
	11,873 Miles 1/	8,430 Miles 2/	5,355 Miles 3/	3,160 Miles 4/
40,000	$9.92	$7.30	$4.74	$3.31
45,000	9.52	7.02	4.56	3.18
60,000	8.69	6.41	4.17	2.90
80,000	8.01	5.93	3.86	2.68
90,000	7.78	5.75	3.75	2.60

1/ Ras Tanura to Philadelphia via Cape of Good Hope.
2/ Ras Tanura to Philadelphia via Suez; canal tolls removed from costs.
3/ Sidon to Philadelphia.
4/ Sidon to English Channel ports.

Source: Economic Survey to Determine the Volume and Characteristics of Traffic through the Suez Canal through 1972, Ebasco Services Incorporated, New York, January 1957, Appendix A.

ton of cargo in canal tolls and still be more economical than the larger vessel operating between Curaçao and Callao. This would mean that present Panama Canal tolls could be increased at least 200 percent before the larger ship becomes more economical via the Strait of Magellan.

The foregoing examples indicate that tolls could be increased substantially before the Panama Canal, with its present vessel size limitations, would lose tanker traffic to very large ships using the Strait of Magellan. These examples are subject to the assumptions given in the footnote on page 27 and fit only roughly the distance conditions of petroleum movements using the Panama Canal. More refined calculations were not possible in the scope of the present study, but they are not needed to illustrate the magnitudes involved.

United States Intercoastal Traffic

An important part of Panama Canal traffic that could be diverted to an alternative route by increasing canal tolls is made up of shipments between the East and West Coasts of the United States. For these shipments, the possibility is not that of diverting ships to another route but of diverting cargo from ships to overland carriers. Postwar developments in the intercoastal trade and the general outlook for the future are discussed in Volume I of the Stanford Research Institute report An Analysis of Future Commercial Freight Traffic through the Panama Canal, and the outlook for shipments of the principal commodities is discussed in Volume II of the same report. This trade is sustained largely by shipments of three commodities--lumber, iron and steel, and canned goods. If these items were diverted to overland carriers, it is doubtful that intercoastal service could still be offered for general cargo under conditions now foreseeable in the trade. Accordingly, the analysis here is confined to these three major commodities. As mentioned in the report cited above, a major cost-reducing development in water transportation could change this situation, but such a development is not now predictable.

How about containers?

Lumber. Intercoastal shipments of lumber are made up principally of Douglas fir and hemlock dimension lumber, timber, and planks that are shipped green from mills at or very near a port. A small amount of western red cedar is also shipped green. Some dry 2 × 4 framing material is also shipped by water, but most dry lumber and all lumber from interior mills to eastern destinations moves by rail. Three vessel operators, Weyerhaeuser, Pope and Talbot, and Calmar, carry practically all the eastbound lumber. A substantial part of the total movement is proprietary cargo rather than common carrier cargo. These lines conduct specialized operations in lumber eastbound and iron and steel westbound.

Freight rates for water shipment are based on the board-foot measure of the cargo. Rail rates, on the other hand, are based on weight. Wet, heavy green lumber can thus be shipped by water without penalty for the weight involved. Shipment by water is especially attractive in winter, when rains in the Pacific Northwest make air drying at the mill virtually impossible.

The current intercoastal freight rate for lumber is $36 per thousand board feet basic measure. However, since dimension lumber is actually smaller than its nominal dimensions, charges are adjusted to allow for this difference. On average, the difference is about 25 percent of the basic measure, and the average rate paid is about $27 per thousand board feet basic measure. To the ocean freight rate must be added the cost of hauling to the port and the wharfage and handling charges. These costs will vary with the distance of the mill from the port. The maximum feasible haul under present conditions is estimated to be about 30 miles. Similar charges are incurred at destination for delivery to consignees. Total costs in addition to the freight rate are estimated to range from $8 to $12 per thousand board feet, depending on particular situations. The total cost of shipping lumber by water would thus range from about $35 to $39 per thousand board feet.

The rail rate on lumber from all West Coast shipping points to Boston, New York, and Norfolk is $1.47 per 100 pounds, and to Charleston and Savannah, $1.60 per 100 pounds. On the basis of a thousand board feet of green dimension lumber of average moisture content, these rates give a shipping cost in the range of $36.75 to $38.25, depending on the lumber sizes involved, to the northern ports and $40 to $41.60 to the southern destinations. In winter an additional charge of $3 to $5 may be incurred because of the weight of excess moisture in the lumber.

Comparing rail and water shipment costs, it can be seen that for Norfolk and points north the rail and water costs are very competitive, while the water carriers have a small advantage in the southern ports. The majority of the tonnage, of course, goes to the north, making this the important area as far as Panama Canal traffic is concerned.

The factors that determine the choice between rail and water shipment in specific cases are complex, and the total cargo volume cannot be analyzed in detail in the aggregate. From the foregoing data it can be seen that hauling costs to and from ports are important in the total cost of water shipment. Variations on this score occur chiefly at ports of origin, where mills vary from having their own deepwater dock to being some miles inland. On the other hand, the weight of the lumber is an important variable in rail shipping costs. Shipping decisions represent a combination of these factors of hauling costs and weight. Some mills may be located where it is always cheaper to ship green lumber by water under existing rates, while others may find it more economical to pay hauling costs to a port when the lumber is very wet and more economical to ship by rail when the moisture content of the lumber is lower. Very detailed study of individual situations would be required to identify the portions of the traffic that are most sensitive to such variations.

Another important factor affecting routing of lumber shipments is the ownership of vessels by lumber companies or their affiliates. For proprietary cargo the published common carrier freight rate may not be the appropriate basis for decisions on routing shipments in the short term. As long as the company is operating vessels it may be better to utilize them, even if rail shipment costs are lower than water shipment costs at published rates. A decision to lay up ships, or to charter or sell ships, and to rely entirely on rail shipments is a more complex matter than a straight comparison of rates. The bargaining position of the company versus the railroads in the future is an important consideration in maintaining a fleet.

The foregoing paragraphs illustrate the difficulty involved in tracing the probable effects of an increase in vessel operating costs, such as would result from an increase in Panama Canal tolls. For lumber in shiploads, canal tolls presently amount to about $0.90 to $1 per thousand board feet. Assuming that tolls are reflected in the freight rate and that rail rates do not change, a doubling of present tolls would significantly affect the small differential that now exists between water and rail shipping costs. Some routings would probably change as a result, but in view of the complexities described above it is not possible to determine the number of cases that would change.

In recent years costs have increased for both the rail and water carriers, and their respective rates have also increased. Further cost increases may be expected in the future, and rates will no doubt be influenced thereby. Canal tolls are a small part of total voyage costs for the intercoastal vessels, but they are large in relation to the present difference between rail and water rates. How increases in canal tolls might affect future differences between rail and water shipping costs is impossible to predict here in any detail.

Canned Goods. Practically all the canned goods movement in the intercoastal trade is eastbound by common carriers to the Atlantic Coast ports. The markets served by these movements are confined rather closely to the immediate vicinity of the ports of destination, because the costs of shipping inland quickly absorb any advantage the water shipment has over direct overland shipment. In the past, rate differentials allowed inland movement for several hundred miles, but the narrowing spread between rail and water shipping costs now confines the market to seaboard.

Pacific Coast canners wish to maintain the opportunity to ship by water in order to have active competition as a check on overland freight rates. The lower the shipping costs from the West Coast, the better the competitive position of western canners versus canners in other areas. However, canned goods are usually sold f.o.b. shipping point or dock, which allows the buyer to designate the carrier. Eastern buyers probably have a shorter range viewpoint with respect to competition in transportation. They are not organized in groups; they have alternative sources of supply; and they can be expected to place emphasis on immediate savings in routing their shipments. Therefore, water shipment must offer economic advantage in order to attract the business.

As was the case with lumber, it is not possible to make a detailed comparison of rail and water shipping costs that is valid for the total movement of canned goods. In addition to differences in rates and ancillary charges, there are differences in the nature of the service offered. The valuation that shippers will place on differences in the service will vary from case to case depending on the particular circumstances of the transaction. At present, the ocean freight rate is based on a minimum of 20,000 pounds being included in each shipment. The rail rate is based on a 60,000-pound minimum to secure the carload rate. This situation gives the intercoastal carriers an important advantage on small shipments. On the other hand, for a small charge in addition to the carload rate a rail car can be consigned for partial unloading at one or two intermediate points before the final destination, and this is an important convenience to some shippers. Documentation and claims procedure is more complicated on ocean shipments than on rail shipments. These factors obviously influence the choice of carrier in individual cases.

The current freight rate for water shipment is $1.54 per 100 pounds, to which must be added about six or seven cents for marine insurance and wharfage charges on the West Coast. At destination, drayage charges are incurred to move the goods from the dock to the consignee's warehouse. In New York City these charges run about 25 cents per 100 pounds. At some unloading docks on the East Coast a wharfage charge will be incurred, but in most cases this is absorbed in the freight rate. The total costs of water shipment therefore are about $1.85 per 100 pounds.

The present rail rate is $1.94 per 100 pounds to East Coast destinations. The consignee handles his own car unloading, thus incurring some additional cost. When goods are brought to the consignee's warehouse by truck from the waterfront, the drayage charge includes unloading the truck, which is a small advantage for the water route.

The foregoing cost comparison shows a small advantage for water shipment in terms of the direct charges involved. It will be noted, however, that the data include no allowance for moving goods from the canner's warehouse to the West Coast port of loading. The canners customarily quote to buyers the same price f.o.b. dock and f.o.b. rail cars, thus absorbing the cost of trucking to the port. Rail car loading itself is a rather costly process and is considered to offset trucking to ports. As mentioned earlier, the industry wishes to keep in being the alternative of shipping by water, which probably also encourages this pricing practice. The willingness of the industry to continue this practice is a key factor in the existence of the intercoastal traffic.

Considering both the direct charges and the differences in the nature of the services offered, it can be said that in general the intercoastal carriers secure their canned goods traffic by a very narrow margin. The exact incidence of Panama Canal tolls per 100 pounds of canned goods cannot be determined, because of the mixed cargoes carried by ships and the variations in vessel load factor from voyage to voyage. However, it appears reasonable to estimate tolls as being in the range of five to ten cents per 100 pounds. On this basis, if rail rates are assumed to remain unchanged and an increase in tolls is assumed to be reflected fully in the water rate, a tolls increase of 100 percent would about close the gap in direct shipping charges between rail and water. Service factors would still remain to be considered, but a change in the rate difference of this magnitude would be very significant in the routing of the traffic.

The foregoing assumptions of unchanged rail rates and full reflection of canal tolls in the water rate are, of course, not necessarily valid. Both rail and water rates have increased in recent years, but the spread has narrowed. As mentioned in the case of lumber, both rates may rise again in the future. What their relation will be and what the effect of canal tolls in the total cost and rate picture will be cannot be predicted accurately. There is presently under discussion a proposal by the railroads to introduce rates based on larger minimum carloads. In return for heavier loads, the rate per 100 pounds would be reduced. This would have important consequences for the intercoastal movement and serves to illustrate the closely competitive situation that now exists. A 100 percent increase in canal tolls could well divert the canned goods to rail shipment.

Steel. The principal westbound intercoastal cargo consists of various products of steel mills. Although steel is being made on the West Coast, production is insufficient for the demand, and certain items are not made in the West at all. Despite future growth in western steel production, it is expected that shipments from the East will continue, particularly in special products not made in the West. For such shipments the water carriers presently have a substantial advantage in rates over the overland carriers. Most of the steel is carried by vessels which bring lumber from west to east--those operated by Weyerhaeuser, Pope and Talbot, and Calmar. The latter is a subsidiary of Bethlehem Steel Corporation and thus has an established source of steel tonnage.

The present freight rate advantage per long ton being offered by the water carriers is $4.03 for tinplate, $28.22 for structural steel, and $31.14 for sheet steel and heavy plates. Wharfage, handling, and drayage costs vary somewhat with the port of destination. However, they are substantial enough to offset entirely the rate advantage on tinplate and to reduce the over-all water shipping cost advantage to about $23.75 per long ton for structural steel and about $26.65 for sheet steel and heavy plates.

Panama Canal tolls at the current rate amount to about $0.50 per long ton of steel for shipload lots. If ships operate at less than 100 percent load factor, the tolls would be correspondingly higher in relation to a ton of cargo. In practice, a tolls cost of $1 per ton of steel would probably cover most cases. Assuming that increased tolls would be passed on to the cargo in higher freight rates, it can be seen from the above data that even very large tolls increases would not offset the advantage of water shipment for structural and sheet steel and heavy plates, which are the main items in the traffic.

Even though canal tolls increases would not shift the shipping cost advantage to overland carriers, higher transportation cost by water could influence the decisions of steel producers to supply western markets from eastern mills versus dropping out of the market or establishing production in the West. These decisions are very complex and will vary with the position of individual companies and the particular products involved. They cannot be examined in detail in the present study. In general, steel is a high value commodity that is presently priced well over $100 per long ton. The Panama Canal toll is therefore small in the total cost, and if steel could be considered alone, large tolls increases would probably not greatly affect the volume shipped from the East Coast.

However, it must be recognized in considering the steel traffic that it is closely related to the lumber traffic eastbound. The feasibility of intercoastal vessel operations depends on having cargo in both directions on a voyage. It was brought out in the discussion of lumber that doubling the present tolls might have a significant effect in diverting traffic to overland carriers. If this were to occur, the economics of voyages carrying steel would be changed, and vessel operators would face new decision-making situations. It is conceivable that to retain the lumber traffic the steel cargoes could be given more than half the burden of increased round-trip tolls. Such possibilities obviously cannot be explored without the assistance of shippers and carriers involved. In view of this factor and of the proprietary interests involved, it seems likely that the lumber and steel traffic would continue in spite of a 100 percent increase in tolls.

Section IV

EFFECTS OF RISING TRANSPORTATION COSTS

The previous section considered the possibility that Panama Canal traffic could be diverted to alternative shipping routes in response to an increase in canal tolls. Two instances were found in which such diversion would probably occur if tolls were increased in the order of 100 percent. However, most of the traffic has no alternative route that would be more economical than the Panama Canal route until tolls are very greatly increased. It is important to recognize that this does not necessarily mean that the traffic having no alternative route is completely insensitive to increases in canal tolls. Another important sequence of possible effects on traffic remains to be considered.

Canal tolls are assessed against vessels and become an element of voyage costs affecting the operation of vessels in the same manner as wages, fuel, and other operating expenses. An increase in Panama Canal tolls means simply an increase in the cost of providing transportation service. If vessels do not divert to alternative routes but instead continue to use the canal, the full amount of the tolls increase is added to voyage costs. It is the purpose of this section to analyze the possible effects of such increases in voyage costs on the volume of traffic using the canal.

For purposes of this analysis it is assumed that increased tolls costs are passed along by the vessel to the cargo, i.e., that increased tolls would be fully reflected in freight rates. This is a reasonable assumption for the long term, because under competitive conditions the prices of transportation services could be expected to be closely related to the cost of providing the services, plus sufficient profit to induce the vessel operators to continue to provide the services. It is believed that conditions are sufficiently competitive in the shipping business and that the pressure of rising costs is sufficiently acute that the operators cannot indefinitely absorb increased costs. Rates will probably be adjusted from time to time to reflect new cost conditions.

In spite of the long-term tendency just described, there could be short-term periods in which the pressure of competition forces vessel operators to absorb increased costs in order to attract cargo. They may continue to operate at a loss rather than to abandon the trade or to incur greater losses by laying up the vessel. Such conditions could conceivably last for a long time but could not continue indefinitely.[1/]

Rising freight rates can affect the number of Panama Canal transits through two types of adjustment to the increased cost of transportation. First, by raising the selling price of goods shipped (or by reducing the price paid to suppliers), increased transportation costs can diminish the total volume of goods moved. The number of vessel transits must eventually adjust to the smaller volume. Second, for some commodity movements the increased cost of transportation on the Panama Canal route may make it more economical for buyers of the commodities to turn to new sources of supply from which shipments would not pass through the Panama Canal at all. Again the effect is to reduce the number of transits. Both these types of adjustment are discussed in subsections which follow.

Lacking direct access to data in the industries concerned, it is possible to use three general principles in the study of commodities. First, canal tolls can be considered in relation to the delivered price of the commodity in question. If the toll makes up only a small part of that price, it follows that a substantial change in the toll will mean only a small change in the delivered price. Thus the effect on the quantity sold should tend to be small also. Second, the availability of alternative sources of the commodity can be considered. If there is no alternative source at a closely competitive price, the effect of the tolls increase on the quantity shipped through the canal should tend to be small. Third, variations in ocean freight rates in recent years have been much larger per ton of cargo than the amount of a substantial tolls increase would be, and the effects of these variations on shipments can be observed.

Effects of Panama Canal Tolls on Supply and Demand for Goods

When there is an increase in the cost of transporting a commodity, such as would be occasioned by an increase in Panama Canal tolls under the assumptions described earlier, there is no general rule by which the resulting effect on the final selling price of that commodity can be

1/ Instead of an increase in freight rates the situation might be resolved by some vessels dropping out of the trade and thus enabling those that remain to operate at a higher load factor and satisfactory earnings. The effect on Panama Canal transits is the same as that described below for rising freight rates, viz., fewer transits.

predicted. Depending on the nature of the demand for the commodity, on the conditions of supply, and on the competitive structure of the industry concerned, the increased cost may be (1) passed on entirely to the final consumer, (2) borne entirely by the producer, (3) borne entirely by intermediate dealers, or (4) shared by producer, dealers, and consumers in varying degrees. To estimate the actual distribution of such increased cost in a particular case and to estimate in detail the way in which consumers and suppliers would respond in terms of the quantities of the commodity they are willing to buy or offer for sale would require intensive study of the industry concerned. Yet this is the problem that is faced in tracing the effect of an increase in Panama Canal tolls on the volume of traffic through the canal.

In the scope of the present study it is possible only to apply in general terms some fundamental principles that are helpful in indicating the probable nature of certain responses to increased tolls. Two categories of situation that have some basic differences can be distinguished. These are the general cargo liner traffic and shipload commodity movements.

General Cargo Liner Traffic

The vessel carrying a variety of general cargo presents a special problem in determining what the effect of any tolls increase will be on the transportation cost of individual items carried in the ship. Since tolls are assessed against the vessel, rather than against the cargo, it remains for the vessel operator to recover the cost through charges to the cargo, i.e., through changes in freight rates. The rate-making process is complex, and on such a broad basis as Panama Canal general cargo traffic it literally defies analysis within any reasonable scope of effort.

It is well known that within any wide range of items, such as are shipped by common carriers, there will be wide variations in "what the traffic will bear." Perusal of a freight tariff quickly reveals a great spread among items in the rate per ton or other unit of measurement. Some of these differences can be attributed to differences in cost of handling, risk of damage, and similar factors, but many are simply reflections of the ability of the carrier to charge more for some items without preventing shipment than can be charged for others. It is not unusual to find a rate for a given item moving in one direction that is higher than the rate for the same item moving in the opposite direction. Under such conditions it is difficult to predict how any future increase in rates might be allocated among the various items in the freight tariff. The fact that most rates are conference rates and must be fixed jointly by a group of carriers further complicates the situation. It is not possible even to approach this problem without the assistance of the carriers.

Fortunately for the present analysis, the problem raised by the impossibility of estimating the effect of canal tolls on individual general cargo rates is offset to some extent by another characteristic of the general cargo traffic that partly removes the necessity to estimate such effects in detail. This characteristic is the high unit value of much of the general cargo carried. When product values run in hundreds or thousands of dollars per ton, the ocean freight rate, and hence the Panama Canal toll effect, are very small parts of the value of the product. Therefore, a relatively large change in shipping cost can still mean a relatively small change in the product price that will have little or no effect on the volume [illegible]d. In view of this characteristic it appears reasonable to assume that general cargo liner operators could recover the cost of increased tolls from those portions of their traffic that are not extremely sensitive to shipping cost and that they could do so over a fairly wide range of possible tolls increases without significantly reducing the cargo tonnage. Factual evidence from carriers or shippers cannot be offered in support of this reasoning at this time, since they could not be approached in the present study. However, it appears that doubling the present canal tolls would not seriously affect the volume of general cargo liner traffic.

Shipload Traffic in Bulk Commodities

When a single commodity is carried in shiploads it is possible to estimate fairly closely the Panama Canal toll cost per ton of cargo, simply by dividing the toll assessed against the vessel by the tonnage carried. Analyses made by the Panama Canal Company have established the typical toll per ton of cargo for the commodities that move in shiploads.

The commodities that move in shiploads usually have lower values per ton than most general cargo items. The transportation charge is therefore more likely to be an important component of the delivered price. Increases in Panama Canal tolls would be expected to have a greater impact on quantity sold for bulk commodity movements than for general cargo. The basis for each of the major commodity movements through the canal is described in Volume II of the Stanford Research Institute report An Analysis of Future Commercial Freight Traffic through the Panama Canal. The possible effects of increased tolls on the movements of these commodities are discussed in the paragraphs which follow.

Sugar. One of the main movements of sugar is from the Philippines to the East Coast of the United States. As long as the Philippines have a quota to sell in a United States market, where prices are maintained substantially above those in other markets, there is a very strong