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Economic Impact of the U.S. Merchant Marine and Shipbuilding Industries: An Input-output Analysis-Volume 1

US Department of Commerce

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Economic Impact of the U.S. Merchant Marine and Shipbuilding Industries

AN INPUT - OUTPUT ANALYSIS

VOLUME I



Economic Impact of the U.S. Merchant Marine and Shipbuilding Industries

VOLUME I



U.S. DEPARTMENT OF COMMERCE
Maritime Administration
Office of Port and Intermodal Development

May 1978

Foreword

The study represents the first application of the Input-Output technique to the United States Merchant Marine and Shipbuilding Industries. It was conducted for the Maritime Administration by the Port Authority of New York and New Jersey.

This report was prepared by the Port Authority's Planning and Development Department, Edward S. Olcott, Director. The team on this original study consisted of Jerome Gilbert, Project Director; Nai-Ching Sun and Amos Ilan, economists, and Walter Hamshar, Consulting Editor.

The assistance of Philip M. Ritz, Chief of the Inter-industry Division, Bureau of Economic Analysis, U.S. Department of Commerce, and his staff is gratefully acknowledged.

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EXECUTIVE SUMMARY

This study is the first major Government effort to analyze the impact of the United States merchant marine and of the country's shipbuilding industry on the Nation's economy.

This study is unique because it focuses on economics, using the Input-Output (I-O) Model which has become one of the most powerful analytical tools of economics. There is no attempt in this study to assess the merchant fleet's great importance to other areas of national concern such as defense policy.

The study demonstrates conclusively that the United States merchant marine and shipbuilding industries are vital economic assets to this Nation's productive output. Their direct and indirect contributions are measured in dollars and jobs for 1970, the base year of this study, because it was the latest year for which complete official I-O figures were available. Gross national product (GNP), however, is known to have doubled to \$1,890 billion from 1970 to 1977. Thus, it can be assumed that the dollar impact figure below for the merchant marine and shipbuilding industries would be approximately double those of 1970.

Major Merchant Marine Findings

1. The American-flag merchant fleet accounts for annual sales (output) of \$8.3 billion.
2. \$3.4 billion of this amount is part of the Nation's gross national product (GNP).
3. 244,900 jobs are created and maintained throughout the Nation through the activities of the American-flag merchant fleet.
4. These activities generate personal incomes of \$2.4 billion and corporate incomes of \$0.8 billion.
5. Federal taxes stemming from the Nation's merchant marine services totaled \$0.5 billion.
6. State and local tax revenues generated by the merchant fleet totaled \$0.3 billion.

Major Shipbuilding Findings

1. The ship construction industry's total output is \$6.0 billion.
2. Its contribution to the GNP is \$2.7 billion.
3. Its activities generate 235,400 jobs throughout the Nation.
4. Personal income generated throughout the economy by the shipbuilding industry totals \$2.0 billion; corporate income, \$0.6 billion.

5. Federal tax collections stemming from shipbuilding activity total \$0.4 billion.
6. State and local taxes total \$0.2 billion.
7. One-third of the shipbuilding industry's activities are generated by demand for new ships and repairs by the privately-owned and operated United States merchant marine.

In addition to producing, for the first time, reliable assessments of the output, income, jobs, and taxes generated by the Nation's entire merchant marine and its shipbuilding industry, the I-0 Model made it possible to evaluate the impacts of the ship operating and construction subsidies solely on their economic merits.

Combined Subsidies Are Responsible For:

1. A total output of \$2.5 billion in the national economy.
2. A contribution of \$1.1 billion to the GNP.
3. 88,500 jobs on ships and ashore.
4. Personal income of \$0.9 billion.
5. Corporate income of \$0.2 billion.
6. Federal taxes totaling \$0.2 billion.
7. State and local taxes of \$0.1 billion.

In fact, from one-third to one-half of the total costs of these subsidy payment programs are recovered by the Treasury in the form of tax accruals induced by the multitude of economic activities related to subsidized vessel operations and construction.

The I-0 Model demonstrated that the merchant marine and the shipbuilding industries are closely related to a large number of other industries in the economy. For some industries, the purchases made by the ship operating and construction industries are an important market segment. For example, they account for sales of:

- * \$461.1 million by the Nation's iron and steel industry.
- * \$381.5 million by the primary non-ferrous metal industry.
- * \$236.6 million by business services.
- * \$167.7 million by the finance and insurance industry.

The model showed that through the intricate chain of purchases initiated by maritime activities, the United States merchant marine's output has a multiplier effect of 1.8 while that of the ship construction industry is 2.1. This means that each dollar of output (sales by the merchant marine) produces a total output of \$1.80 in sales throughout the economy while each dollar of output by the shipbuilding industry produces a total output of \$2.10 in the economy.

It is important to note that the I-0 Model constructed for this study has the capability of simulating alternative policy positions that will be posed in the future. Such simulations can facilitate decision-making by measuring the impact of changes in shipping activities, ship construction or subsidies.

THE MARITIME INDUSTRIES' ROLE
IN THE NATION'S GROWTH

Purpose

The privately owned and operated United States merchant marine has been a vital military and economic asset to the Nation since its founding two centuries ago. Through the years the merchant marine's military role has received much public attention because of its great importance to the country's defense. The economic role has been equally important to the Nation's growth, but it has not received the same notice largely because there has never been a full measurement of its impact on the economy.

This study was undertaken by the Maritime Administration to fill that information gap. It is the first merchant marine analysis to use the Input-Output (I-O) Model for such an analysis.

The I-O Model

The I-O Model is a sophisticated economic measuring tool that is in general use by economists throughout the world. With the assistance of the computer, the model can accurately measure in terms of dollars the interrelationships and interdependencies of industries as well as determine the present and, under certain simulated conditions, the future impact of an industry on the total economy.

This makes the I-O Model a valuable aid to industry and Government in making forecasts and, more importantly, determining planning policy.

Merchant Marine Contributions

The model for this study was constructed from data provided by the Bureau of Economic Analysis of the United States Department of Commerce for the base year of 1970, the latest year for which full and accurate official data were available. The study showed that:

- o Sales of goods and services totaling \$8,301.5 million throughout the economy that year were attributable to the United States merchant marine.
- o Payments for goods and services to other industries by the merchant marine totaled \$2,332.0 million.
- o 244,900 jobs within the economy stemmed from United States merchant marine activities.
- o Wages and salaries totaling \$2,401.2 million were paid to those jobholders.
- o Corporate income produced through merchant marine activities totaled \$805.6 million.

- o Federal tax revenues stemming from the merchant marine totaled \$489.1 million.
- o State and local tax revenues generated by the merchant marine totaled \$259.8 million.

Shipbuilding Contributions

Construction of merchant ships in this country dates back to colonial days. The close link between the merchant marine and shipbuilding is recognized in the Nation's maritime policy and legislation. The Maritime Administration in fact was established to protect and promote both industries.

The United States shipbuilding industry's contributions to the national economy are as vital to the Nation's welfare as those of its sister industry. The I-0 Model constructed for this study shows that:

- o Sales of goods and services totaling \$6,028.6 million throughout the economy were attributable to the shipbuilding industry in the base year of 1970.
- o The shipbuilding industry made payments for goods and services to other industries totaling \$1,543.0 million.
- o 235,400 jobs were created within the economy by the shipbuilding industry.
- o Wages and salaries totaling \$1,980.2 million were paid to those jobholders.
- o Corporate income produced through shipbuilding activities totaled \$579.2 million.
- o Federal tax revenue generated by shipbuilding totaled \$377.2 million.
- o State and local tax revenues generated by shipbuilding totaled \$170.7 million.

Historical Perspective

The United States merchant marine's military services have brought it worldwide renown as the Nation's fourth arm of defense - after the Army, Navy and Air Force. This service began during the American Revolution. Merchant vessels, commissioned as privateers, caused so much disruption to British trade that the merchants of Britain brought extreme pressure on their government to end the war at any cost.

The United States merchant marine's greatest contribution to the Nation's defense was its magnificent accomplishment in World War II of carrying troops and supplies to fighting fronts in every part of the globe. It was this achievement that turned the tide of war against the Axis powers and brought victory to the Allies.

While the United States merchant marine's economic achievements through the years may have been less dramatic, they have been of great significance in the growth of the Nation's - and the world's - economies. Some highlights:

- * American merchant vessels were the first to use steam propulsion.
- * American sailing ships early in the 19th Century introduced the liner concept in which ships made scheduled sailings on specified trades. Application of this concept revolutionized oceanborne commerce throughout the world. Today it continues to be a basic principle of merchant ship operations.
- * The world famous Clipper ships were the creations of American designers.
- * The first merchant vessel to use nuclear propulsion was the American-flag N.S. Savannah.
- * American merchant ships have led in introducing mechanization and automation to increase maritime efficiency. Application of the gyrocompass, gas turbine propulsion, and high-pressure steam propulsion are a few examples.
- * Containershipping, the latest and one of the greatest developments in merchant ship operations, was originated by American companies. Since its inception only a quarter of a century ago, container-shiping has revolutionized practices in merchant shipping that had not basically changed since the days of the Phoenicians.

But American innovations have not been sufficient to keep the Nation's merchant marine afloat economically. Because living standards are higher in this country than in the rest of the world, the costs of constructing and operating its merchant fleet are much greater than those of its foreign-flag competitors.

Tariffs that have protected many other industries from low-cost competition are not applicable to the merchant marine. And in cases where Yankee innovation has given American ship operators a temporary advantage, foreign competitors have been quick to adopt it, and in some instances, have improved it.

Maritime Legislation

From the time shortly after the Constitution was adopted, the policy of the United States has always been to protect and promote its merchant marine. One of the first acts of the new Government was to create a Navy to protect American merchant vessels from piracy.

In 1817 the Congress adopted cabotage laws restricting the carriage of domestic waterborne trade to vessels of United States registry. These laws are still in effect and their protection has resulted in the operation of a sizable number of cargo ships and tankers in domestic trade routes.

But cabotage cannot be extended to trade with other countries. In foreign commerce American-flag ships must compete with foreign vessels. Since almost all foreign-flag merchant vessels have lower construction and operating costs than ships of this Nation, American vessels are at an economic disadvantage.

During the 19th Century and early part of this century the Government sought to encourage American merchant ship construction and operations by granting subsidy contracts for carrying mail. But these mail contracts were limited in scope and granted mostly to passenger ships. The result was that this country relied almost totally on foreign-flag merchant shipping for the transportation of its commerce when World War I broke out in 1914.

This almost caused a major economic disaster. With the outbreak of the war, orders poured into American industry. But there were virtually no ships to deliver goods to foreign destinations. The belligerent countries had withdrawn their ships from United States trade routes for their own war use.

Cargo piled up on the Nation's piers and wharves; rates soared to astronomical heights; and prices for any kind of merchant tonnage, even sailing ships, set all-time records.

Of course the Government took prompt action in the form of emergency legislation authorizing the purchase of foreign ships for registry under the American-flag and also the construction of a huge Government-financed emergency fleet. More important was the awakened public consciousness of the economic importance of having an American merchant marine.

The war-built and-purchased ships revived American-flag participation in foreign trade routes. But by 1932, despite liberal mail contracts, the United States merchant marine again was rapidly shrinking as almost no new tonnage was being built for foreign trade routes.

After a period of careful investigation, the Government's remedy was passage of The Merchant Marine Act of 1936.

Subsidies

The 1936 Act frankly recognizes the need of subsidies to maintain a viable United States merchant marine in foreign trade routes. Prompt effectuation of this new maritime policy revived the Nation's declining shipbuilding and ship-operating industries, enabling them to be ready for the Second World War which broke out 5 years after the legislation's adoption.

The 1936 Act, as amended, provides:

- * Direct subsidies to American ship operators to enable them to operate their vessels at the same basic costs of their foreign competitors;
- * Direct subsidies to American shipbuilders to enable them to sell the merchant ships they build, at prices competitive with foreign shipyards;

- * Tax incentives to American ship operators to enable them to accumulate funds to purchase new ships and for conversion of certain vessels.
- * Construction loan guarantees to enable American ship operators to borrow money at low interest rates for ship construction or conversion.

In return for the subsidies, American ship operators must operate their ships under the American flag with American crews. They must also operate under American maritime safety standards which are the highest in the world.

To meet demands of changing times the 1936 Act has been corrected by subsequent amendments. When originally adopted, the legislation required that subsidized ships be common carriers operating on approved trade routes. This was because the major part of the Nation's waterborne foreign commerce at that time consisted of passenger and general cargo trade.

The years have changed conditions. Waterborne passenger business, except for ocean cruises, has been captured by air transportation. While general cargo foreign trade is still a major part of this Nation's commerce, a substantial trade in bulk cargoes, such as ores, petroleum, and grain, has developed since World War II. In fact, volume of bulk foreign trade is many times greater than general cargo commerce.

In recent years American industries and private consumers have had to depend more and more on foreign-flag bulk carriers for imports of ores and petroleum. American-flag operators cannot meet low-cost competition in this type of trade.

When a 1969 Government study showed that dependence on foreign carriers for these vital imports was reaching dangerous proportions, legislation was adopted to extend subsidies for construction and operation of bulk cargo vessels. This legislation is known as the Merchant Marine Act of 1970.

Application of the extended subsidies is still in the development stages and had not substantially increased the size of the American-flag bulk cargo fleet when this report was written. In 1970, the base year for this study, the United States merchant marine consisted of 557 dry cargo ships; 13 combination passenger-cargo vessels; and 249 tankers and ore carriers. The bulk carriers operate principally in the protected domestic services - coastal, intercoastal, Great Lakes and contiguous services to Alaska, Hawaii and Puerto Rico.

This report will now analyze in detail the impact of that merchant fleet and of the shipbuilding industry on the United States economy.

THE MODEL AND ITS MULTIPLIERS

The Input-Output Model method of measuring economic activity was developed by the Nobel Prize winning economist, Professor Wassily W. Leontief. The model describes the sales and purchases relationships of all industries in the Nation's economy as well as those between industries and final consumers. This is the unique function of the I-O Model. No other national accounting system shows the interaction between sellers and buyers before reaching the final consumer.

General Methodology

Construction of a new I-O Model for this economic study required three basic phases. In the first phase a sales and purchases table for representative industries, including the United States merchant marine, was prepared.

This table (See Appendix, Table 1) shows the purchases and sales of goods in dollars from producing industries to consuming industries up to the final consumers. The dollar figure in each cell represents the total amount of sales during the base year by the industry named on the left to the industry named at the top.

Each vertical column therefore shows the total purchases by the industry named at the top from all sellers; each horizontal row of cells shows the total sales by the industry named on the left to all consumers. All the rows and columns represent the total transactions of the economy.

The United States merchant marine column shows purchases of goods and services (inputs) from a wide variety of industries (including the merchant marine itself) in the model year of 1970. The merchant marine's horizontal row in the table shows the merchant marine sales (outputs) of services to the economy. Thus, the table demonstrates how the merchant marine is a consumer of goods produced by other sectors of the Nation's economy as well as a producer of services which enable other industries to sell finished goods to the final consumers.

The second phase was the derivation of technical coefficients for each of the sectors in the above table. These are shown in Table 2 of the Appendix. Technical coefficients are derived by dividing the inputs of each industry by the total output for that industry.

In effect, the technical coefficients table reflects the technical composition of the economy in terms of inputs required in the production process. The technical coefficients of each industry in Table 2 show the proportion of each input which must be purchased by the industry named at the top from the industries named on the left for it to produce each dollar of output. For example: each dollar of output by the merchant marine in 1970 required 22¢ in purchases of feeder and port services, and 4¢ in purchases of ship repair.

The third phase in constructing the I-0 Model was the derivation of a table of total requirements which provides the base for obtaining multipliers. This process is known as the Leontief inversion. Table 3 of the Appendix is the Table of Direct and Indirect Requirements for this study.

Each element in this table represents the level of output that must occur in the industry -- named on the left -- to satisfy the demand generated throughout the economy by the production - or purchase - of one final unit of the output of the industry named at the top. Table 2's technical coefficients show only the initial changes in output of various industries in response to a change in demand; Table 3's elements show the chain reaction as well.

The sum of the coefficients of the direct and indirect requirement in each column of Table 3 also shows the output levels that must be sustained by each industry named at the left of the table as the output of the industry named at the top is increased by one unit. This is called the sectoral multiplier and is discussed in the next section.

Multipliers

One of the most important properties of the I-0 Model is its ability to generate multipliers. These multipliers are used to measure the direct and indirect effects (chain reactions) of a change in the gross national product (GNP) components* on the economy and also on individual industries. For example, the multipliers can be used to measure the ripple effects of a change in the final demand of the United States merchant marine not only on the entire economy but also on each industry served by the merchant marine.

Through the multiplier, the I-0 Model provides a powerful tool for projecting the potential impact of proposed changes of policy affecting any industry on income, employment, tax revenues, and output.

A sectoral multiplier is a ratio reflecting the requirements on the whole economy placed by a new requirement in a particular industry. It represents the sum of outputs that would have to be produced throughout the economy in response to a change of final demand in one industry.

For example, the sectoral multiplier would indicate the ripple effect throughout the entire economy if there were an increased requirement on the merchant marine for transporting the Nation's exports and imports.

Mathematically the sectoral multipliers are derived by summing up the column coefficients in the Direct and Indirect Requirements Table for each industry at the top of the table. The computer is a valuable aid in performing this computation.

Sectoral multipliers differ substantially from one industry to another, depending on the complexity of the chain relationships that are initiated in the production process of each industry. The larger the multiplier, the larger the total outputs generated in the economy by a change in an industry's final demand.

*GNP components and the sectors listed under the final demand column in Table 3 are identical. GNP and final demand are used interchangeably in this report.

The sectoral multiplier not only provides vital information as to how the economy would react to a change in final demand, it can also be used to examine the impact of such a change on individual industries. In this study sectoral multipliers were derived for measuring the United States merchant marine and shipbuilding industries in terms of outputs, income, employment, and tax revenues.

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ECONOMIC IMPACT
OF
MERCHANT SHIP OPERATIONS

The economic impact of American ship operations is manifest chiefly in the services rendered (output) measured in gross sales; purchases (inputs) from suppliers; jobs created by these activities; wages and income generated; and direct and indirect taxes paid out. Capital invested in new ships will be discussed under shipbuilding.

Output

The direct sales of American ship services to various users during the base year of 1970 totaled \$3,996.2 million. This figure represents the gross revenues to United States ship operating companies in performing services in this Nation's waterborne domestic and foreign trades. Domestic trades are defined in this report as trade by large merchant ships between United States deep-sea and Great Lakes ports.

Intermediate Sales

Users of merchant ship services can be divided into two groups: intermediate users and final users.

Intermediate users are industries which move merchandise by ship to plants, warehouses, yards, or refineries to be processed before reaching the final consumers. Iron ore is carried to steel mills; food to sorting and packaging depots; and machine parts are carried to assembly plants.

Final users are consumers, business investors, exporters, or the government, all of whom pay ship companies for moving cargoes to final markets of consumption. Exporters are classified here as final users since further processing of unfinished exports in foreign plants is outside the American economy. Intermediate sales accounted for 36 percent of the merchant marine industry's output, and final sales 64 percent.

The major intermediate users of United States merchant ship services and the amounts they expended for such services in the base year are listed in Table 1. The list clearly demonstrates that most of these customers used the services to transfer inputs of industries within the economy.

The leading intermediate user of the American merchant fleet was the petroleum industry which paid \$346.9 million during the base year for transporting imported and domestic petroleum products to its refining facilities. The primary iron and steel manufacturing industry, which spent \$141.5 million for American ship services in transporting imported and domestic supplies by water to food processing plants, was the second leading user.

Other important industries that purchased American-flag ship services in 1970 were food and kindred products, \$123.1 million; new construction, \$72.8 million;

and other transportation, \$51.5 million. Government enterprises, including the Postal Service and the Post Exchange, spent 100.6 million for waterborne services.

Expenditures by intermediate users for merchant ship services are not components of the Nation's gross national product (GNP), the yardstick frequently used by economists to measure the Nation's aggregate economic activity. This is because such expenditures for waterborne services in delivering merchandise for further processing are reflected in each industry's total sales set forth in the final demand column of the I-0 Model.

TABLE 1
Interindustry Sales of the U.S. Merchant Marine Industry - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Petroleum refining	\$346.9
Primary iron & steel manufacturing	141.5
Food & kindred products	123.1
Federal Government enterprises	100.6
New construction	72.8
Other transportation	51.5
Wholesale & retail trade	39.3
Chemicals	39.0
Other agricultural products	36.2
Stone & clay products	33.9
Merchant marine	31.6
Electric, gas, water, & sanitary	27.1
Rubber & misc. plastics	24.4
Maintenance and repair construction	17.5
Paper & allied products	12.2
Livestock & products	10.5
Lumber & wood products	10.3
Motor vehicles & equipment	8.9
Primary nonferrous metals	7.9
Paperboard containers & boxes	7.8

Final Demand

The final demand components (GNP) of the United States ship operating industry are listed in Table 2. Only the expenditures for direct waterborne services are listed.

Payments by exporters for shipping finished and unfinished goods to consumers abroad are by far the largest component in this group. During 1970 total payments for the carriage of exports and third-country trade* aboard American-flag ships amounted to \$1,110.1 million, about 28 percent of all the revenues of the United States merchant fleet. The remainder came from the carriage of imports and domestic cargoes to final consumers.

Private consumers were the second leading group in terms of final demand for merchant marine services. They spent \$772.2 million in 1970 primarily for direct import shipments of consumer items such as foreign cars and television sets.

The Federal Government's expenditures of \$612.1 million for transportation of defense and other materials made it the third largest final user of merchant ship service in 1970.

Other final users of American-flag ships were small in comparison. The investment sector of the economy spent \$26.1 million during the base year for waterborne movement of capital goods; State and local governments spent \$13.5 million; inventory change was \$15.8 million.

TABLE 2
Expenditures for Merchant Marine Services
by Final Demand Sectors - 1970
(In \$ Millions)

<u>Final Buyers</u>	<u>Amount</u>
Consumption	\$ 772.2
Investment	26.1
Inventory	15.8
Exports	1,110.1
Federal Government	612.1
State & local government	<u>13.5</u>
Total Final Demand	\$2,549.8

* Third-country trade refers to transportation by U.S. ships of cargo between two foreign countries. It is classified here under exports.

Purchases

To keep their ships in service United States ship operators must purchase services and materials (inputs) from other industries. In turn, each merchant marine supplier creates additional economic activity in making purchases so that it, too, can produce. This ripple effect is felt throughout the economy.

Since most purchases of supplies and services for American-flag ship operations are made within the United States, they have a profound effect on the national economy. The United States ship operating industry in 1970 made direct purchases of goods and services in this country totaling \$2,332.0 million.

The leading suppliers of inputs to the merchant ship operating industry are listed in Table 3 with the amounts of their direct sales to American ship companies. The list does not include the input of labor which is analyzed elsewhere in the study.

Table 3 does not include the \$1,846.0 million spent abroad by United States ship operators and importers for foreign services although this amount is considered as an input entry in the I-0 matrix.

The American-flag merchant fleet's largest group of expenditures in this country, \$1,121.0 million in 1970, was for other transportation and port services. These included payments for railroad and trucking services; tugboat assistance in docking and undocking ships; rental of piers; stevedoring; feeder vessel transport; and warehousing.

The shipbuilding and repair industry received \$160.0 million from American ship operators for ship repairs and related services. As already noted, large expenditures for purchasing new ships are classified in this study as capital investment and dealt with under shipbuilding.

Total Supplier Impact

The economic impact of merchant ship purchases on the suppliers is not limited to the direct purchases. Each supplier contributes to additional output by other sectors of the economy through purchases of supplies. This mutual interdependence, which is captured through use of the multipliers, produces a truer expression of the dependence of suppliers on merchant ship business.

Using a multiplier of 1.8, developed for the merchant marine in this I-0 Model, \$4,305.3 million* of additional domestic output was necessary throughout the economy to sustain the 1970 sales of merchant ship services. The total economic impact of the United States merchant marine in terms of sales was therefore the sum of its direct and indirect sales, \$8,301.5 million. The contribution of the industry to GNP was \$3,405.6 million, using the value-added criterion.

* Adjusted for transferred imports.

TABLE 3
 Direct Input Requirements of the U.S. Merchant Marine Industry
 by 20 Leading Supplying Industries - 1970
 (In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Inland waterways & ports	\$865.7
Other transportation	255.3
Shipbuilding & repair	160.0
Petroleum refining	120.5
Business services	112.4
Finance and insurance	110.6
Other fabricated metal products	84.2
Real estate and rentals	77.4
Wholesale & retail trade	72.4
Maintenance & repair construction	50.6
Primary iron & steel manufacturing	38.9
Primary nonferrous metal manufacturing	38.5
Merchant marine	36.7
Communications	31.6
General industrial machinery	29.9
Federal Government enterprises	22.7
Paints	21.9
Scientific & control instruments	20.5
Misc. fabricated textile prod.	19.7
Misc. textile goods	19.1
Business travel	17.3

The direct and indirect dependence of the 20 leading suppliers on the United States ship operators industry is presented in Table 4. Sectoral multipliers developed in the I-0 Model were used to obtain the total economic impact of the purchases from each industry.

Thus, the total impact for the inland waterways and port services becomes \$936.0 million; business services of all kinds, \$227.3 million; finance and insurance (primarily ship insurance), \$206.7 million.

TABLE 4

The Direct and Indirect Requirements of the U.S.
 Merchant Marine Industry by 20 Leading Supplying Industries - 1970
 (In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Inland waterways & ports	\$936.0
Other transportation	383.4
Business services	227.3
Finance & insurance	206.7
Shipbuilding & repair	187.2
Petroleum refining	186.3
Real estate & rental	181.3
Wholesale & retail trade	176.3
Primary iron & steel manufacturing	141.8
Maintenance & repair construction	126.1
Other fabricated metal products	123.7
Primary nonferrous metal	122.5
State & local government enterprises	111.6
Crude petroleum	90.4
Electric, gas & water	80.6
Communications	62.0
Printing & publishing	57.6
General industrial machinery	56.4
Business travel	45.5
Chemicals	43.3

Some suppliers are more dependent than others on merchant ship purchases. The I-O Model can be used to determine the degree of dependence. For example, purchases made directly and indirectly by United States ship operators accounted for 28 percent of the total services sold by the inland waterway and port industry in 1970, and as much as 7 percent of the output of the shipbuilding and repair industry. Most other leading suppliers of the ship operators sold about 1 percent of their output in this market.

Personal Income

The total sales and purchases of any industry are actually dollar infusions into various sectors of the economy. A significant part of these infused funds are utilized for employee compensation by the affected industries.

The total economic impact of the United States merchant marine, measured in terms of personal income, should therefore include incomes earned in the related industries as well as those earned by the ship operators' own labor forces.

In 1970 the labor force - aboard ships and ashore - of American-flag ship companies was paid a total of \$1,057.0 million in wages and overtime. An additional \$1,344.2 million in wages were generated in related industries throughout the rest of the economy. This amount is based on an income multiplier of 2.3 derived from the 1970 I-0 Model.

The total direct and indirect domestic personal income attributable to the merchant marine was therefore \$2,401.2 million.

The leading industries in this country that benefit from activities of its merchant ships in terms of personal income paid to employees are shown in Table 5. Again it is evident that the domestic transportation facilities that interact with the merchant ship industry are the major beneficiaries. Income totaling \$393.4 million was generated for workers of the inland waterways and port services; \$151.4 million paid to labor of other modes of transportation dependent on activities of the American-flag merchant fleet.

TABLE 5
Direct and Indirect Personal Income Generated
by the U.S. Merchant Marine in Leading Supplying Industries - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Inland waterways & port services	\$393.3
Other transportation	151.4
Finance and insurance	85.8
Wholesale & retail	75.7
Shipbuilding and repair	72.7
Maintenance & repair construction	66.5
Business services	66.1
Primary iron & steel manufacturing	40.5
Other fabricated metals	35.5
Federal Government enterprises	33.2

Corporate Income

The ships and other property of the United States merchant marine produced \$180.5 million in interest, profits, and rentals during 1970. This was direct corporate income.

Using the corporate income multiplier of 4.5 derived from the I-0 Model, the indirect income generated in other industries by the merchant fleet amounted to \$625.1 million for that year.

Consequently, the United States merchant marine was directly and indirectly responsible for a total of \$805.6 million of corporate income in the Nation's economy during the base year.

The corporate income generated indirectly by the merchant marine in 10 leading industries is shown in Table 6.

TABLE 6

Direct and Indirect Corporate Income Generated
by the U.S. Merchant Marine in Leading Supplying Industries - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Real estate & rental	\$99.9
Inland waterway & ports	67.2
Other transportation	65.0
Business services	52.0
Crude petroleum	39.8
State & local government enterprises	35.1
Wholesale & retail	27.7
Communication	22.2
Primary nonferrous metal	12.1
Shipbuilding & repair	10.1

Employment

The number of jobs attributable to any industry is a very important aspect of its place in the national economy. During the base year of this study 93,000 persons were directly employed by the United States merchant marine - 50,000 aboard the ships, the rest as administrative and clerical workers of the ship operating companies.

In addition, the merchant marine industry generated jobs in other industries which provided goods and services to the ship companies. In turn, further employment was generated in the industries that supported the suppliers.

The resultant total impact on the national economy was therefore much greater than the employment generated within the merchant marine itself. In fact, the total direct and indirect employment throughout the economy attributable to American ship activities was 244,900 jobs. This was based on a multiplier of 2.62 developed by the I-0 Model.

The 10 industries that benefited most in jobs generated by the United States merchant marine are shown in Table 7. Inland waterways and port services were the leading beneficiaries, with 34,600 jobs created on tugboats, other harbor craft, piers, and in the offices of these service companies. This represented 28 percent of all inland waterway and port employment.

At least 19,100 jobs were created in railroad, trucking, and air transport through merchant marine activities. Another 13,800 jobs in wholesale and retail trades and 9,800 jobs in finance and insurance were generated by the merchant marine.

TABLE 7
Direct and Indirect Employment Impact
of the U.S. Merchant Marine in Leading Supplying Industries - 1970

<u>Supplying Industry</u>	<u>Employment</u>
Inland waterways & ports	34,600
Other transportation	19,100
Wholesale & retail	13,800
Finance & insurance	9,800
Shipbuilding & repair	8,800
Business services	8,800
Maintenance & repair construction	4,600
Federal Government enterprises	4,000
Primary iron & steel manufacturing	3,700
State & local government enterprises	3,700
 <u>Tax Revenues</u>	

Taxes that accrued in 1970 to the Federal Treasury from activities of the United States Merchant Marine totaled \$489.1 million.

Personal income taxes from these sources came to \$300.9 million; corporate taxes totaled \$40.8 million.

In addition, direct and indirect State and local taxes accruing from merchant marine activities came to \$259.8 million.

Final Demand Absorption

The I-0 Model showed how the final demand value of every product or service consumed by private or public sectors of the economy in the course of a year contained some element of merchant marine services to make it available to the final user.

The total requirements table (Table 3 of the Appendix) can be used to measure and analyze the direct and indirect absorption of the output of the United States merchant marine industry by other final demand sectors (GNP components) of the economy. This analysis reveals dependence on the merchant marine industry in areas where such dependence is not readily apparent.

Reciprocally, measurement of the absorption of any industry's output by final demand sectors reveals the degree of dependence of the merchant marine of final users. It also can be used to determine the impacts of development in major market segments -- such as exports, consumption, investment, inventory and Government expenditures -- upon the output of the merchant marine industry.

For example, simulations and projections of alternative Government policies or of outside economic forces can be computed to evaluate their impact on the merchant marine fleet.

According to the 1970 I-0 tables, the largest use of the United States merchant marine industry's output was attributed to private consumers. The foreign sector (exports) ranked second and Federal Government was third. Private consumer expenditures (PCE) through purchases of all kinds of consumer products, domestic products and foreign imports, accounted for 44.8 percent of the merchant marine industry's output; exports of products to foreign consumers accounted for 23.4 percent of the industry's output.

Based on this information, the impact of changes in PCE on exports, or Government expenditures on merchant marine output, can be simulated and computed. To illustrate: If PCE were to grow by 10 percent output of the merchant marine would increase 4.5 percent. Similarly, if exports were to increase 10 percent, demand for merchant marine services would go up 2 percent.

Since the aggregate economic variables such as GNP, consumption, investments, and exports are widely projected by Government and private economists, the I-0 Model can therefore be used to project future needs for merchant marine services or to determine how large the United States merchant marine should be in order to serve markets effectively and prevent loss of business to foreign-flag merchant marine services.

ECONOMIC IMPACT OF SHIPBUILDING

The United States shipbuilding industry traditionally has been closely linked with the merchant marine in legislation and Government administration. Under the subsidy provisions of the 1936 Merchant Marine Act and its subsequent amendments, the Maritime Administration is mandated to promote and maintain a viable privately owned ship construction industry. For that reason, the economic impact of shipbuilding in this country will be analyzed separately.

Analysis of the shipbuilding industry's impact on the economy follows the same procedures as those used in examining the impact of the ship operating industry.

Output

The total output of the United States shipbuilding industry in 1970 was \$2,810.2 million. It included the gross revenues received by shipyard operators from sales of new ships, repairs to ships, and construction or fabrication of specialized equipment such as offshore oil-drilling platforms and other large assemblies which are by-products of the shipbuilding industry.

Sales of small pleasure craft were not included since they are considered the output of a separate "boatbuilding" industry.

The shipbuilding industry's output is concentrated among a relatively few intermediate and final buyers compared with the sales of merchant marine services. This reflects the nature of the industry's principal activity - the construction and repair of ships.

Intermediate Sales

The United States merchant marine is the largest intermediate customer of the shipbuilding industry. In 1970 American ship operators paid out \$160.0 million for shipyard services, mostly repairs and maintenance. Operators of commercial inland waterway and harbor craft - towboats, barges, and lighters - were the second largest customers, with expenditures of \$90.4 million for shipyard services and products.

Shipyard services such as fabrication and assembly -- performed in the manufacture of engines, turbines and transportation equipment other than vehicles, aircraft, or watercraft -- ranked next. Boatbuilders and even shipbuilders themselves made purchases of repair services for their own use. Table 8 lists direct payments to United States shipbuilders by the 10 leading groups of intermediate users.

TABLE 8

Expenditures on U.S. Shipbuilding by Leading Industries - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Merchant marine	\$160.0
Inland waterways & ports	90.4
Heating, plumbing & fabricated metals	51.1
Other transport equipment	34.0
Engines & turbines	18.2
Boatbuilding	17.5
Shipbuilding	14.9
Construction, mining, oil field machinery	12.2
General indust. machinery	12.1
Other fabricated metal products	6.2

Final Demand

Purchases for ships are considered as capital investment in this study. Sales of ships by the shipbuilding industry are primarily to final demand sectors (GNP) of the economy. The shipbuilding industry's final direct sales in 1970 amounted to \$2,358.8 million.

Table 9 lists expenditures in 1970 by consumers (final demand sectors) of the shipbuilding industry's products. The Federal Government tops the list, having purchased \$1,503.7 million in ships and related repair services. The bulk of Government purchases - \$1,408.7 million - was made by the Department of Defense for Naval and other vessels.

The second largest group, listed as private investment, consists mainly of purchases of merchant ships by private water carriers. Expenditures in this category were \$660.2 million in 1970. This shows that as the principal private buyers of ships, the Nation's merchant fleet operators account for much of the livelihood of the shipbuilding industry.

Inventory change in the base year, which totaled \$160.3 million, was comprised of uncompleted or unsold vessels.

Exports of ships built in United States shipyards are relatively small. They amounted to only \$34.6 million in 1970. Competition with Japanese and European shipyards, which have much lower labor and material costs than American yards, accounts for the weakness in this sector.

TABLE 9
Expenditures on Shipbuilding by Final Demand Sectors - 1970
(In \$ Millions)

<u>Final Buyers</u>	<u>Amount</u>
Federal Government	\$1,503.7
Private investment	660.2
Inventory change	160.3
Exports	<u>34.6</u>
Total Final Demand	\$2,358.8

Purchases

The United States shipbuilding industry must make purchases from many other industries to produce its output. Only a few of the components of ocean or Great Lakes vessels are actually manufactured in the shipyards themselves.

Virtually all such purchases are made in the United States and therefore have an impact on the National economy. During the base year of 1970, shipyard purchases from other industries amounted to \$1,543.0 million.

Purchases for merchant ship construction range from the huge turbine machinery for the engine room to the sophisticated electronic equipment for the bridge. Purchases include cooking equipment, piping, furniture, linens, paints, fittings, and rope as well as steel assemblies and other prefabrications.

The 20 leading suppliers of the United States shipbuilding industry, according to purchases made in 1970, are listed in Table 10. Producers of fabricated metals such as plumbing and heating equipment lead the list with \$213.0 million worth of their products sold to shipyards. Iron and steel manufacturers were next with \$195.2 million. A total of \$156.3 million was spent for engines and turbines.

Payments to wholesalers and retailers were high with \$121.0 million spent for their services. Purchases of business services came to \$44.3 million; lumber and wood products, \$36.4 million.

Total Supplier Impact

By applying the domestic multiplier of 2.16 as derived for shipbuilding in the I-0 Model, the total sales generated by that industry throughout the economy came to \$6,032.6 million. This measure of impact is just under the

\$8,301.5 million achieved by United States merchant marine operations. The GNP contribution of the shipbuilding industry was \$2,671.5 million, in terms of value-added.

TABLE 10
Direct Input Requirements of the U.S. Shipbuilding Industry
by 20 Leading Supplying Industries - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Heating, plumbing and fabricated metals	\$213.0
Primary iron & steel manufacturing	195.2
Engines & turbines	156.6
General indust. machinery	134.4
Wholesale & retail	121.0
Primary nonferrous metal manufacturing	117.1
Other fabricated metal products	80.0
Business services	44.3
Metalworking machinery & equipment	41.2
Other transportation	41.1
Lumber & wood products	36.4
Electrical transmission equipment	28.3
Business travel	27.8
Motor vehicles & equipment	25.0
Machine shop products	23.9
Stone & clay products	23.1
Electric, gas, water and sanitary services	21.1
Finance and insurance	20.7
Construction, mining & oil field machinery	18.7
Communications	18.4

The greatest dollar impact of shipyard purchases occurs in the primary iron and steel industry. In 1970, the direct and indirect impact of purchases by the shipbuilding industry from primary iron and steel manufacturers totaled \$422.7 million.

Ranking second in impact were the direct and indirect purchases from manufacturers of nonferrous metals, with a total of \$280.0 million. Manufacturers of plumbing and heating and other fabricated metal products ranked third with \$228.0 million.

Table 11 shows the impact on the economy of United States shipyard purchases from the 20 leading suppliers.

TABLE 11
The Direct and Indirect Requirements of the U.S. Shipbuilding Industry
by 20 Leading Supplying Industries - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Primary iron & steel manufacturing	\$422.7
Primary nonferrous metal manufacturing	280.0
Heating, plumbing and fabricated metals	228.5
Wholesale and retail	218.2
Engines & turbines	180.9
General industrial machinery	168.5
Other transportation	128.1
Business services	124.2
Other fabricated metal products	117.9
Real estate and rental	80.5
Electric, gas, water & sanitary services	75.1
Metalworking machinery & equipment	64.8
Lumber & wood products	61.3
Finance and insurance	57.1
Electrical transmission equipment	57.0
Motor vehicles & equipment	54.1
Business travel	50.6
Maintenance & repair construction	44.9
Machine shop products	43.4
Stone & clay products	39.9

Personal Income

Wages and salaries earned by employees of the shipbuilding industry came to \$1,092.2 million during 1970. Using the multiplier of 1.82 derived from the I-0 Model, the total personal income directly and indirectly attributable to shipbuilding throughout the national economy for the base year came to \$1,980.2 million.

Income generated directly and indirectly in the 10 major groups of supplying industries in the United States is listed in Table 12. The industries benefitting most from shipbuilding were those supplying the basic construction materials such as steel plates, and pipings. As much as \$120.9 million in personal income were generated in the primary iron and steel manufacturing industries.

Workers in industries supplying machinery necessary for ship operations were also major beneficiaries. Earnings of metal fabricators totaled \$62.3 million; workers producing machinery were paid \$55.2 million while the suppliers of engines and turbines paid out \$45.4 million in wages.

Workers in service industries throughout the economy also owed income to shipyard activity. Wholesale and retail employees earned \$93.6 million during 1970 from this source; wage earners in transportation other than waterborne received \$50.6 million; and business service employees whose jobs stemmed from shipbuilding activity, were paid \$36.1 million.

TABLE 12

Direct and Indirect Personal Income Generated by the U.S. Shipbuilding Industry in Leading Supplying Industries - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Primary iron & steel manufacturing	\$120.9
Wholesale & retail	93.6
Heating, plumbing & fabricated metals	62.3
General industrial machinery	55.2
Other transportation	50.6
Engines & turbines	45.4
Primary nonferrous metals	45.4
Business services	36.1
Other fabricated metal products	33.8
Metalworking machinery & equipment	24.5

Corporate Income

Property type income - interest, rents, and profits - accruing directly to the shipbuilding industry during 1970 came to \$151.8 million.

Using the multiplier of 3.86 derived from the I-0 Model, the direct and indirect corporate income attributable to the United States shipbuilding industry in 1970 consequently totaled \$579.2 million.

Industries throughout the economy in which such incomes were generated were primarily the service industries and the major raw material suppliers. The real estate industry received \$60.3 million from shipbuilding activities; primary iron and steel manufacturers earned \$51.0 million; wholesalers and retailers, \$46.5 million; and business services, \$38.6 million. Table 13 lists the industries which benefited most in corporate income from shipbuilding activities.

TABLE 13

Direct and Indirect Corporate Income Generated by the U.S. Shipbuilding Industry in Leading Supplying Industries - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Real estate & rentals	\$60.3
Primary iron & steel manufacturing	51.0
Wholesale & retail	46.5
Business services	38.6
Primary nonferrous metals	37.6
Other transportation	29.5
Electric, gas, water & sanitary services	27.8
Heating, plumbing & fabricated metals	26.6
Other fabricated metal products	22.9
Engines & turbines	20.7

Employment

The shipbuilding industry in this country employed a direct labor force of 132,700 persons in 1970. Included were administrative and clerical personnel, engineers and designers, and skilled and unskilled construction workers.

Applying the employment multiplier of 1.79 developed by the I-0 Model, the direct and indirect employment created within the economy through shipbuilding activities was 235,400 jobs.

Outside the shipyards the job impact was felt mostly by wholesalers and retailers, 17,000 jobs; manufacturers of iron and steel, 11,100 jobs; makers of fabricated metals, 8,000 jobs; and land and air transportation, 6,400 jobs. Table 14 lists the other industries in which most jobs were generated by shipbuilding.

Tax Revenues

A total of \$377.2 million was paid to the Federal Government from tax sources within the shipbuilding industry and by its direct and indirect suppliers.

Personal income taxes amounted to \$248.1 million; corporate taxes came to \$106.0 million; indirect business taxes such as customs collections came to \$23.1 million.

In addition, State and local governments benefitted from shipbuilding activities by \$170.7 million.

TABLE 14

Direct and Indirect Corporate Income Generated by the U.S. Shipbuilding Industry in Leading Supplying Industries - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Employment</u>
Wholesale & retail	17,000
Primary iron & steel manufacturing	11,100
Heating, plumbing and fabricated metals	8,000
Other transportation	6,400
General industrial machinery	5,600
Primary nonferrous metals	4,800
Business services	4,800
Engines & turbines	3,600
Other fabricated metal products	3,200
Finance & insurance	2,700

Final Demand Absorption

As in the analysis of merchant ship operations, a new dimension is added to the understanding of the shipbuilding industry's impact on the economy by pinpointing its impact on the accumulated final demand sales of each of the leading sectors of the economy. This final disposition of output, which becomes apparent only through the I-0 Model's inverse matrix (Table 3 of the Appendix), is important in assessing the overall impact of the shipbuilding industry.

One illustration to clarify this important linkage is that the shipbuilding industry made no direct sales to private consumers in 1970. Yet the I-0 Model demonstrates that \$153.5 million in shipbuilding sales were required that year in order to maintain the 1970 level of private consumption in the United States.

The shipbuilding industry's two major final demand (GNP) sectors are the Federal Government and private investment. In 1970 they showed a total of \$1,559.1 million absorbed through Federal Government expenditures, and \$766.9 million through private investment.

Inventory accumulation, private consumption, and exports ranked fairly evenly in final demand absorption, registering \$168.7 million, \$153.3 million, and \$146.9 million, respectively.

The composition of some of these final sales should be noted. Federal Government expenditures were for ships and repairs. Private investment consisted of \$660.2 million in private investment directly in the output of the shipbuilding industry - namely new ships - and \$106.7 million in intermediate sales of the shipbuilding industry to many other industries. These sales became embodied almost beyond recognition in the investments of those other industries.

HOW MARITIME SUBSIDIES
AFFECT THE ECONOMY

The Merchant Marine Act of 1936 declares that a modern privately owned and operated United States merchant marine is necessary for the Nation's defense and for carrying a substantial portion of its foreign commerce. To assure the existence of an up-to-date American-flag merchant fleet, the Act and its various amendments provide for the payment of operating- and construction-differential subsidies.

The operating subsidies are designed to enable the Nation's merchant fleet to compete with foreign-flag vessels in carrying this country's foreign commerce. The construction-differential subsidies enable American shipbuilders to construct and sell merchant ships for operation under American registry in foreign trade at prices competitive with foreign shipyards.

The subsidy program thus enables United States ship operators to purchase and operate their vessels where they otherwise could not operate them. The Input-Output Model can be used to appraise for the first time the economic impact of the maritime subsidy program by quantifying the economic activity created by such subsidies both in the maritime industry itself and in various dependent industries.

The overall methodology used in appraising the subsidy program's economic impact follows closely the techniques used in the two preceding sections of this report. The multipliers developed for the Nation's complete merchant marine (subsidized and unsubsidized) are also applied for the operating subsidy analysis. The multipliers for shipbuilding industry are used for the construction subsidy analysis.

Operating-Differential Subsidies

For the base year 1970, the Federal Government paid out subsidies totaling \$234.8 million to 13 United States ship companies. During that same year the same 13 operators grossed \$909.4 million for their shipping services.

More than 80 percent of the operating-differential subsidy payments were for the differences between the higher wages paid to officers and seamen on the American-flag ships operated by those companies and the wages paid to crews of competing foreign vessels. The remainder was used to make up the differences between the higher costs of insuring, maintaining, and repairing ships in this country and the same services in competing foreign countries. The subsidies do not guarantee a profit, they merely make American ships competitive.

Output

Using the sectoral multiplier developed in the I-0 Model for the United States merchant marine, the operating-differential subsidies in 1970

contributed \$1,905.2 million to domestic output in direct and indirect sales. This figure reflects the economic impact of the total operating revenues generated by subsidized carriers. It is assumed that these revenues were sustained only through the operating-differential subsidy program. The direct and indirect contribution of these expenditures to GNP were \$895.4 million in terms of value-added.

Table 15 shows the 20 supplying industries affected most by the operating subsidy program. The dollar amounts of their output were attributable directly and indirectly to subsidies paid. By far, the greatest impact was felt in terms of revenues generated for inland waterway carriers and ports - \$214.8 million. Revenues generated in other domestic transport modes totaled \$88.0 million; business services, \$52.1 million; finance and insurance, \$47.4 million; and shipbuilding and repair, \$43.0 million.

TABLE 15
Direct and Indirect Personal Income Generated by ODS
In Leading Supplying Industries - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Inland waterways & ports	\$214.8
Other transportation	88.0
Business services	52.1
Finance & insurance	47.4
Shipbuilding & repair	43.0
Petroleum refining	42.8
Real estate & rental	41.6
Wholesale & retail	40.5
Primary iron & steel manufacturing	32.5
Maintenance & repair construction	29.0
Other fabricated metal products	28.4
Primary nonferrous metal	28.1
State & local government enterprises	25.6
Crude petroleum	20.8
Electric, gas & water	18.5
Communications	14.2
Printing & publishing	13.2
General industrial machinery	13.0
Business travel	10.4
Chemicals	9.9

The table clearly shows that the benefits of the operating subsidy program extend to many major industries in the country. Outstanding beneficiaries were the real estate, petroleum refining, wholesale and retail, and metals and equipment industries.

It is also important to note that a total of \$895.4 million was contributed to the Nation's gross national product (GNP) as a result of the merchant marine operating-differential subsidy program.

Personal Income

By enabling the subsidized ship companies to keep their ships sailing, the operating-differential subsidy program generated a direct maritime payroll of \$360.1 million during 1970. In addition, wages and salaries were earned in United States industries that served or supplied the subsidized merchant fleet. Using the multiplier derived by the I-0 Model, the combined direct and indirect personal income attributable to the operating subsidy program totaled \$671.7 million.

Table 16 lists the major supplying industries of the subsidized operators ranked by the amount of income generated within each as a result of the subsidies. Again, the domestic transportation industry, finance, business services, ship repair, and metal manufacturing industries were the prime beneficiaries.

TABLE 16
Direct and Indirect Personal Income Generated by ODS
In Leading Supplying Industries - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Inland waterways & port services	\$90.3
Other transportation	34.7
Finance & insurance	19.7
Wholesale & retail	17.4
Shipbuilding & repair	16.7
Maintenance & repair construction	15.3
Business services	15.2
Primary iron & steel manufacturing	9.3
Other fabricated metals	8.1
Federal Government enterprises	7.6

Corporate Income

Total corporate income (rental, interest, and profit) generated throughout the economy in 1970 as a result of the activities of the subsidized ship carriers amounted to \$181.2 million (before depreciation). This amount included \$37.8 million in income accruing to the ship companies; the remainder represented direct and indirect income of the suppliers of the merchant marine industry.

Table 17 shows that the leading beneficiary industries were real estate and rentals, \$22.9 million; inland waterways and ports, \$15.4 million; other transportation, \$14.9 million; and business services, \$11.9 million.

TABLE 17
Direct and Indirect Personal Income Generated by ODS
In Leading Supplying Industries - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Real estate & rental	\$22.9
Inland waterway & ports	15.4
Other transportation	14.9
Business services	11.9
Crude petroleum	9.1
State & local government enterprises	8.1
Wholesale & retail	6.4
Communications	5.1
Primary nonferrous metals	2.8
shipbuilding & repair	2.3

Employment

The I-0 Model showed that 66,800 jobs throughout the United States were directly and indirectly attributable to the operating-differential subsidy program during 1970. Of these, 31,700 persons were employed at sea or on shore by the subsidized ship companies and 35,100 jobs were generated in various industries supplying the merchant marine.

To meet the requirements of the subsidized ship operators, 8,000 persons were employed by inland water carriers or by port industries during the base year. Another 4,400 jobs in the trucking, railroad and other transportation industries were attributable to subsidized ship operations. Similarly, 3,200 jobs in wholesaling and retailing, 2,300 jobs in various

financial and banking institutions, and 2,000 jobs in ship repair and maintenance companies were derived from the subsidy program. In fact, employment impact was felt to some extent in most of the Nation's industries. See Table 18.

TABLE 18
Direct and Indirect Employment Impact of ODS
In Leading Supplying Industries - 1970

<u>Supplying Industry</u>	<u>Employment</u>
Inland waterways & ports	8,000
Other transportation	4,400
Wholesale & retail	3,200
Finance & insurance	2,300
Shipbuilding & repair	2,000
Business services	2,000
Maintenance & repair construction	1,000
Federal Government enterprises	900
State & local government enterprises	900
Primary iron & steel manufactures	900

Tax Revenues

Using tax and income multipliers developed by the I-0 Model, it is also possible to quantify the total tax collections accruing to the United States Treasury from all sources as a result of the operations of the subsidized American-flag carriers. Such collections amounted to a total of \$126.1 million in 1970, of which \$117.4 million were in personal and corporate income taxes and \$8.7 million in indirect business taxes.

Since actual expenditures by the Government for operating-differential subsidies were \$234.6 million in 1970, as much as 54 percent of this amount was recovered through Federal taxes. An additional \$61.0 million in State and local taxes generated by activities of the subsidized merchant fleet.

Construction-Differential Subsidies

The Federal Government paid \$115.2 million in subsidies to privately owned and operated shipbuilding companies in the United States during 1970. The subsidies enabled shipyards to build and sell merchant ships to American-flag ship operators at prices that were competitive with foreign costs of constructing similar ships.

The construction-differential subsidies enabled the shipyards and the American ship operating companies that purchased the new vessels to make a total investment of \$256.0 million during that base year. Had there been no subsidies this investment in new merchant ships would most likely have been lost to the economy. The high costs of constructing ships in this country had virtually eliminated United States shipyards from competing in the open market.

By enabling the Nation's shipyards to produce merchant vessels under the construction subsidy program, a significant economic impact was created in many sectors of the national economy. The following are highlights of that impact as measured through the I-0 Model.

Output

The construction-differential subsidy program made possible sales of merchant ships in 1970 totaling \$256.0 million. The ripple effect produced by the subsidy throughout the economy was much higher than those direct sales. In fact, the construction subsidy program was shown to be directly and indirectly responsible for \$552.6 million of domestic output in 1970. Of this sum, \$244.9 million were contributed to GNP by value-added.

The new sales (output) generated by the construction subsidy program for major suppliers of the Nation's shipbuilding industry are listed in Table 19.

TABLE 19
Direct and Indirect Sales Impact of CDS - 1970
(In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Primary iron & steel	\$38.7
Primary nonferrous metal manufactures	25.7
Heating, plumbing & fabricated metals	20.9
Wholesale & retail	20.0
Engines & turbines	16.6
General industrial machinery	15.4
Other transportation	11.7
Business services	11.4
Other fabricated metal products	10.8
Real estate & rental	7.4
Electric, gas, water & sanitary services	6.9
Metalworking machinery & equipment	5.9

TABLE 19 (continued)
 Direct and Indirect Sales Impact of CDS - 1970
 (In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Lumber & wood products	\$ 5.6
Finance & insurance	5.2
Electrical transmissions	5.2
Motor vehicles & equipment	5.0
Business travel	4.6
Maintenance & repair construction	4.1
Machine shop products	4.0
Stone & clay products	3.7

While the major beneficiaries are the industries that supplied primary construction materials, it can be seen that substantial sales activities in many service industries, such as banking and finance, real estate and rentals, and other transportation were generated by the construction subsidy program.

Personal Income

Merchant ship construction motivated during 1970 by the construction-differential subsidy program produced direct wages and salaries totaling \$99.5 million to employees of the Nation's shipyards.

In addition, the subsidy-induced purchases of ship construction inputs generated income in other industries throughout the economy. The personal income multiplier derived from the I-0 Model showed that total direct and indirect personal income resulting from the construction-differential subsidy program came to \$181.5 million in 1970.

Table 20 lists the 10 supplier industries in the United States that benefited most in terms of personal income from the merchant ship construction induced by the subsidy program.

Corporate Income

The Nation's shipbuilding industry received \$13.8 million directly from its construction-subsidy-related operations in 1970. An additional \$39.3 million in corporate income (property type income) was earned by other industries in response to the shipbuilding activities. Total corporate income thus amounted to \$53.1 million in that year.

TABLE 20
 Direct and Indirect Personal Income Generated by CDS
 In Leading Supplying Industries of the Shipbuilding Industry - 1970
 (In \$ Millions)

<u>Supplying Industry</u>	<u>Income</u>
Primary iron & steel manufacturing	\$11.1
Wholesale & retail	8.6
Heating, plumbing & fabricated metals	5.7
General industrial machinery	5.1
Other transportation	4.6
Engines & turbines	4.2
Primary nonferrous metals	4.2
Business services	3.3
Other fabricated metal products	3.1
Metalworking machinery & equipment	2.2

Table 21 presents the amount of corporate income attributable to construction-differential subsidy expenditures in leading supplying industries during 1970, ranked by the magnitude of the impact.

TABLE 21
 Direct and Indirect Corporate Income Generated by CDS
 In Leading Supplying Industries of the Shipbuilding Industry - 1970
 (In \$ Millions)

<u>Supplying Industry</u>	<u>Amount</u>
Real estate & rentals	\$4.1
Primary iron & steel manufacturing	3.4
Wholesale & retail	3.1
Business services	2.6
Primary nonferrous metal manufactures	2.5
Other transportation	2.0
Electric, gas, water & sanitary service	1.9
Heating, plumbing & fabricated metal	1.8
Other fabricated metal products	1.6
Engines & turbines	1.5

Employment

Merchant ships constructed in 1970 under the construction-differential subsidy program required employment of 12,100 persons by the shipbuilding companies. This did not include, of course, the jobs generated in many other industries throughout the country to produce the materials and services (inputs) purchased by the shipbuilding companies in building the vessels.

The I-0 Model shows that as many as 9,600 jobs were required in the supporting industries. Thus the direct and indirect employment contribution of the construction-differential subsidies to the United States economy in 1970 was 21,700 jobs.

The employment impact of the subsidy program is illustrated in Table 22 which pinpoints the industries in which the highest additional employment was induced.

Tax Revenues

While construction subsidy expenditures in 1970 totaled \$115.2 million, it is important to note that approximately one-third of this amount is returned to the United States Treasury in the form of taxes. Personal and business taxes related to the construction-differential program amounted to \$34.5 million that year. Of this amount, \$32.4 million were in income taxes (personal and business) and \$2.1 million were in indirect business taxes.

An additional \$15.7 million were paid in State and local taxes generated by the construction of subsidized vessels.

TABLE 22

Direct and Indirect Jobs Generated by the CDS Program
In Leading Supplying Industries of the Shipbuilding Industry - 1970

<u>Supplying Industry</u>	<u>Employment</u>
Wholesale & retail	1,600
Primary iron & steel manufacturing	1,000
Heating, plumbing & fabricated metals	700
Other transportation	600
General Industrial machinery	500
Business services	400
Primary nonferrous metals	400
Engines & turbines	300
Other fabricated metal products	300
Finance & insurance	300

CONCLUSION

This economic impact study demonstrated for the first time in quantifiable terms the extent to which the Nation's economy relies on the United States merchant marine and the shipbuilding industry.

The results of the study show that both industries are highly important as producers of goods and services and as generators of jobs, income, and tax revenue. Their interactions with the rest of the economy promote vital business activities throughout the Nation.

The economic impact can be clearly separated from the military significance of the two industries, a new dimension in analyzing the importance of the merchant marine and shipbuilding industries.

Using the I-O Model developed for this study, it is also possible to perform a variety of simulations analyzing the impact of various policy issues and projected alternatives. Application of this model to national maritime issues as they arise will assist in decision-making.

TECHNICAL PROCEDURES

Input-Output Technique

The conventional input-output matrix displays the transactions taking place among all industries in the economy in a specified year. A row in the matrix shows the distribution of output to all other industries and to final demand sectors. A column shows the purchases of inputs made by each industry from all others, including payments to factors of production. By definition, the sum of each industry's output is equal to the sum of its inputs. Moreover, the sum of the final demand for all industries is equal to the sum for the value-added by factors of production in all industries, providing a double accounting determination of GNP from both the product and the income sides.

The dollar transaction table conveys additional information when converted into a table of technical coefficients. The table shows the direct input requirements per dollar output of each industry. The proportionality is assumed to hold for all levels of output. Technical coefficients are also assumed to be relatively constant over a period of several years, primarily because of the gradual nature at which technological change takes place. (Technological change includes such elements as changes in capital-labor requirements, development of new production techniques, the introduction of new products, etc.). Other factors may influence the proportion of input requirements. Among these are: relative price changes, substitution of one raw material for another, nonproportionality of certain inputs as reflected in the relative rigidity of overhead costs over the business cycle, and a variety of statistical factors relating to definition of industries and techniques of transferring secondary outputs.

Based on the table of technical coefficients, the inverse matrix can also be derived showing the direct and the indirect production requirements per unit of final demand. The inverse coefficient matrix provides a measure of the total chain impact (multiplier) throughout the economy.

Imports of goods and services in the transaction table are treated in two distinct ways. Imports that have no domestic counterparts are directly allocated by consuming industries. Imports that are competitive with domestic goods or services are treated as transfers and distributed along with domestic outputs of corresponding sectors. In deriving the amount of output of the domestic industries, these imports are subtracted.

In the case of the U.S. merchant marine industry (defined as the deep-sea portion of sector 65), output consists of earnings of U.S. vessels generated through the carriage of U.S. exports, imports and passengers, and transportation to and among noncontiguous territories and the Great Lakes. Foreign-flag services for carrying U.S. imports and passengers are treated as transferred imports, and integrated into the total output of the industry. To obtain total output of domestic-flag carriers, the amount of transferred imports

is subtracted from the total output figure as well as from the intermediate sectors to which transferred imports are allocated.

Analytical Methodology

The primary source of data utilized in this study is the 1970 input-output table of the United States, prepared by the Interindustry Division of the Bureau of Economic Analysis, U.S. Department of Commerce. The table is an update of the 1967 survey, using new control totals at the two-digit I-0 sector level.

The merchant marine industry and the shipbuilding industry are defined at the more disaggregative level, and therefore, special estimates were necessary in order to update the data for the two industries. The underlying assumption in the updating procedures was that the proportionality within the components of I-0 industries 61 and 65 remained constant between 1967 and 1970. (The Merchant Marine Industry included I-0 sectors 650401, 650402, and 650403. The Shipbuilding Industry consisted of I-0 sector 61.01.)

To obtain direct and indirect employment figures related to the Merchant Marine and Shipbuilding Industries, an employment row for the year 1970 was developed based on several sources of data:

- 1) Employment and Earnings
Bulletin 1312-9, U.S. Dept. of Labor, Bureau of Labor Statistics.
- 2) Occupation by Industry, U.S. Department of Commerce, Bureau of the Census, Oct. 1972.
- 3) Economic Report of the President, 1975.

In developing the employment data, SIC-based classifications were converted to I-0 classifications utilizing the published bridge. To ascertain the reasonableness of the estimates, a further test was taken comparing the average wage per employee using I-0 classifications against statistics on average earnings developed by BLS.

Analytically, several measures are utilized to convey how the merchant marine and shipbuilding industries interact with the rest of the economy beyond the employment impact. These are: analysis of the distribution of the industries' outputs and inputs; analysis of gross product originating (or value-added) by their components; analysis of final demand absorbed by the industries; and multiplier analysis of both the output and the input sides, as they relate to total sales, income, and taxes.

In estimating the total impact of the two industries, given the static nature of the input-output table and the assumption of a homogeneous production function, the measures obtained describe how the merchant marine and shipbuilding industries fit within an existing economic framework. In order to answer questions on what the economy might be like in the absence of the two industries, additional information about the response of the economic system and of

policy makers would be required, particularly in the area of import substitution. For example, if it is assumed that foreign-flag service would replace any U.S.-flag services that are eliminated, the I-O Model can help assess the areas that would be affected directly and indirectly. An economic evaluation of the domestic inputs that will continue to be required under such circumstances could also be performed.

The application of the sectoral multiplier in this report should also be amplified. Sectoral multipliers were derived in the traditional fashion by summing up the column coefficients of the inverse matrix for the relevant industries. The domestic multiplier is obtained by subtracting the import element of the inverse columns. These multipliers quantify the total (direct and indirect) requirements placed on the economy as a result of change in the level of output of any specified industry's final demand.

In an advanced economy that is roundabout in terms of the production process (i.e., in which intermediate sales are large relative to final demand), it is also of interest to measure the amount of sales transactions that are indirectly attributable to the activities of a given sector. The sectoral multiplier, when applied to the total output of an industry, provides a good estimate of such sales in the economy. When applied to gross output, the sectoral multiplier is adjusted slightly downward (by the weight of the diagonal element of the inverse matrix of the particular industry). Multipliers that are applied to the value-added elements of the relevant industries describe the total change in value-added throughout the economy relative to a unit change in the value-added of a single industry. The same concept is applied to the job multiplier.

It should be noted that some of the economic definitions in the study are used primarily to modify technical input-output terminology and they are not to be confused with more formal definitions of national income accounting. For example, personal income and corporate income in this study actually stand for the conventional input-output definitions of employee compensation and property type income, respectively.

Finally, in computing the tax impact of the merchant marine and shipbuilding industries, the average 1970 tax rate on personal incomes was utilized to obtain the amount of personal income taxes paid. A weighted average tax rate (adjusted for non-wage incomes by individuals) was utilized in determining corporate income taxes. Indirect business taxes were obtained directly from the input-output transaction table.

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