REPORT OF RESEARCH
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NEW YORK SHIPPING ASSOCIATION

—

ECONOMIC IMPACTS OF THE NEW YORK/NEW JERSEY PORT INDUSTRY 2004

SUBMITTED BY

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EXECUTIVE SUMMARY

The New York and New Jersey (NY/NJ) region's rich maritime heritage is perpetuated at its waterfront port terminals and piers. It is from there that international cargo moves to users by truck, rail, pipeline, and barge. It is also from there that American made goods are shipped overseas after long inland journeys from manufacturing plants. The port industry, however, does not just embrace the physical handling of cargo and the transport of cargo to and from port terminals: it also requires workers from a myriad of other private enterprises and governmental agencies to ensure the movement of millions of tons of goods through NY/NJ terminals.

In 2004, 100 million tons of cargo flowed through the NY/NJ terminals. This cargo movement

- provided nearly 122,550 direct full-time-equivalent jobs in the region (20% above 2000's count);
    - A lion's share (63.6%) of these direct jobs was at distribution centers.
    - Only 16.3% worked directly at terminals. This includes truck drivers and other inland transportation employees.
    - At the terminals, the most significant direct job growth occurred between 2000 and 2004 in container, cruise passenger and auto handling.
- supported a total of 232,900 full-time-equivalent jobs in the 26-county metropolitan area;
- generated $12,568 million for port-region workers (33% higher than reported for 2000) and;
- contributed state and local tax revenues totaling nearly $2.0 billion in the port region; and
- contributed $3.8 billion to federal tax coffers.

INTRODUCTION

The New York/New Jersey area has a rich maritime heritage. Since the nation's formation, the area's growth has been propelled by the strength of its seaport and the cargo and passengers that flowed through it. Today, the various terminals that form the port continue the tradition—moving cargo that supports the businesses and population of the area, as well as the rest of North America, and supporting a growing cruise business. This report summarizes the economic impacts stimulated by cargo and passengers passing through the marine facilities of the Port of New York and New Jersey. This particular report discusses the economic effects on the region of cargo flows in 2004; the prior report published in 2001, discussed them for the year 2000.

CONTINUATION OF A RICH MARITIME HERITAGE

The businesses and institutions that make up the Port of New York and New Jersey understand that it is critical to maintain "the highest quality, most efficient transportation and port commerce facilities and services that move people and goods within the region [and] provide access to the rest of the nation and to the world."[1] These organizations provide such facilities and services proactively, generally as part of their everyday operations, in order to keep a competitive edge over other ports/those on the eastern seaboard and others worldwide. They do so by investing in transportation infrastructure that will help their customers and the region exploit opportunities that arise in the climate of global economic change. By providing more efficient port commerce facilities and intraregional transportation systems, the organizations create the capacity for greater port throughput and attract businesses seeking to take advantage of the net lower transportation costs associated with the delivery of their supplies and products.

The New York/New Jersey region is one of the largest and wealthiest consumer markets in the world. Because of this, maritime movement of cargo and passengers spans and affects many sectors of the area's economy. Much of the physical handling of cargo is concentrated along the waterfront in Elizabeth, Newark and Bayonne, New Jersey, and in Staten Island and Brooklyn, New York. From there, the cargo moves by truck, rail, pipeline, and barge. The port industry extends beyond the physical handling of cargo, however. It requires activity by financial and insurance institutions, freight forwarders, customhouse brokers, wholesalers and warehouses, and governmental agencies to ensure the efficient movement of millions of tons of goods through the port's terminals.

Thus, it is clear that maritime cargo and passenger flows generate immediate economic value in terms of business activity, jobs, income, and tax revenues for New York City, the 26-county metropolitan area, and the states of New York and New Jersey. Through interindustry transactions, this economic value ripples throughout the entire region, enhancing the economic benefit of the port industry to the region.

The purpose of the study, which this report conveys, was to update the estimate of economic impacts of the port upon its hinterland. In so doing, it is hoped that policymakers, decision makers, and other citizens in the region will come to learn the importance of this industry, which otherwise is not always well understood.

[1] This quote is from the Mission Statement of the Port Authority of New York and New Jersey.

FORMAT OF THIS REPORT

The current report focuses strictly on a single topic:

The Economic Impacts of Port Operations: This section summarizes both the direct and total economic impacts of cargo flows that accrue to New York City, the 26-county port region, the States of New York, and New Jersey.

This differs from the 2001 report, which contained three topics. The section of the year 2001 report about future construction and capital spending related to port activity is not replicated in the current report. The section on terminology and concepts has been relegated to an appendix. Hence, the appendices to the report now include (A) a discussion of terminology, concepts, and economic measures used in the body of the report, (B) technical descriptions of the data used in the model and the sources of the data, and (C) the approach used in the economic impact assessment.

The current report also differs from the more detailed report for 2000 in that the data on cargo and maritime carriers' headquarters operations within the region were not identified by state or county of their location. Thus analyses were not performed by terminal as was the case in 2000. Instead, average cargo-handling technology identified in the course of fieldwork and interview for the 2000 study were adjusted to account for productivity changes and extra costs for security at terminals in the wake of the September 11, 2001 disaster, and the total economic impacts were measured by cargo-handling type and industry only for the entire 26-county New York metropolitan area used in the prior analysis.

THE ECONOMIC IMPACT OF PORT OPERATIONS

DIRECT EFFECTS OF PORT OPERATIONS

The economic impact assessment of 2004 cargo and passenger flows was undertaken as soon as initial tonnage and cruise information became available. The data used is primarily from the New York Shipping Association and the New Jersey Petroleum Council. Information for 2004 was not available from the Port Authority of New York and New Jersey at the time of this analysis.

Table 1 summarizes the cargo and passenger flows used in the analysis that follows. Note that operations of Royal Caribbean Cruise Lines terminal in Bayonne, New Jersey, are a new addition to the current assessment. The analysis assumes that these cruise operations in Bayonne differ from those at the Passenger Ship Terminal in New York City in terms of how passengers arrived and departed the terminals.

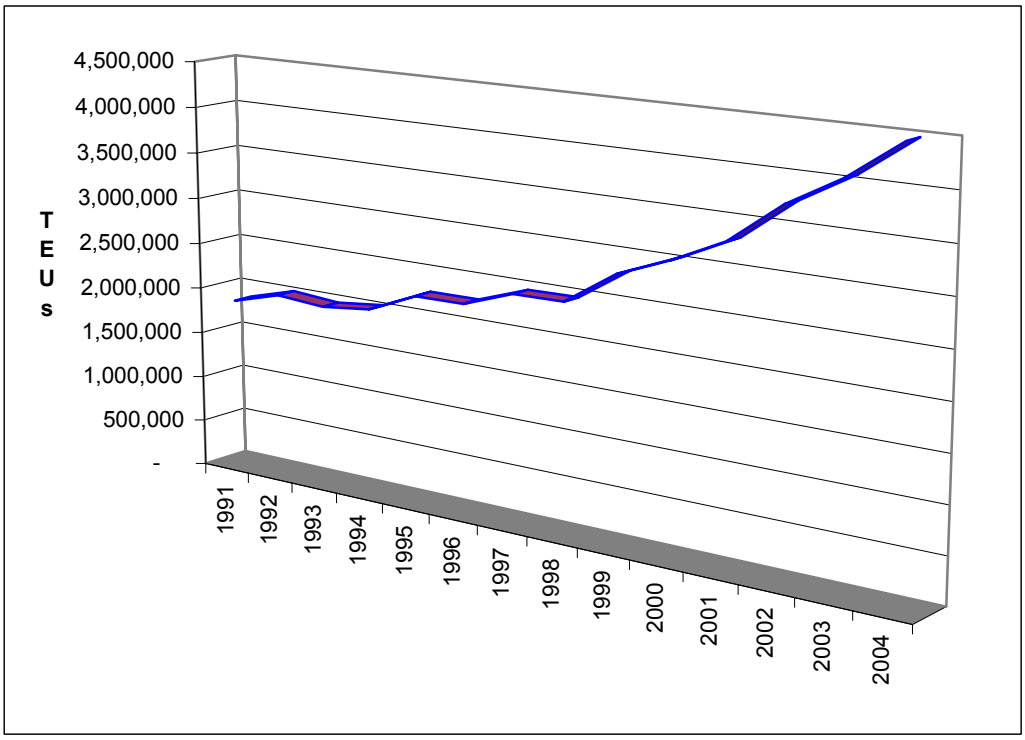
Table 1. 2004 Cargo and Passenger Flows through the Port of NY & NJ

Category	*Volume*	*Port-based Jobs*
Containerized cargo	4.3 million TEUs	16,995
Auto	682,100 vehicles	888
Dry Bulk	2,370,000 short tons	203
Liquid Bulk	57,600,000 short tons	1,697
Breakbulk	296,000 short tons	173
Cruise Lines	567,500 passengers	991
Total	--	20,947

Sources: New York Shipping Association, NJ Petroleum Council, and A. Strauss-Wieder, Inc. estimates.

Cargo traffic, particularly that which is containerized (see Figure 1), grew substantially over the last decade. Table 2 shows the changes in tonnage since 2000. Much of the growth can be attributed to the increase in international trade (in particular, the growth in imported goods) due to enhanced competitive pressure in supply chain management practices by major retailers. After the events of September 11, 2001, the 2002 West Coast port strike, and the significant increase in traffic in 2004 due to congestion at the West Coast ports and on western railroads, customers have opted to diversify the number of ports they use when importing commodities. The Port of NY & NJ with a vast, wealthy population in its immediate hinterland has benefited significantly from this trend. The most notable result has been a marked increase in the region‘s need for warehousing and distribution space. The simultaneous increase in the use of warehouses for value added activities related to port traffic is reflected in the 2004 economic impacts for the region.

Figure 1. Trends in Containerized Cargo Movements through the Port of NY/NJ



Source: Port Authority of New York and New Jersey data

Table 2. Changes in Cargo Flows at the Port of NY & NJ, 2000-2004 (in short tons)

Category	*2000*	*2004*	*% change*
Containerized cargo	26,428,506	38,796,916	46.8
Breakbulk	391,494	296,359	-24.3
Motor Vehicles	946,500	818,520	-13.4
Dry Bulk	1,784,496	2,373,380	33.0
Liquid Bulk	48,997,757	57,626,720	17.6
Total	78,550,753	99,913,899	27.2

Sources: Table 1 of the 2001 report; Table 1 above; CUPR, Rutgers University

As part of the New York Shipping Association (NYSA) Port Industry Assessment released in 2001, A. Strauss-Wieder Inc. (henceforth, ASWinc) surveyed area maritime terminals and related facilities to estimate the expenditure patterns of individual terminals and maritime flows through the Port of New York and New Jersey. Some details of this aspect of the research effort are available in the prior report.

The terminal and vessel-related spending was subsequently customized in the MARAD Port Kit for the region of the Port of New York and New Jersey (see Appendix A) to reflect the average spending at a terminal by cargo handling type and passenger mode at the Port. These patterns were further adjusted in the course of research for the current report to reflect improved productivity, increased fuel costs, and increased security costs since the year 2001 report. Moreover, as opposed to the terminal-by-terminal accounting performed in 2000 and 2001, the economic impacts for the current report are based upon average spending patterns by cargo handling type.

The number of port-based rose 29.0 percent from 16,232 jobs in 2000 to 20,947 jobs in 2004, virtually paralleling the growth of container-based shipments during the period, which experienced a 27.2 percent rise. Terminal-based productivity improvements sought and gained at the terminals apparently were offset by security enhancements there in the wake of September 11, 2001.

It should be noted that the counts of direct on-terminal jobs for rail workers and truckers were gauged from freight rates (per ton or TEU), the inland modal splits obtained from the terminals, and the prevailing average earnings per job established by the U.S. Department of Labor (US DOL) in its database on covered and wages by industry for the 26-county port region. Thus, it should be noted that the US DOL tends to report jobs in terms of something very close to full-time equivalents. And while some adjustments were made to account for differences between the annual wages of workers and proprietors, especially in the case of trucking, the actual count of all workers at port terminals is probably somewhat higher than is reported here. In particular, a large number of truckers dedicate less than half of their working hours to the movement of port-based freight. A full-time equivalent job is a sought-after standard by which one can gauge the quality of the job when an income level is associated with it.

HEADQUARTERS OPERATIONS AND OTHER OFF-PORT MARITIME ACTIVITY

As in 2000, a special assessment was undertaken to account for other maritime-related activity not counted through terminal activity. The 2000 analysis was supplemented with discussions with industry representatives in 2004, government data sources, and an independent analysis of space on the distribution of goods. The result was an estimate of the estimated percentage of each industry devoted to the port industry. The percentages derived and applied in the remaining analysis are displayed in the center column of table 3 and are translated into jobs in the table's first column.

The port-industry components that occur away from piers and terminals—and that are therefore less visibly connected with the port—are, perhaps surprisingly, the greatest sources of jobs and other economic value to the region (see table 3). Further, as on-pier activity continues to find ways to reduce costs and become more productive, these off-site port industry jobs will not only continue to increase their share of overall port-related activity but will also grow in absolute terms since marine cargo traffic will grow.

Table 3. Offsite Port Industry Jobs by Sector, 2004

Sector	# of Jobs	% of Sector's Jobs in Region	% of Offsite Job Total
Water Transportation (headquarters & other unallocated)	6,500	95%	6.4%
Wholesaling/Warehousing*	78,000	15%	76.8%
Banking	2,500	3%	2.5%
Insurance	3,100	2%	3.1%
Freight Forwarding/Customhouse Brokerage	9,900	55%	9.7%
State and Local Government	1,600	1%	1.6%
Offsite Total	101,600	--	100.0%

Source: A. Strauss-Wieder, Inc.; CUPR, Rutgers University.

Since 2000, the number of direct jobs in the Port Industry grew by 41,750 workers. The most significant increases within the Port Industry were experienced at warehouses, distribution centers, and wholesalers within the New York-New Jersey region. It is clear from tables 3 and 4 and figure 2 that the wholesale/ warehousing industry is the region's dominant employer within the industry. Even when direct cargo-handling employment is included (19,956 of the jobs from table 1), this sector is estimated to maintain 63.6 percent of the port industry's direct employment—a total of 78,000 jobs. This is a jump from the 55,000 more roughly allocated to the Port Industry in the 2000 analysis. During that time, the amount of industrial space in northern and central New Jersey grew from 736 million square feet to nearly 800 million square feet while maintaining a relatively low vacancy rate. More warehouses and distribution centers are receiving goods through the Port of New York and New Jersey, increasing demand for these facilities within the region. Because of this, this report provides more details on the wholesaling and warehousing function in a following section

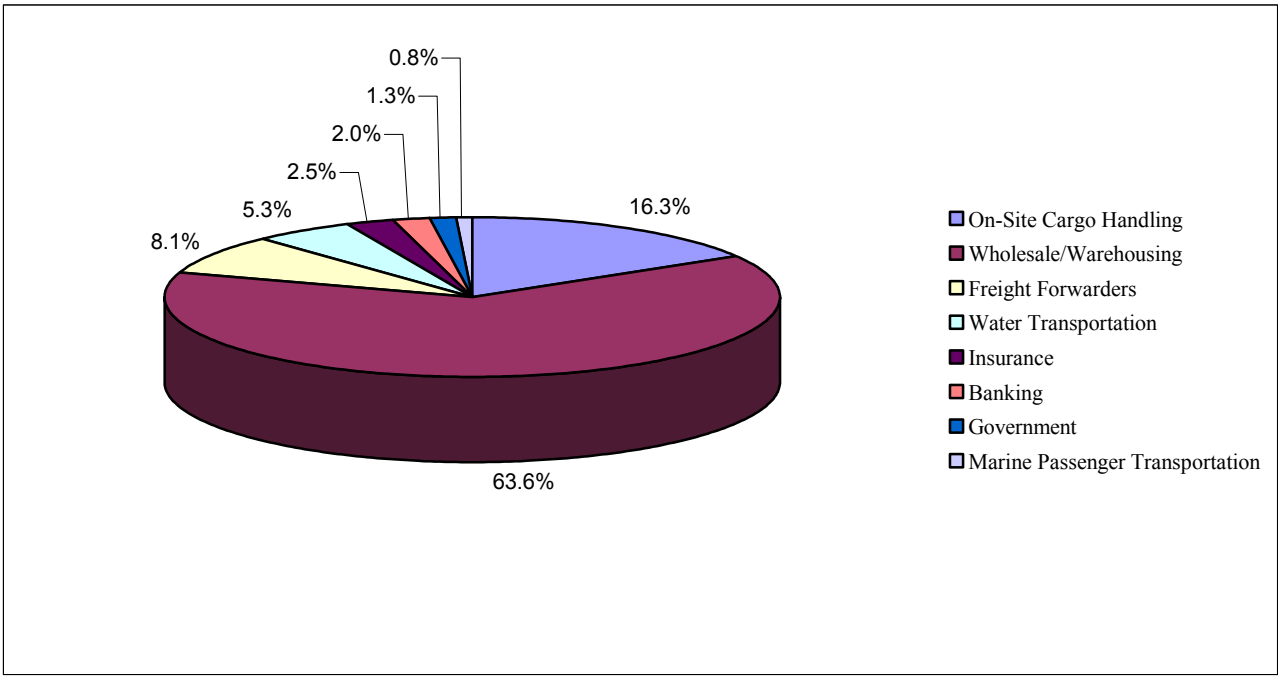
Freight forwarders and customhouse brokers are the next largest direct off-site employer with an estimated 9,900 jobs (9.7 percent of all off-site jobs). Banking and insurance follow with about 5,600 direct commercial maritime/related jobs. Although most of the water transportation industry was included in the on-site count, an additional 6,500 direct jobs were estimated to not be included in the terminal count. About 5,500 of these jobs are allocated to the headquarters of steamship lines and terminal operators. Needless to say, with total of more than 122,000 jobs directly employed by it, the Port Industry is a large and vital element of metropolitan New York City's economic landscape.

Table 4. Direct Port-Industry Jobs in the New York/New Jersey Port Region in 2004

Industry	Jobs
Marine Passenger Transportation	991
Water Transportation (Headquarters & unallocated maritime services)	6,500
Wholesale/Warehousing	78,000
Banking	2,500
Insurance	3,100
Freight Forwarders	9,900
Government	1,600
Total Off-Site Port Industry Employment	**102,591**
On-Site Cargo Handling Employment (see table 1)	19,956
Total Port Industry Employment	**122,547**

Sources: Tables 1 and 3, and CUPR calculations.

Figure 2. Share of Direct Port-based Jobs by Sector, 2004



The Wholesaling and Warehousing Function of the Port Industry

The Port Industry definition originally adopted by the Port Authority of New York and New Jersey included wholesale and warehousing firms who receive nearly all of their inputs through the Port. In keeping with the previous economic impact assessments of the Port of New York-New Jersey, the present series of three reports on the economic impacts of the port (of which this is the second) also includes this wholesaling and warehousing function is its Port Industry definition.

The study team developed initial estimates of port-related warehousing and distribution center activity in the 2000 analysis. Since that time, team members at A. Strauss-Wieder, Inc. have further investigated warehouse activity as part of the North Jersey Transportation Planning Authority Brownfield and Freight System Performance Studies; the New Jersey Department of Transportation (NJDOT) Portway Extensions Concepts Study and the NJDOT Freight Master Plan. These recent studies show a growing connectivity between the port and value added warehouses in the region.

The extent of the existing warehousing space in the New Jersey portion of the region is shown in table 4. Nearly 700 million square feet of warehousing and distribution center (DC) space exists in this portion of the port region, with several million additional square feet currently under construction.

Warehouses and distribution centers have taken on new importance within the global economy. Goods are produced at the least-cost location but final assembly, customization and shelf-readiness often is undertaken near the end users. Accordingly, as more goods are produced overseas, these final elements of the production process are occurring near the key points of entry to the US.

Table 5. Warehouse Space in Northern and Central New Jersey, Fourth Quarter of 2004

County	*Gross Bldg Sq. Ft.*
Bergen	103,088,894
Essex	82,832,142
Hudson	98,262,219
Morris	26,482,872
Passaic	48,492,767
Hunterdon	2,597,948
Mercer	15,315,673
Middlesex	173,107,540
Monmouth	20,344,788
Somerset	35,797,061
Union	80,212,737
Total Northern/Central NJ	686,534,641

Source: CB Richard Ellis

The Port of NY and NJ is one of the leading gateways in North America. Combined with the proximity of one of the nation's largest concentrations of consumer activity, the demand for warehousing and DC space for final customization and shelf-readiness will continue to grow. Indeed, port-related warehousing employment is now among the fastest growing sectors in the regional economy. And, compared to retail trade and personal services, it pays its employees rather well. In fact because of the increasing amount of value-added work being performed at these facilities, the jobs offered at these new warehouses represent the new manufacturing jobs of the region.

TOTAL EFFECTS OF PORT OPERATIONS

The regional economic impacts associated with the 2004 cargo and passenger flows are summarized in Table 6. The cargo and passengers moving through the maritime facilities in the New York-New Jersey region in 2004 supported:

- 122,550 jobs directly in the Port Industry.
- A total of 232,910 jobs in the New York-New Jersey region.
- Local, state and federal tax revenues of $5.8 billion.
- Personal income of $12.6 billion.

Port Industry jobs include those activities directly needed for the maritime movement of cargo and cruise passengers. Port Industry jobs, as previously noted, include workers at the region's maritime terminals, truck drivers and railroad workers who move cargo between the port and inland locations, vessel operations, warehouse operations, maritime freight forwarders and customshouse brokers, and maritime governmental agencies. The industry definition does not include the significant intra-harbor movements of goods and ferried passengers.

The total number of jobs in the region grew from 227,285 in 2000 to 232,910 in 2004. Changes in the regional and national economies, particularly the introduction of technological improvements, increased workforce productivity, and increased use of imported products, have generally reduced multiplier effects not only within the port region but throughout the nation. This makes the increase in direct jobs in the Port Industry even more significant since they help dampen the effect of losses in other industrial sectors like manufacturing, which are being gained by international competition. Indeed, it is relatively well-known to regional economic analysts that while productivity improvements, in general, can help an economy to grow, it need not do so in the immediate vicinity of the main site of productivity improvements. In the case of port-based productivity improvements, the economic gains are in the form of lower delivered prices of goods shipped due to lower transshipment costs. Thus the improvements are garnered by customers of the port, and in many cases they are located outside of the port region.

Table 6. Total Economic Impacts on the Port Region of Activity through the Port of New York and New Jersey in 2004*+

Handling Type/ Port-related Industry	Direct jobs	Jobs in other industries	GDP	Income	Federal Taxes	State Taxes	Local Taxes
Containerized	16,995	15,687	2,007.6	1,441.8	430.6	93.9	97.7
Breakbulk	173	150	17.4	12.6	3.9	0.7	0.5
Auto	888	989	110.8	77.7	24.5	4.5	3.5
Dry bulk	203	189	21.6	15.5	3.3	0.8	0.6
Liquid bulk	1,697	2,433	302.0	190.8	59.3	12.8	11.3
Passenger	991	861	143.6	93.5	63.8	13.5	11.6
Terminal-based total	**20,947**	**20,309**	**2,603.0**	**1,831.9**	**585.4**	**126.2**	**125.2**
Wholesale & warehousing	78,000	65,007	9,800.1	8,042.5	2,508.0	736.1	780.6
Freight forwarders	9,900	8,658	1,133.9	905.5	264.2	44.1	27.4
Government	1,600	1,568	231.6	184.3	72.9	10.0	3.7
Banking & insurance	5,600	4,431	567.8	885.3	158.0	27.5	17.6
Other water transportation	6,500	10,392	1,172.9	718.6	206.3	42.5	35.7
Total	**122,547**	**110,365**	**15,509.3**	**12,568.1**	**3,794.8**	**986.4**	**990.2**

Source: CUPR, Bloustein School of Planning and Public Policy, Rutgers University
Notes: *All but "jobs" are in terms of millions of year 2004 dollars.
+The economic impacts displayed in this table span all major industries in the economy and are not limited to the identified aspect of the port industry denoted in the left-most column.

Other highlights of the findings include:

- The number of workers at the terminals grew from 16,230 in 2000 to 20,950 in 2004 driven by the increase in cargo and passenger movements.
- Personal income grew from $9.4 billion in 2000 to $12.6 billion in 2004.
- Local, state and federal tax revenues supported by the region's Port Industry grew from $4.3 billion in 2000 to $5.8 billion in 2004.
- In comparison, the New York-New Jersey Port Industry in 1993, as measured for a slightly smaller region, supported 166,500 jobs and generated $6.2 billion in personal income.
- At the terminals, the most significant direct job growth occurred between 2000 and 2004 in container, cruise passenger and auto handling.

APPENDIX A: TERMINOLOGY AND CONCEPTS

APPENDIX A: TERMINOLOGY AND CONCEPTS

This section defines the port industry and provides a glossary of terms related to economic impact assessments. These terms are used through the remainder of the report.

THE PORT INDUSTRY

The port industry is defined as *any regional economic activity that is directly needed for the movement of waterborne cargo and passengers*. This definition includes activities that take place on the vessel, at the terminal, and during the inland expenditures related to cargo and passenger movement. As shown in figure 1, port-industry activities pertaining to cargo movement include documentation, financing, brokering and other essential services (e.g., warehousing and wholesaling) that are directly required to move international cargo.

Fig.1. Port-Industry Activities in Cargo Movement

VESSEL EXPENDITURES	TERMINAL EXPENDITURES	TRANSACTION EXPENDITURES	INLAND MOVEMENT EXPENDITURES
Pilotage, tugs, provisions, bunkers, etc.	Cranes, stevedoring, yard handling, etc.	Banking, freight forwarding, insurance, Custom-house	Varies by Mode and Distance

Source: A. Strauss-Wieder, Inc.

The port-industry activities involved in maritime passenger movement are shown in figure 2. These activities include vessel expenditures, cruise terminals, visitor spending associated with pre and post cruise stays at the local port and the inland-movement expenditures of passengers by a variety of modes (including transit, automobile, rail, or pedestrian).

Fig. 2. Port-Industry Activities Associated with Passenger Movement

VESSEL EXPENDITURES	TERMINAL EXPENDITURES	PRE- AND POST-CRUISE EXPENDITURES	INLAND MOVEMENT EXPENDITURES
Pilotage, tugs, provisions, bunkers, etc.	Stevedoring, passenger services, etc.	Hotels, restaurants and other visitor expenditures at the port-of-call location	Varies by Mode and Distance

Source: A. Strauss-Wieder, Inc.

TERMINOLOGY

The MARAD Port Kit was developed by the study team for the U.S. Maritime Administration and was applied in this study. The Port Kit is used to analyze the economic impacts of maritime activities. Following are definitions of the activities needed for the movement and handling of waterborne cargo and passengers and the terminology used to define the composition of spending by handling type.

Maritime Cargo and Passenger Movements

The MARAD Port Kit has the capability of assessing the economic impacts associated with the following activities:

Containerized cargo handling refers to the handling of cargo loaded in maritime containers. Each container, which can handle a wide range of commodities, is handled as a single unit. The most commonly used containers are either 20 feet or 40 feet in length. A common measure used in the maritime industry refers to a "twenty-foot equivalent unit" or TEU. A TEU equals one 20-foot container. A 40-foot container equals two TEUs.

Breakbulk cargo handling is the traditional means of handling general cargo. It describes the handling of a broad variety of commodities in individual pieces or as palletized cargo. Breakbulk handling techniques are used to move such commodities as forest products, paper, bananas, fresh fruit, steel, and cocoa beans.

Liquid bulk cargo handling refers to the handling, in a continuous operation, of liquid commodities, such as petroleum and petrochemicals. For example, petrochemicals are loaded and off-loaded from vessels using hoses and pipelines. The cargo is not divided into individual units.

Dry bulk cargo handling refers to the handling, in a continuous operation, of dry, uniform commodities, such as rice, grain, and coal. The cargo is not divided into individual units.

Auto and vehicle transport describes the waterborne movement of motorized, wheeled units. Typically, vehicles and autos are "rolled on and rolled off" (RO/RO) vessels with multiple decks by terminal workers.

Project cargo handling refers to cargo movements that involve shipments of a unique size and/or those that require unique handling. Examples of project cargo movements include aircraft fuselages, modular housing, manufacturing-plant elements, transmission towers, and yachts. Project cargo handling may require unique inland movements; for example, trucks or railcars able to handle oversized loads. These cargo movements may also require staging areas at the port, as well as freight forwarder and customhouse broker services tailored to the specific move.

Cruise passenger movement refers to trips by vessels that carry passengers on recreational cruises of various durations.

Cargo-Handling Terminology

A variety of activities are directly related to the movement of waterborne cargo. These are listed below. Most of the activities are self-explanatory. In the conduct of the present study specific costs were allocated to each for handling type. Less commonly known terms are defined.

Waterside Services

- Tugs
- Pilots: Navigation experts who board the vessel to facilitate travel and calling within the harbor and channels.
- Line hauling: The port fee that covers the labor costs associated with tying up or releasing the mooring lines from a vessel.
- Launch: The fee associated with the use of launches to transport pilots, other personnel, or supplies to or from a vessel.
- Radio/radar: The fees associated with radio and radar use and equipment.
- Surveyors: The fees associated with insurance reviews of the vessel.
- Dockage: The fees assessed a vessel to offset the use of the docking facility.
- Lighterage: The expenditures associated with off-loading or loading cargo from a smaller vessel to larger vessel.

Government Requirements

- Customs
- Entrance/clearance
- Immigration
- Quarantine
- Fumigation

Loading/Discharging

- Stevedoring
- Clerking and checking
- Watching/security
- Cleaning/fitting
- Equipment rental

Suppliers

- Chandler/provisions
- Laundry
- Medical
- Waste handling

Bunkers

- Oil
- Water

In-Transit Storage

- Wharfage: The fee charged against cargo that is discharged (or crosses the wharf) from the vessel while at dock. Wharfage fees may be flat rates applied on a per-ton basis or a commodity-specific rate, such as $45 per auto driven off a roll-on, roll-off (RO/RO) vessel.

- Yard handling
- Demurrage: The fee associated with storing cargo at the terminal beyond the time specified in the transportation arrangements.
- Warehousing
- Auto and truck storage
- Grain storage
- Refrigerated storage

Cargo Packing

- Export packing
- Container stuffing/stripping
- Cargo manipulation: Activities that include strapping, blocking, and arranging the cargo to minimize shifting and damage during transit.

Inland Movement

- Long-distance trucking: The fee charged by trucking firms for the inland movement of the cargo beyond the port region. Usually, long-distance trucking rates are developed and drivers compensated on a mileage basis. Note that the analysis includes only the cost elements associated with long-distance truck movements that occur *within* the region for which impacts are measured.
- Short-distance trucking: The fee charged by trucking firms for the inland movement of cargo to a destination or from an origin within the port region (such as a warehouse or manufacturing facility). Usually, shorter-distance trucking rates are quoted, and drivers are compensated on a flat-rate basis.
- Barge: Barges are a means used for conveying cargo between vessels and ports/terminals other than the one where the vessel is docked.
- Rail: Inland rail movements include the truck drayage fee associated with moving the cargo from the marine terminal to the rail yard, and the costs incurred by the railroad(s) for moving the shipment. Rail costs include spending associated with rail-terminal operations, switching, and line-haul movements. Note that the analysis includes only the cost elements associated with inland rail movements that occur *within* the region for which impacts are measured.
- Pipeline: Pipeline movements are generally associated with the movement of liquid bulk commodities.

Passenger Terminology

The activities associated with cruise passenger movement are similar to those associated with cargo movement. These activities include the following:

- Waterside service expenditures: tugs, pilots, line hauling, launch, radio/radar, surveyors, dockage, wharfage, and tenders
- Governmental fees: customs, entrance/clearance fees, immigration, quarantine, and taxes (including Head taxes and federal cruise taxes)
- Loading/discharging: stevedoring, clerking and checking, watching and security, cleaning/fitting, and equipment rental

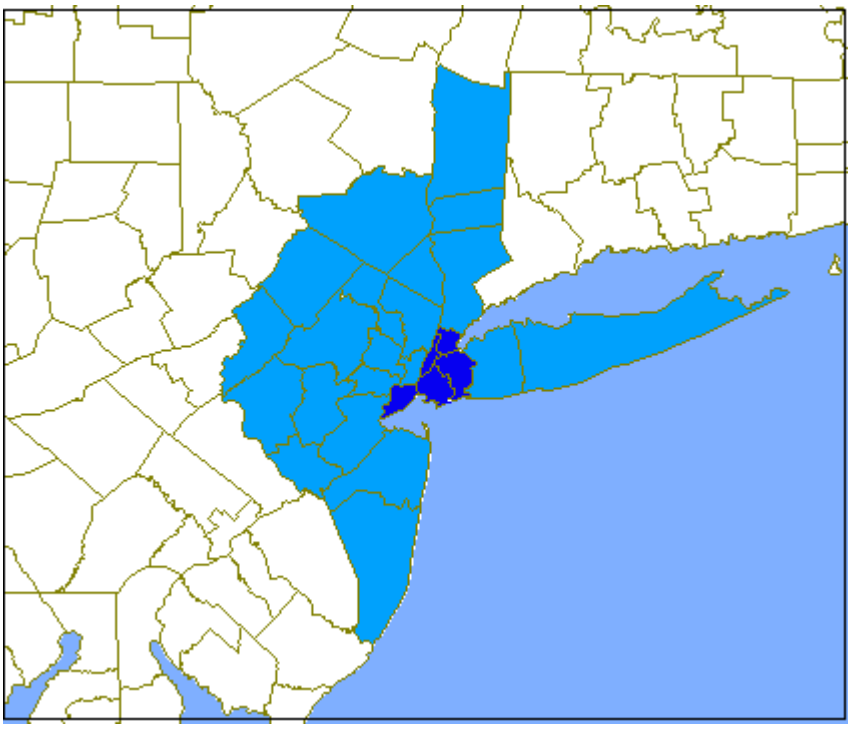
- Suppliers: chandler/provisions, entertainment services, laundry, medical, waste/sludge/garbage removal, and minor repairs/maintenance
- Bunkers: oil and water
- Inland transportation: auto, transit, taxi, air, and other.

Cruise passengers also spend time in the port city before or after the voyage, generating additional economic impacts through their visitor expenditures. As part of the NYSA Port Industry Assessment, ASWinc customized the expenditure patterns to reflect individual terminals and maritime flows through the Port of New York-New Jersey based on surveys conducted in 1999 and 2000. The expenditure patterns were further modified to reflect improved productivity, increased fuel costs and increased security costs.

REGIONAL DEFINITION

The main geographic focus of the study is the 26-county New York metropolitan area. This region encompasses the following 12 counties in New York State: Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, and Westchester. It also encompasses the following 14 New Jersey counties: Bergen, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union, and Warren. The map in figure 3 displays the geographic extent of the region. Although the economic impact results included in the study focus on the above region, the report also includes numbers for New York City, as well as separately for New York State and for the state of New Jersey and for the United States.

Fig. 3. Map of the New York/New Jersey Port Region
for Which Economic Impacts Were Measured



DESCRIPTIONS OF ECONOMIC MEASURES

In evaluating the effects of an economic activity on the economy of a region, various measures can be used. In this study, the measures include the changes in regional employment, output, wages, tax revenue, and value added. Although at first glance the meaning of most of these measures may appear obvious, they are discussed here to minimize the possibility of misunderstanding or misinterpretation.

The measures are described in terms of effects caused by the change in economic activity level. Therefore, the measures reported are only the total effects due to the economic change and not the totals for all activities currently existing in the region.

- *Jobs* are a measure of employment at the place of business. The value of this measure depends on the prevailing mix of full- and part-time employment in the industries in the region affected by the economic change. That is, no distinction is made between these two categories since the employment levels used are based on those reported by the U.S. Bureau of Economic Analysis, which in return bases its numbers largely on those reported by state and local employment offices. Nonetheless, for all but retail trade and certain service-producing sectors, the number of jobs reported tends to be very close to full-time equivalents. All jobs generated at businesses in the region are included, even though households in other regions may spend the wages associated with in-commuters.
- *Income* includes wages, salaries, and proprietors' income only. It does not include nonwage compensation (e.g. pensions, insurance, and health benefits); transfer payments (e.g. welfare or social security benefits); or unearned income (e.g. dividends, interest, or rent), even if the unearned income is generated in economic activities affected by the economic change entered into the model run. Wages are paid to workers at their place of work and spent at the workers place of residence, which may be outside the region. The terms "income" and "wages, salaries, and proprietors' income" are used interchangeably in discussing the results.
- *Federal taxes* consist of revenues collected by the federal government from corporate income, personal income, social security, and excise taxes.
- *State taxes* are revenues collected by state governments from personal and corporate income, state property, excise, sales, and other state taxes generated by changes in output or wages or by purchases by visitors to the region.
- *Local taxes* are revenues collected by substate governments. These are collected mainly from property taxes on new worker households and businesses, but also from income, sales, and other major local taxes in some areas.
- *GDP* is the economic measure preferred by economists. It is the difference between the value of goods and services purchased as production inputs and the value of goods and services produced. As such, it is the amount of total wealth generated by the economic activity. Also called “value added” or “gross regional product,” it consists of wages, state and local taxes, federal taxes, and "other value added." The last of these includes changes in nonwage employee compensation, profit-type income (other than proprietors’ income), net interest, and capital consumption allowances.

Note that the total wages paid may not equal the change in total wages received and spent in the region. That is because labor demand is met from sources outside of the study region. The

difference reflects the extent to which jobs in the region are held by resident households rather than by in-commuters from other regions. Household expenditures and concomitant induced effects for such in-commuters are assumed to take place predominantly in their region of residence.

Often, a combination of the measures listed above can provide additional guidance in economic development efforts and in making an argument about the importance of an industry. For example, income per job (which is obtained by dividing total income by total jobs) may reveal that the port industry provides wages that are higher relative to other industries in the region. Similarly, certain activities, like retail trade and real estate, may be more laden in terms of value added than in terms of income.

MULTIPLIER EFFECTS

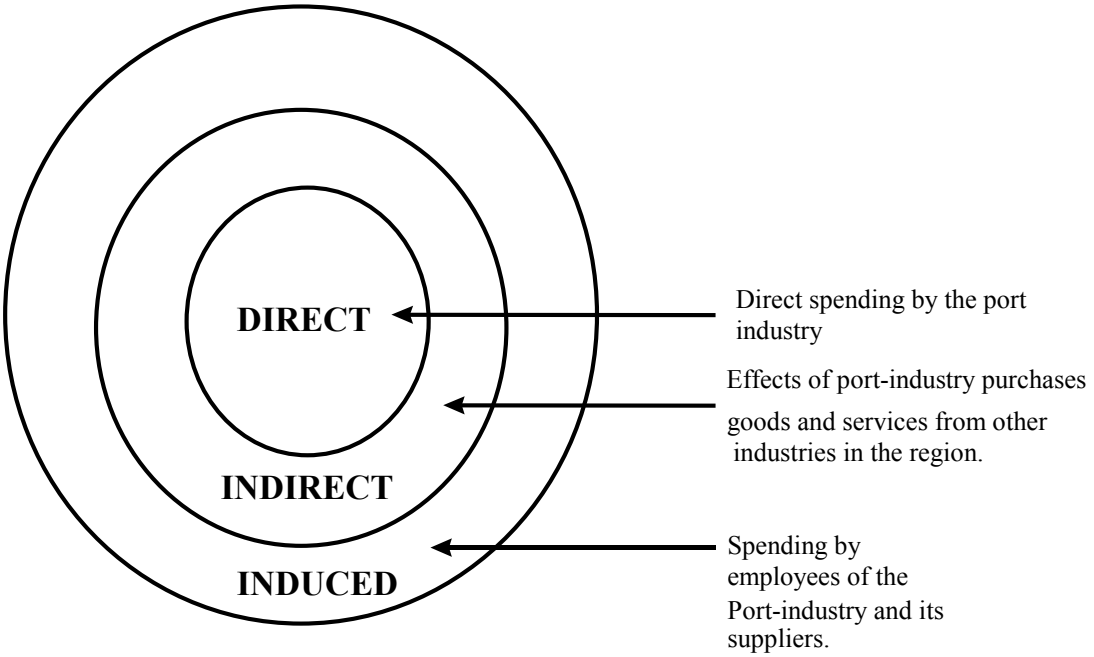
Direct effects are the focal point of an impact analysis. Thus, in this study, the set of port industries and the construction of their facilities are the *direct effects*. Most economic activities influence the economic behavior of other regional firms, organizations, and institutions *indirectly* and *induce* new spending by households. The process for estimating a given activity's indirect and induced economic impacts is somewhat more roundabout. By definition, a project's first round of *indirect impacts* includes the purchase of supplies and services that are required to produce the direct effects. Subsequent purchases of supplies and services generate other rounds of indirect impacts. The *induced impacts* are the purchases that arise, in turn, from the increase in the aggregate labor income of households. Both the indirect and induced economic impacts demonstrate how the requirements of the direct effect reverberate or ripple through an economy.

As shown in figure 4, vessels, terminals, transportation providers, and other port-industry businesses purchase goods and services from other industries to support their operations. These suppliers, in turn, purchase supplies and services to support their operations. In addition to the indirect impact of expenditure ripples, the workers employed by the port industry and the industry's suppliers also generate economic impacts. The employees of the port industry and its suppliers spend their wages and salaries on food, clothing, retail items, vehicles and other items. The economic ripples generated by employee spending are known as the *induced impact*. The *total economic impact* of the port industry consists of the direct, indirect and induced effects.

This study employs the MARAD Port Kit economic impact model to estimate the extent of the indirect and induced economic impacts of the direct costs of port-based activities, as well as the impacts upon income. R/ECON's economic impact model, which underlies the Port Kit, describes how sectors of an economy interact with one another. (R/ECON is the acronym for the Rutgers Economic Advisory Service.) That is, for a given industry, it shows the "production recipe" for the goods and/or services it sold as well as the shares of the industry's revenues that are consumed by other industries in the economy. Because of the high level of detail in a sector's use of inputs and the disposition of its outputs, this model is better suited to depict the so-called "multiplier effects" inherent in an economy than are other less detailed economic models.

R/ECON's economic impact model is distinctive in the way it portrays the economies of regions. Only the best and most recent data available on the region's employment, payroll, other labor income, state and local tax revenues, and profit-type income are used. Further, its estimates of interregional trade by sector are theoretically and intuitively appealing. For these reasons, the academic community recognizes R/ECON models as being conceptually the best.

Fig. 4. The "Ripple" Effect of the Port Industry



Source: A. Strauss Wieder, Inc.

APPENDIX B: REGIONAL ECONOMIC DATA IN THE MARAD PORT KIT

APPENDIX B
REGIONAL ECONOMIC DATA IN THE MARAD PORT KIT

Every copy of the model comes with economic data to support analysis for the nation and for all states with deepwater ports on the Atlantic, Pacific, and Gulf coasts as well as along the shores of the Great Lakes. Additional economic data on a region or on multiple regions for which impacts analysis is desired can be added to the MARAD Port Kit either by purchasing it or by using the User Defined Region utility of the MARAD Port Kit.

The regional economic data provided with the MARAD Port Kit are derived from supplied data by a variety of federal sources, as listed below.

- *County Business Patterns Data*, U.S. Bureau of the Census, Department of Commerce, http://www.census.gov:80/epcd/cbp/view/cbpview.html
- *Earnings by Industry (Table SA05),* Regional Economic Measurement Division, Bureau of Economic Analysis, U.S. Department of Commerce, http://leap.nlu.edu/bea/wwwhome.htm
- *Wage and Salary Disbursements by Industry (Table SA07)* Regional Economic Measurement Division, Bureau of Economic Analysis, U.S. Department of Commerce, http://leap.nlu.edu/bea/wwwhome.htm
- *Full- and Part-time Employment by Industry (Table SA25),* Regional Economic Measurement Division, Bureau of Economic Analysis, U.S. Department of Commerce, http://leap.nlu.edu/bea/wwwhome.htm
- *Gross State Product* (*GSP*) *Data*, Bureau of Economic Analysis, U.S. Department of Commerce, http://www.bea.doc.gov/bea/regional/gsp/
- *Covered Employment and Wages (ES202 data),* Bureau of Labor Statistics, ftp://146.142.4.23/pub/special.requests/cew/
- *Value of Production by Commodity, Census of Agriculture,* National Agricultural Statistics Service, U.S. Department of Agriculture, http://govinfo.kerr.orst.edu/ag-stateis.html/
- *Census of Government Finances*, U.S. Bureau of the Census, Department of Commerce, http://www.census.gov:80/govs/www/cog.html

To produce earnings (labeled "income" in the MARAD Port Kit report) and total employment by region, *County Business Patterns* (CBP) data on payroll and payroll employment,[2] available at the four-digit Standard Industrial Classification (SIC) level for nonagricultural and nongovernment sectors, are compiled for the specified geography.[3] The CBP payroll and payroll

[2] Payroll employment is the number of employees who receive regular wages and salaries. Hence, these figures do not include business proprietors unless they receive wages as well as income that they accrue by owning the business.

[3] The smaller a region is from an economic perspective, the greater the number of the disclosure problems in CBP data. Hence, before using the CBP data in the MARAD Port Kit, all disclosure problems were filled in using a method like that described in Gerking et al. (2001).

employment data are subsequently enhanced using BEA's state-level *Table SA05* earnings/payroll and *Table SA25* total employment/payroll employment ratios at the two-digit SIC level. These ratios are then applied to the detailed sectors in the economic model with which they are associated. Government enterprise and private household employment figures are obtained separately from the *ES202* files. Subnational data on agricultural income and employment by industry are derived using the region's share of the national value of production of the commodity. (Thus, for agriculture only it is assumed that the sector has the same average earnings per employee everywhere in the United States)

To produce value-added and tax revenue data, the value added/earnings ratios by industry are calculated from the two-digit SIC data and the data on earnings derived as discussed above. Similar calculations from the same data sets are made to estimate indirect federal government tax/earnings ratios and indirect state and local government tax/earnings ratios. The state-local split of indirect business taxes and personal taxes is calculated based on *Census of Government Finances* data for the region. Wages net of taxes are estimated by calculating the share of compensation from the GSP data files composed of the wages from BEA's *Table SA07*, which are also only available by state.

The estimated outputs by industry are derived from the labor-income coefficients of the R/Econ national Input-Output table and the earnings data discussed above. See Lahr (2001) and Jackson (1998) for a more precise mathematical treatment of the techniques discussed here.

After the above data are collected, regional demand data by industry are estimated using the techniques described in Treyz and Stevens (1985, equation 2). That is, in order to derive regional demands by industry, the regional output estimates (obtained using the techniques discussed above) are first multiplied up the columns of the national direct requirements matrix.[4] The sums of the rows of the resulting matrix are then obtained to get regional interindustry demand. To get total regional demand, of course, one must add to interindustry demand the demands for industry production placed by regional final demand—i.e., locally based government operations, regional households, and the region's international exports. Regional final demand was estimated by finding the product of regional output and national final demand/output ratio by industry.

Adjustments for interregional trade[5] are also made using techniques developed by Treyz and Stevens (1985, 553/554). In fact, it is the same approach to interregional trade estimation that was used in prior versions of the MARAD Port Kit. The main difference between the current version and earlier ones is that the industries in this version are in far finer detail, which makes the trade-flow estimation more accurate.

References

Gerking, S.D., A. Isserman, W. Hamilton, T. Pickton, O. Smirnov, and D. Sorenson, (2001). "Anti-suppressants and the creation and use of nonsurvey regional input-output models". M.L. Lahr and R.E. Miller,(eds.), *Regional science perspectives in economic analysis: A festschrift in memory Benjamin H. Stevens, 379/406.* Amsterdam: Elsevier Science.

Jackson, R.W. 1998. "Regionalizing national commodity-by-industry accounts." *Economic Systems Research* 10: 223/238.

[4] See Appendix C for an explanation and demonstration of this matrix. Note that, in this case, the household column and the labor row are omitted.

[5] The adjustments made in the economic model used in the Port Kit to account for interregional trade are called regional purchase coefficients or RPCs and do not account for international exports. (See Appendix C.)

Lahr, M.L. 2001. "Reconciling domestication techniques, the notion of re-exports, and some comments on regional accounting." *Economic Systems Research, 13:* 165/179.

Treyz, G.I. & Stevens, B.H. 1985. "The TFS regional modelling methodology." *Regional Studies* 19: 547/562.

APPENDIX C: BACKGROUND ON ECONOMIC IMPACT ANALYSIS

APPENDIX C
BACKGROUND ON ECONOMIC IMPACT ANALYSIS

INTRODUCTION

Total economic impacts encompass both direct and multiplier effects. The latter incorporate indirect and induced impacts. The character of the direct impacts of any maritime activity is derived from the recipes of the activities involved: the local spending on terminal operations; steamship, ferry, and cruise operations; port authorities, inland transportation services, passengers and crew, and various types of construction and equipment purchase activities. The process for estimating a given project's indirect and induced economic impacts is more roundabout. By definition, a project's first round of indirect impacts includes the local purchases of any supplies and/or services that are required to produce the direct effects. Subsequent purchases of supplies and services generate other rounds of indirect impacts. Induced impacts are the purchases that arise, in turn, from the increase in aggregate labor income of households. Aggregate labor income is defined as the sum of wages, salaries, and proprietors' income. Both the indirect and induced economic impacts demonstrate how the demand for direct requirements reverberates or ripples through an economy.

One means of estimating indirect and induced impacts would be to start off by researching the business transactions of, say, terminal operators, in much the same way as when using the Port Kit. The business questionnaire for this market research would ask for the names and addresses of the terminal's suppliers; what and how much they supply; the names and addresses of the contractor's employees; and their annual payroll. Subsequent steps, however, diverge from those recommended when using the Port Kit.

A related questionnaire would examine the household spending of the employees of the surveyed firms. It would request a detailed characterization of each employee's household budget by line items, including names and addresses of the organizations or individuals from which each line item is purchased.

Both questionnaires subsequently could be used to measure indirect and induced impacts of each terminal's contribution to the economy. The business questionnaire would be sent to the business addresses identified by a terminal; the household questionnaire, would be sent to the homes of the employees of those businesses that responded to the survey. This snowball-type sampling would continue until time or money was exhausted. In order to keep each organization's or household's contribution to the activity in proper perspective, its total spending would be weighted by the size of its transaction with the customers included in the survey activity. The sum of the weighted transaction values obtained via the surveys would be the total economic impact of the project.

Many organizations simply do not have the time and/or money required to undertake the survey work necessary to accurately estimate indirect and induced impacts. Consequently, relatively less-expensive economic models based on census and other secondary data are typically used to measure economic impacts.

Of the economic models presently available, the one that has proven most accurate in estimating the indirect and induced economic effects of events is the input-output (I-O) model. Its success can be attributed to its level of industry detail and its depiction of interindustry relations. A single calculation—known as the Leontief inverse—simulates the many rounds of business and

household surveys. Input-output tables are constructed from exhaustive nationwide census surveys of businesses and households.

A SHORT HISTORY OF INPUT-OUTPUT ANALYSIS

The basic framework for input-output (I-O) analysis can be traced back to nearly 250 years to 1758 when François Quesenay published *Tableau Economique.* Quesenay's "tableau" graphically and numerically portrayed the relationships between sales and purchases of the various industries of an economy. More than a century later, Leon Walras adapted Quesenay's description, and generalized it into a concise dynamic theoretical model of an economic system (including consumer purchases and the economic representation of "technology").

Wassily Leontief was awarded the Nobel Prize in 1973 for his significant pragmatic advancement of Walras's theoretical formulation. Leontief first used his approach in 1936 when he developed a model of the 1919 and 1929 U.S. economies in order to estimate the effects of the end of World War I on national employment. Recognition of his work came later with wider acceptance and use of the approach. This meant development of a standardized procedure for compiling the requisite data (today's national economic census of industries) and enhanced capability for calculations (i.e., the computer). The federal government immediately recognizing the importance of Leontief's development, has been publishing I-O tables of the United States economy since 1939.

DEPICTING THE ECONOMY

I-O modeling focuses on the interrelationships between sectors in an economy. Within the I-O model, the economy of an area is mapped out in table form, with each industry listed across the top as a consuming sector (or market) and down the side as a producing sector. A column in the table, or "matrix," depicts the inputs needed from every other industry to produce its output. The table, shown in figure B-1, is known as an *interindustry transactions matrix*.

Fig. B-1. Hypothetical Interindustry Transactions Matrix ($ Billions)

	Agricul-ture	Manu-facturing	Services	Other	Final Demand	Total Output
Agriculture	10	65	10	5	10	100
Manufacturing	40	25	35	75	25	200
Services	15	5	5	5	90	120
Other	15	10	50	50	100	225
Value Added	20	95	20	90		
Total Input	100	200	120	225		

Note: Based on the example matrix developed for the Regional Port Impact Model Handbook.

Each column shows the purchases made by a consuming industry from each of the producing-industry sectors. Similarly, each row depicts the sales of a producing industry to all consuming-industry sectors. For example, in figure B-1, agriculture, as a producing-industry sector, sold $65 million of goods to manufacturing. Conversely, the table depicts that the manufacturing sector of the economy as a consuming industry purchased $65 million of goods from the agricultural sector.

An interindustry matrix can be either aggregated or quite detailed in terms of the sectors of the economy for which separate columns and rows are created. Research has found that detailed matrices tend to be more accurate; aggregated models can have as much as a 50 percent error. The current U.S. model includes about 500 industries representing many four-digit Standard Industrial Classification (SIC) codes. The R/Econ® I-O model extends the U.S. model to 517 sectors to assess port redevelopment scenarios.

A *final demand* column is also included in figure B-1. This column, which is outside the square interindustry matrix, includes imports, exports, government purchases, changes in inventory, private investment, and household purchases. The value-added row, which is also outside the square interindustry matrix, includes wages and salaries, profits, dividends, interest, rents, royalties, interest, capital consumption allowances, and indirect business taxes. Separately, both the final demand column and the value-added row equal the gross national product (assuming the table depicts a national economy).

As previously noted, the final demand column includes household purchases and the value-added row includes wages and salaries. By extracting household purchases from the final demand column into a separate column in the interindustry matrix and, similarly, wages and salaries from the value-added row into a separate row in this matrix, the *induced impacts* can be captured later in the multiplier calculations. The elements included in the multiplier—direct, indirect, and induced impacts are defined in the main body of this handbook.

The information in matrix depictions of economies (such as the example in figure B-1) are used to develop a *direct* or *technical requirements matrix*. An example of a technical requirements matrix is shown in figure B-2. Using the matrix in figure B-1 as a starting point, the numbers in each column are divided by the column total. For example, the cell for manufacturing's purchases from agriculture is 65/200 = .33. Each cell in a consuming-industry column in the direct requirements matrix shows how many cents of the *input* from a producing industry is necessary to produce one dollar of the consuming-industry's *output;* these numbers are called *technical coefficients*. Hence the term "input-output."

Fig. B-2. Direct or Technical Requirements Matrix

	Agriculture	Manufacturing	Services	Other
Agriculture	.10	.33	.08	.02
Manufacturing	.40	.13	.29	.33
Services	.15	.03	.04	.02
Other	.15	.05	.42	.22

The resulting technical requirements matrix can be used mathematically in a procedure called the *Leontief Inverse* to generate a matrix whose elements reflect the *total requirements including the direct, indirect, and induced requirements*, needed to support the level of final demand shown in figure B-1. In mathematical terms, the Leontief inverse is represented by $(\mathbf{I}\text{-}\mathbf{A})^{-1}$ The resulting

matrix is called the *total requirements matrix.* The total requirements matrix for the direct requirements matrix displayed in figure B-1 is shown in Figure B-3.

Fig. B-3:Total Requirements Matrix

	Agriculture	Manufacturing	Services	Other
Agriculture	1.5	0.6	0.4	0.3
Manufacturing	1.0	1.6	0.9	0.7
Services	0.3	0.1	1.2	0.1
Other	0.5	0.3	0.8	1.4
Industry Multipliers	3.3	2.6	3.3	2.5

Let's now compare how the direct or technical requirements are transformed through the Leontief Inverse into the total requirements or impacts. Note that the technical coefficient for the manufacturing sector's purchase from the agricultural sector was .33, indicating that 33 cents worth of agricultural products must be directly purchased to produce a dollar's worth of manufacturing products. The same "cell" in figure B-3 has a value of 0.6. This value indicates that, in order for the manufacturing sector to sell a dollar's worth of output, agriculture must produce output worth 60 cents, 33 cents worth of which is sold directly to the manufacturing sector. The remaining 27 cents worth is sold to other sectors in the economy that will use it to produce materials and services that they, in turn, need to sell to the manufacturing sector or other industries that support manufacturing production. The sum of each column in the total requirements matrix is the *multiplier* for that sector of the economy. The relationship between the total requirements matrix and final demand (which is the market for the products) is depicted mathematically as

$$(\mathbf{I}-\mathbf{A})^{-1} \quad \text{x} \quad \mathbf{Y} \quad = \quad \mathbf{X}$$

Total Requirements Matrix	x	Final Demand	=	Total Output

CHANGES IN INVESTMENT AND ECONOMIC TRANSLATORS

Output multipliers are the column sums of the total requirements matrix. These multipliers can be used to assess the economic impacts associated with changes in investment, such as an investment in the construction of expanded maritime terminals. In I-O analysis this change in investment technically must be, derived from a change in final demand and can be either positive or negative. (A negative investment is a situation where funds or an activity becomes lost to a region, for example, the loss of maritime-based commerce resulting from vessels being unable to enter the harbor because of inadequate channel depths.) Mathematically, this is depicted as

$$(\mathbf{I}-\mathrm{A})^{-1} \quad \text{x} \quad \Delta\mathrm{Y} \quad = \quad \mathbf{\Delta X}$$

Total Requirements Matrix	x	Change in Final Demand	=	Change in Total Output

As described earlier in the main text of this report, a change in investment can be short-term, such as expenditures for labor and materials during construction, or ongoing, for example, the annual operation and maintenance expenditures associated with a new maritime facility.

ADVANTAGES OF AND LIMITATIONS TO INPUT-OUTPUT MODELS

Advantages

As previously indicated, Input-output modeling is one of the most accepted methods of assessing economic impacts. The approach provides a concise and accurate means for articulating the interrelationships among industry sectors. The models can be quite detailed. As noted earlier, the current U.S. model has about 500 industries representing many four-digit Standard Industrial Classification (SIC) codes. The model used in port redevelopment analysis has slightly more detail, with 517 sectors. This level of detail provides a consistent and systematic approach, as well as a more accurate means for assessing the multiplier effects of changes in economic activity.

National I-O models can also be readily adapted to regional economies, capturing the flows across geographical boundaries. As discussed in the next section, the MARAD Port Kit can assess the economic implications of maritime investments and flows for counties, states, or groups of counties and states.

Limitations

I-O analysis makes several key assumptions. First, the information used to create an input-output model is for *a given point in time*. Thus, the model is in essence a "snapshot" of the technical requirements and industry relationships at a given point in time. Because of this, input-output models are updated regularly. The survey-based U.S. model is updated every five years. More frequent updates generally are not needed as overall industry requirements and relationships change at a slow pace.

In addition, input-output modeling assumes that there are no economies of scale to production in an industry; that is, the proportion of inputs used in an industry's production process does not change regardless of the change in the final demand that is entered into the model.

Further, regional input-output models generally assume that technical requirements and industry relationships are the same for a region as they are at the national level. That is, the type and proportion of inputs required to produce an industry's output for any subregion of the nation is the same as the national average. For regions that are large and economically diverse, this assumption should not be problematic. As the regions become economically smaller and less diverse, particularly with regard to the production of goods as opposed to services, the assumption is probably less valid. Accordingly, the MARAD Port Kit has been released with data for all states with deepwater ports.

THE MARAD PORT KIT

R/Econ (Rutgers Economic Advisory Service) of the Center for Urban Policy Research (CUPR) at Rutgers University supplied the 517-sector I-O base model and specialized port sectors, which were refined using data collected by ASWinc. This model uses the U.S. I-O model produced by the United States Bureau of Economic Analysis as a template. The technical coefficients in the

model are based on 1997 information that has been updated to 2003 using data from the United States Bureau of Labor Statistics.[6]

ADAPTING I-O MODELS TO REFLECT REGIONAL ECONOMIES

Regional input-output models, such as the one used in the MARAD Port Kit, must account for the percentage of the demand for an industry's output or the requirements for a transportation project that can be readily supplied by firms in the area. Firms within a region may not be able to supply all the products needed. Therefore, goods and services may have to be purchased from outside the region.

Demand that is met by area firms generates a multiplier effect within the region. Expenditures for goods or services produced outside the region "leak" a substantial portion of the multiplier effect to that other area. That is, the relative location of where these goods are produced has some bearing on the extent and magnitude of the ripple effect of the expenditures. The greater the percentage of expenditures made within the region, the greater the multiplier effect to the area is likely to be. In summary, while the region may gain substantial benefits from the ultimate outcome of a transportation project, the multiplier effects generated through the expenditures for the project will vary depending on the location of the supplying firms.

The MARAD Port Kit uses *regional purchase coefficients* to account for the leakages of expenditure flows. A regional purchase coefficient (RPC) is defined as the proportion of regional demand expected to be supplied by producers within a given region.

An RPC value of one indicates that firms within either the city or region meet all local demand for an industry's product. Similarly, an RPC of zero indicates that none of the demand is met within the city or region. That is, RPCs range in value from zero to one. RPCs are applied to both the impact vector for an investment and to the direct requirements matrix so expenditure streams that leak out of the area after the initial investment are accounted for. If we let $\boldsymbol{\rho}$ be the vector of RPCs, then in mathematical terms, this is depicted as

$(\mathbf{I}-\boldsymbol{\rho}\mathbf{A})^{-1}$	x	$\boldsymbol{\rho}\Delta\mathbf{Y}$	=	$\Delta\mathbf{X}$
Regionalized Total Requirements Matrix	x	Regionalized Translator	=	Change in Regional Output

A variety of techniques are available to develop RPCs, including modified location-quotient, supply-demand, econometric analysis, and regional analysis. The MARAD Port Kit uses an econometric approach developed by Treyz and Stevens (1985)—a location analysis of the detailed interstate flow of goods as presented in the Census of Transportation's Commodity Flow Survey.

[6] Updating the 1997 U.S. model using the 198-sector BLS model maintains technological integrity.