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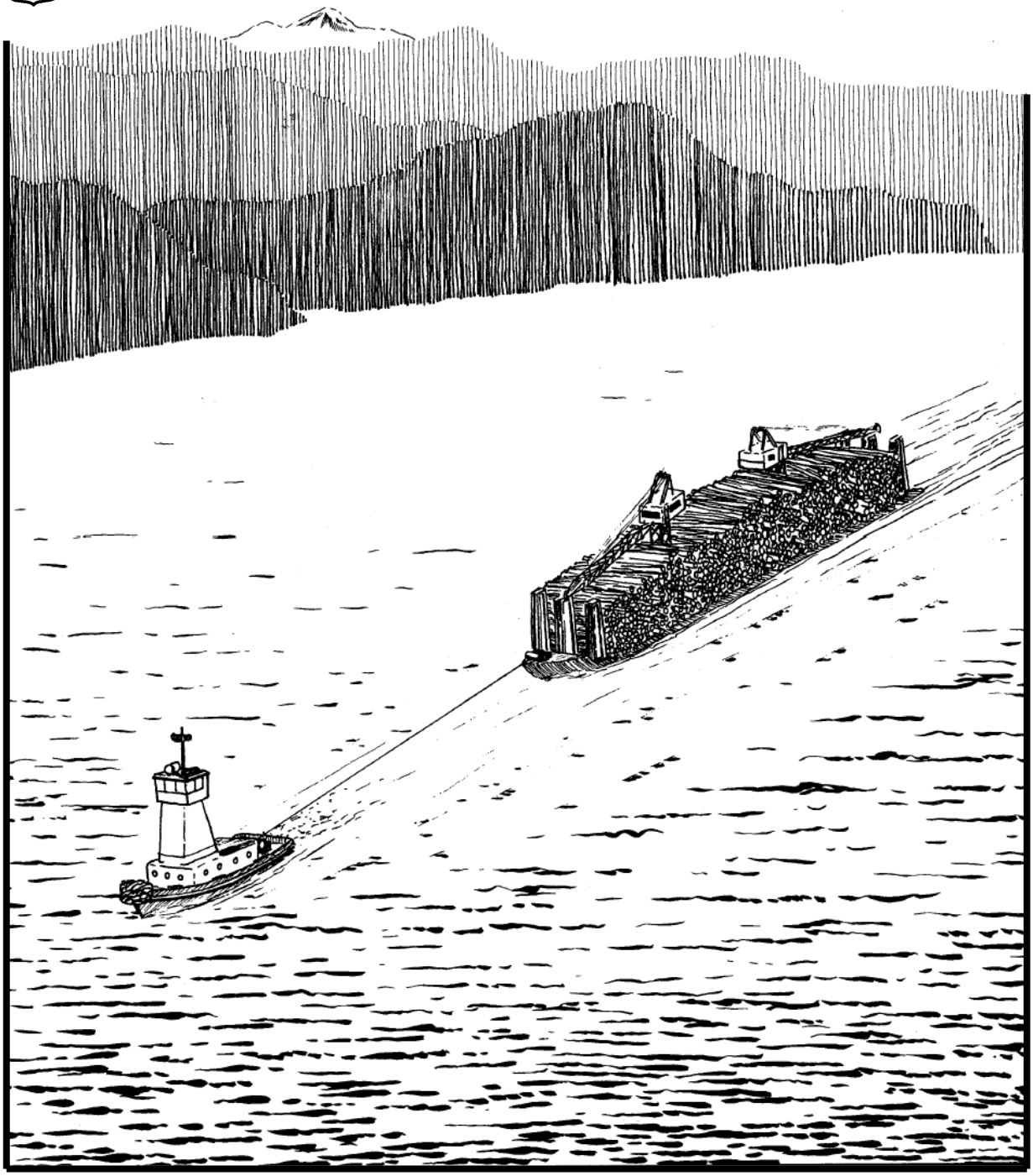
Impacts of the Jones Act on the Alaska Forest Products Trade

Kristine C. Jackson and Charles W. McKetta



Authors

KRISTINE C. JACKSON is a research forester, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, P.O. Box 3890, Portland, Oregon 97208. CHARLES W. McKETTA is associate professor of forest economics, University of Idaho, Department of Forest Resources, Moscow, Idaho 83843.

Abstract

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Alaska forest products trade flows for 1982 were studied to determine the effects of the Merchant Marine Act of 1920 (the Jones Act). Information was collected from timber producers, forest product industries, and waterborne shippers in Alaska, British Columbia, and the Pacific Northwest. Trade flows were simulated, using a partial equilibrium model based on resource rents, with and without the Jones Act restrictions.

Results indicate that $4.77 million in additional costs were incurred in 1982 because of the Jones Act. These effects appeared small, however, relative to the wholesale value of trade. Further, the Jones Act cost differential was not a major factor in market determination, although low-value products and longer trade routes were more sensitive to cost changes. Primary movements of logs and chips and lumber imports from the Pacific Northwest showed the greatest potential for cost savings after relaxing the Jones Act.

Keywords: Jones Act, trade balance, markets (external), forest products carriers, economics (forest transport), Alaska (southeast), southeast Alaska.

Summary

Movements of Alaska forest products are dependent on waterborne transportation systems because of the State's location and geography. The Merchant Marine Act of 1920 (the Jones Act) restricts waterborne shipments between U.S. ports to vessels built and registered in the United States. The goal of this study was to assess the effects of the Jones Act on Alaska forest products trade. This included measuring forest product trade flows and determining the economic impact of the Jones Act on timber producers, consumers, and shippers in Alaska. Specific objectives were to examine the size of the Jones Act freight rate differentials; the effects of the rate differentials on trade flows; and the effects on the wealth of forest resource owners and forest products consumers in Alaska.

Three analytical tools were used. First, Jones Act freight rate differentials were calculated by calibrating 1982 shipping rates to indices of U.S. construction and maintenance costs as imposed by the Jones Act. Relaxing of the Jones Act was simulated by calculating the expected decreases in domestic freight rates, thus causing a corresponding increase in resource rents. Second, models of the southeast Alaska forest products trade flows were developed. F.O.B. product prices represented the resource rent values of timber resources. Constraints on supply, demand, and individual movements were used to simulate actual 1982 market conditions. Using a model of internal log transfers and a derived-demand, partial equilibrium model, effects on both coastwise and internal southeast Alaska forest products trade were estimated. Finally, these changes in costs were used in an input-output simulation of the southeast Alaska economy using the *Interactive Policy Analysis Simulation System* to estimate the indirect and induced effects.

The direct effect of the Jones Act was a reduction in income for 1982 for Alaska forest resource owners and consumers of forest products that totaled $4.77 million. Freight differentials ranged from under $2.00/MBF to over $13.00/MBF for the domestic routes, which indicated that protection of domestic shipping did have an adverse effect on Alaska forest products trade in 1982. Relaxing the Jones Act did not cause shifts in trade flows for most products. As transportation costs to the Pacific Northwest decreased, lower value products showed greater sensitivity to shift in market destinations. Pulpwood was the only product to actually shift direction, but spruce and hemlock cants and wood chips would be the next to shift with additional changes in transportation costs.

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Introduction

Forest products is one of several predominant natural resources industries in Alaska. This industry is concentrated in southeast Alaska. In our study year, 1982, 563 million board feet (MMBF) of Sitka spruce *(Picea sitchensis* (Bong.) Carr.) and western hemlock *(Tsuga heterophylla* (Raf.) Sarg.) was harvested in this region and sold as export logs, lumber and cants, dissolving and sulphite pulps, pulpwood, and wood chips. Pacific Rim countries typically purchase 95 percent of Alaska forest products, with Japan taking over 90 percent. About 4 percent is shipped to the Pacific Northwest and the remainder is consumed in-State. In addition, 193 MMBF of building supplies were barged from the Pacific Northwest to Alaska in 1982.

The dependence of Alaska on waterborne transportation systems has raised a number of questions. These concern how restrictions in the Jones Act1 affect U.S. built and crewed U.S.-flag vessels in this trade. A number of shippers allege that all waterborne trade between Alaska and the lower 48 States incurs higher shipping costs, and the costs are partly a result of the Jones Act. This may have helped to shape current Alaska trade patterns; however, the effects of the Jones Act on Alaska forest products trade have not been substantially addressed in previous studies.

In this report, we examine the proposition that the Jones Act limits trade from Alaska to the lower 48 States. Measurement of freight rate differentials and measurement of the impact on trade routes were the major goals of this study. Specific objectives were:

1. To determine the differences between freight rates for equivalent vessels under U.S. and foreign flags and to measure these differences for the Alaska forest products trade by product, route, and transportation mode.

2. To determine the effect that Jones Act differentials have on the direction of trade between foreign and domestic destinations.

3. To measure the potential monetary losses for Alaska timber resource owners and forest products consumers caused by the Jones Act.

This three-step analysis provided a useful basis for discussing the Jones Act, for identifying the shipping modes and forest products that are most affected, and for approximating the cost of the Jones Act to Alaska in 1982.

Alaska Forest Products Trade

The coastal rain forest of southeast Alaska is the northern extension of the rain forests of Oregon, Washington, and British Columbia. Western hemlock comprises 68 percent of this forest type, Sitka spruce 27 percent, and cedar *(Chamaecyparis* sp.) about 5 percent (University of Alaska 1964). In southeast Alaska, Sitka spruce is the dominant lumber species, and western hemlock is used primarily in the production of high-grade dissolving pulp.

[1/] For convenience, a glossary adapted from Long and Blattner (1985), is provided at the end of this paper. Definitions of unusual terms used in this report are included.

Of the 5.6 million acres of commercial forest land in southeast and south-central Alaska, about 5.1 million acres are in the Tongass and Chugach National Forests. Much of the remainder is in State and private ownership, although a small area is under Bureau of Land Management jurisdiction. The Bureau of Indian Affairs manages timber on the Annette Island Indian Reservation. By 1984, 464,605 Federal acres were transferred to Native Corporations under the Alaska Native Claims Settlement Act of 1971 (ANSCA) (Mehrkens 1983). Most ANSCA lands are of high commercial value and were selected from the Tongass National Forest.

Timber harvests for southeast Alaska are summarized in table 1. The Tongass National Forest provides most of the volume harvested and averages 337 MMBF per year. State timber harvests have been relatively constant since 1980 and average 5.3 MMBF. Since the land transfers to Native Corporations began, these harvest levels have increased from 70.3 MMBF in 1980 to an average annual cut of 214 MMBF since 1982 (Mehrkens 1985).

Due to federal primary manufacturing requirements, most of the National Forest timber is manufactured into cants or high-grade dissolving pulp. The balance is sawn into dimension lumber or is chipped. Between 80 and 85 percent of the Native Corporations timber harvest is exported unprocessed.

Table 1-Timber harvests in southeast Alaska by ownership, 1980-84

Ownership	1980	1981	1982	1983	1984
	MMBF, log scale 1/				
Forest Service (Tongass NF)	452.1	385.7	344.9	251.2	249.8
State of Alaska	5.1	5.4	5.7	5.6	4.7
Native Corporations 2/	70.3	122.0	209.2	232.0	202.0
BIA/Annette Island	15.3	2.5	2.5	3.2	.7
Total	542.8	515.6	562.7	492.0	457.2

1/ Includes utility volume.

Native Corporation production is expected to fluctuate in response to different marketing strategies and changing demand. Estimates range from 150 MMBF per year at a sustained yield level to 225 MMBF using intensive management practices.

Source: Mehrkens: 1985.

The major Alaska products are logs; pulpwood; green-sawn lumber, cants and waneys; wood chips; and high-grade dissolving pulp. Production is concentrated in the southeast region and accounts for 32 percent of total regional primary employment (Sandor 1981) and 78 percent of the State's lumber and paper products work force (USDA Forest Service 1982). Of the 208 sawmills in operation in 1982, Clark (1983) estimates that southeast Alaska mills have 74 percent of the sawmill capacity in Alaska, with a saw-log capacity of 365 MMBF per year and an annual woodchip capacity of between 230,000 and 315,000 metric tons (MT). Production in southeast Alaska has not approached capacity for several years because of poor conditions in major markets, most notably Japan. During 1982, 60 percent of the logs were reduced to pulp and 40 percent were sawn as poor market conditions reversed the usual ratio for saw logs to pulpwood (Development Planning and Research Associates 1983).

Alaska's main advantage in international trade is its location relative to the Pacific Rim markets. Figure 1 shows the comparative advantage Alaska has in domestic and foreign trade. Primary trading partners are few in number: Japan, Canada, India, People's Republic of China, The Republic of China (Taiwan), and the Republic of Korea together account for nearly two-thirds of Alaska's imports and exports in all sectors. Overall, Japanese markets account for 95 percent or more of all forest products exported from Alaska, but the recent removal of trade restrictions between the United States and the People's Republic of China has opened new markets for Alaska timber producers, Rapid growth and industrialization in China, Taiwan, Korea, Indonesia, and other Pacific Rim countries indicate rising demand for forest products in these regions (Jackson 1983).

A small volume of wood products is shipped to the lower 48 States each year. This trade mostly consists of high-valued products, such as high-quality, music-grade Sitka spruce logs and cants, and dissolving pulp. Several institutional factors, including the Jones Act, are alleged to limit entry to domestic markets in the lower 48 States (USDA Forest Service 1982).

Less than 1 percent of the reported 1982 wood products consumption in Alaska was produced within the State. This figure may be slightly higher because of small volume, unreported sawmills, mostly in interior Alaska. Both imported kiln-dried lumber from British Columbia and the Pacific Northwest and locally produced lumber from the interior are cheaper in interior markets than is green-sawn lumber from southeast Alaska (USDA Forest Service 1982). Another factor in the minimal domestic utilization of Alaska timber is the demand for products that are not produced in Alaska, such as kiln-dried lumber and softwood plywood.

Transporting Alaska Forest Products

Figure 1 shows the major trade routes used in Alaska waterborne trade. Most shipments are to foreign destinations, mostly around the Pacific Rim. The Jones Act affects both coastal shipments within Alaska and shipments between ports in Alaska and those, such as Seattle, that are separated by ocean or by an intervening nation. Intercoastal shipments of Alaska forest products to the eastern United States are also regulated by the Jones Act but are nonexistent.

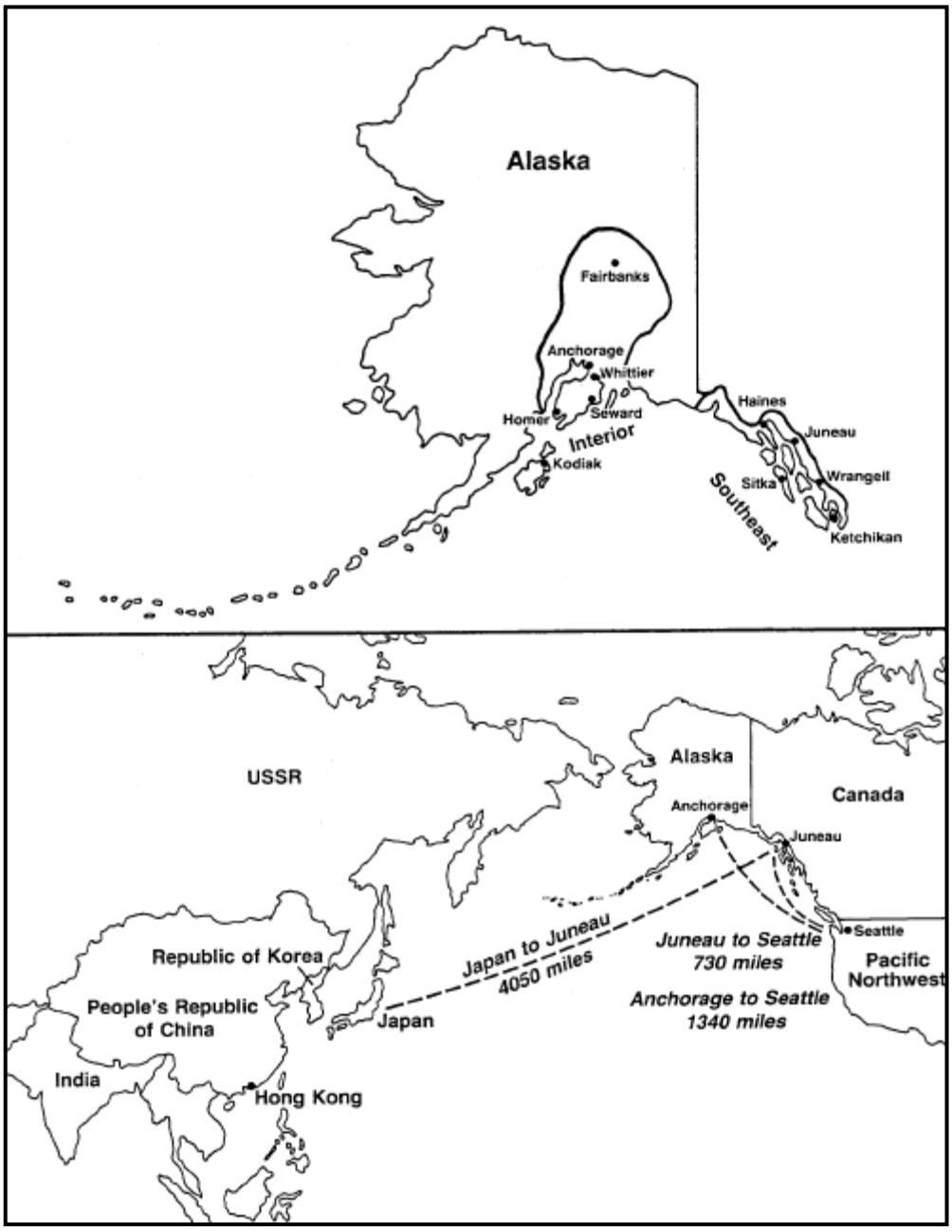


Figure 1--The interior and southeast regions of Alaska and major trading partners around the Pacific Rim.

Domestic shipments use two main types of vessels-tankers and barges-that haul mostly petroleum, dry bulk, and general cargoes. Barge shipments consist principally of consumer goods moving to Alaska, with some natural resource products carried on the backhaul to the Pacific Northwest. Ocean barging has increased in the last 30 years, mainly because barges do not require deepwater ports and can carry high-bulk, low-value commodities without time limits. Alaska barges often carry logs, pulp, and wood chips, as well as other forest products (Jackson 1983).

Most of the demand in Alaska for forest products comes from Anchorage and the populous interior region and is supplied by ocean barges from the Puget Sound area. Construction lumber, plywood, and other forest products are transported by railcar or container barge to Whittier, Seward, or Anchorage, and then by rail or truck to final destinations.

Logs harvested in southeast Alaska are towed to processing sites in log rafts or on a log barge. The mode is determined mostly by transportation cost, but route and distance also affect the decision. We estimated log barge movements to have an average 190-mile hauling distance; log rafts average 150 miles.

Appendix 1 contains the shipping information for selected Alaska forest products used throughout the study to test effects of the Jones Act. These tables in appendix 1 include route specifications, 1982 freight rates, the 1982 F.O.B. dock prices, and the volume traded for each of the major products.

Previous Analyses of the Jones Act

The Merchant Marine Act of 1920 (the Jones Act) was suggested by private shipping interests and was passed by Congress to discriminate against foreign shipping, to protect domestic interests, and to revive the declining private merchant marine (Boyd 1981). Section 27, sponsored by Senator Wesley Jones, deals with "transportation of merchandise between points in the United States" (Merchant Marine Act 1920). This states:

> . . .That no merchandise shall be transported by water, or by land and water, on penalty of forfeiture thereof, between points in the United States, including Districts, Territories, and Possessions thereof embraced within the coastwise laws, either directly or via a foreign port, or for any part of the transportation, in any other vessel than a vessel built in and documented under the laws of the United States and owned by persons who are citizens of the United States. . . .

This section extended previous cabotage restrictions by requiring the use of ships built in, crewed by, and owned by U.S. companies for all domestic trade, including that in Alaska.

Analysis of the effects of the Jones Act has been done for certain facets of both the Alaska economy and the Pacific Northwest forest products industry. Studies have been done by Kaplan (1970), the Alaska Statehood Commission (1982), and A.R. Tussing and Associates (1982) on general transportation issues. Both I.P. Morgan (1980) and R.G. Boyd (1981) concentrated on the effects of the Jones Act on the forest products industry in the lower 48 States. Simat, Helliesen and Eichner, Inc. (1982-this will be referred to as "the Simat study") examined the effects of the Jones Act on the Alaska oil trade. Our report will be the first to focus on the combination of Alaska forest industries and the effects of the Jones Act.

No laws regulate other transportation modes like the Jones Act does waterborne shipping. Where other modes of transportation are not available, as in the Alaska waterborne trade, it is generally believed that the shipping public, the producers, and final consumers subsidize the higher transportation costs resulting from the Jones Act (Leback and McConnell 1983). Even a small difference in transportation costs can be sufficient to shift markets if no other factors interfere. The net effect of higher costs may be distortion of normal trade patterns and reorientation of the affected economies toward foreign trade where lower ocean freight rates are available (U.S. Congress, Senate 1970).

In 1970, Kaplan calculated the effects of the Jones Act on living costs. For Alaska, ocean freight charges accounted for 4.5 to 5 percent of personal expenditures. Savings from changing the Jones Act were unlikely to reduce transportation costs by more than 1.5 percent. The major finding was that demand for services and a shortage of labor distorted the cost of living in Alaska much more than transportation costs did.

In 1982, Totem Ocean Trailer Express compared consumer retail prices in Seattle and in Anchorage for the Alaska Statehood Commission (1982). This study revealed that prices averaged 8.5 percent higher in Anchorage than in Seattle. Transportation costs were only 22 percent of the average price difference and were less than 2 percent of the Anchorage retail price. However, plywood was priced 52.8 percent higher in Anchorage; transportation costs were only 18.3 percent of the Anchorage price, but were 34.7 percent of the total price difference. Food and construction materials from the Pacific Northwest appeared to be most affected by transportation costs.

Some of Alaska's present export industries are oriented to overseas markets where the Jones Act is irrelevant. Other industries can take advantage of lower cost, southbound backhaul rates (A.R. Tussing and Associates 1982). The Tussing study concludes that because few shippers now take advantage of Canadian markets or existing exemptions, the effective burden of the Jones Act on general merchandise imports to Alaska is not great. The major effect is on southbound bulk commodities and on the petroleum industry. The extent that structural development of Alaska markets was affected by the Jones Act was not testable, as no alternative evidence exists.

Morgan (1980) studied how Pacific Northwest forest products producers, excluding those in Alaska, shift their production strategies in response to shipping changes in the United States. His results indicate that providing U.S. barge operators access to foreign-built tugs and barges would have little effect on existing trades. Nor would removal of cabotage laws equalize competition with British Columbia producers for East Coast markets. Morgan concluded that the main effect of these laws is to accelerate the restructuring of the U.S. forest products industry. These adjustments, already in place, consist of supplying the Japanese, export trade and moving production to the southeastern United States to supply East Coast markets.

Boyd (1981) developed a mathematical programming model to quantify the impact of the Jones Act on the U.S. lumber industry, excluding Alaska. He concluded that the present economic effect of the Jones Act on the softwood lumber industry in the lower 48 States is small and insignificant. Changing Jones Act restrictions did lead, however, to changes in lumber prices and trade flows.

The Simat study (1982) used a cost-determined freight rate approach to determine the effect of the Jones Act-on petroleum shipments. It estimated shipping costs to Alaska and Jones Act premiums by vessel type by comparing the component costs of actual service with equivalent foreign-flag costs for similar vessels. Using a simulation model of vessel and service characteristics and basic cost data, vessel route costs were converted to a cost-per-unit freight rate. This served as the minimum rate that must be earned to sustain service on that route (Simat study 1982).

The Simat study concluded that Alaska is served by a competitive liner transport system with low rates already available. Because most costs in modern container operations are not flag related, the possible reductions from changes in the Jones Act are low. Bulk carriers in the southbound trades are mostly charter vessels. Changes in U.S. regulations would not greatly affect this mode, as long-term charters will continue to control these freight rates. The Simat study found that the oil tanker trade would show the greatest response to lifting of Jones Act restrictions, as an excess supply of tankers exists on the world market. The Simat study is the most comprehensive study of Jones Act effects on the Alaska economy, but does not specifically address effects on forest products.

Applicability of the results of these studies on the Jones Act to our study is somewhat limited. Most other studies analyze complete removal of the Jones Act; that is, allowing foreign-flag vessels into the domestic trade. We only allowed entry of U.S.-flag, foreign-built vessels in testing the first objective of this study. A limited change in the Jones Act is perceived to be more feasible than a total change because of potential reactions by special interest groups. If Alaska continues to rely on barge traffic, foreign-built barges could enter this U.S.-flag trade; thus, Alaska barge traffic could retain a competitive advantage over other flags and shipping modes.

Calculating the Effects of the Jones Act

To assess the effects of the Jones Act on the Alaska forest products trade, we constructed a partial equilibrium model of 1982 trade patterns. Using resource rent theory and a linear program to simulate product shipments, we estimated the direct effects of the Jones Act in Alaska. Details of this process are presented by Jackson (1984).

Meeting the Objectives

The three objectives of this study are related. The data collected for the first objective were used to determine the existence and scope of Jones Act differentials. This data set was also used in the partial equilibrium model to estimate the effects of Jones Act freight rates on the direction of trade (the second objective). These results were then used to estimate the effects on net returns and on consumption. This met the third objective: to measure the monetary losses incurred by producers and consumers in Alaska. Positive responses in all three steps rejected our null hypothesis that the Jones Act would have no economic effects on Alaska forest products trade.

The existence of a U.S.-flag rate differential (objective 1) could be confirmed by comparing quoted rates on the same products and routes where equivalent U.S. and foreign-flag vessels operate. This was possible for only a few, mostly foreign, routes. Only U.S.-flag vessels are now permitted to operate on routes restricted by the Jones Act, and their numbers are few. There is some comparability with ocean rates on long coastwise and intercoastal routes; however, direct comparison was not possible as rate information was not disclosed.

To meet objective 1, we applied the technique used in the Simat study (1982) to the specific Alaska trades involved in our analysis. After collecting 1982 transportation data, we calibrated it with the Simat rates. This calibrated data set was used to calculate the Jones Act freight rate differentials for all applicable routes (Cathcart 1984) .

The second objective addressed the effects of the Jones Act on the direction of trade. Our partial equilibrium model of Alaska forest products movements is detailed in appendix 2. This model was run twice using two data sets; the Jones Act freight rates and the unrestricted freight rates. The first run was calibrated to existing 1982 trade patterns and used transportation costs incurred under the Jones Act. The second run tested the effects of an immediate change to transportation rates that were unaffected by Jones Act restrictions on place of construction.

For objective 3, estimates of the primary impacts on each trade route were found by identifying the rate differential between Jones Act trade and unrestricted trade. The model of objective 2 also solved for changes in markets for individual products. Each affected trade volume was multiplied by the change in the freight rate to compute gains under unrestricted trade. The increases in revenue for the internal barge and raft movements and the cost reductions for forest products moving into Alaska also were added. This gave the total primary impact of the Jones Act on the Alaska timber economy, thus satisfying objective 3.

The Theory of Resource Rent

Waterborne transportation of Alaska forest products to foreign and domestic markets is the last in a series of processing steps. Each step consists of intermediate inputs of resources, manufacturing, marketing, and transportation services.

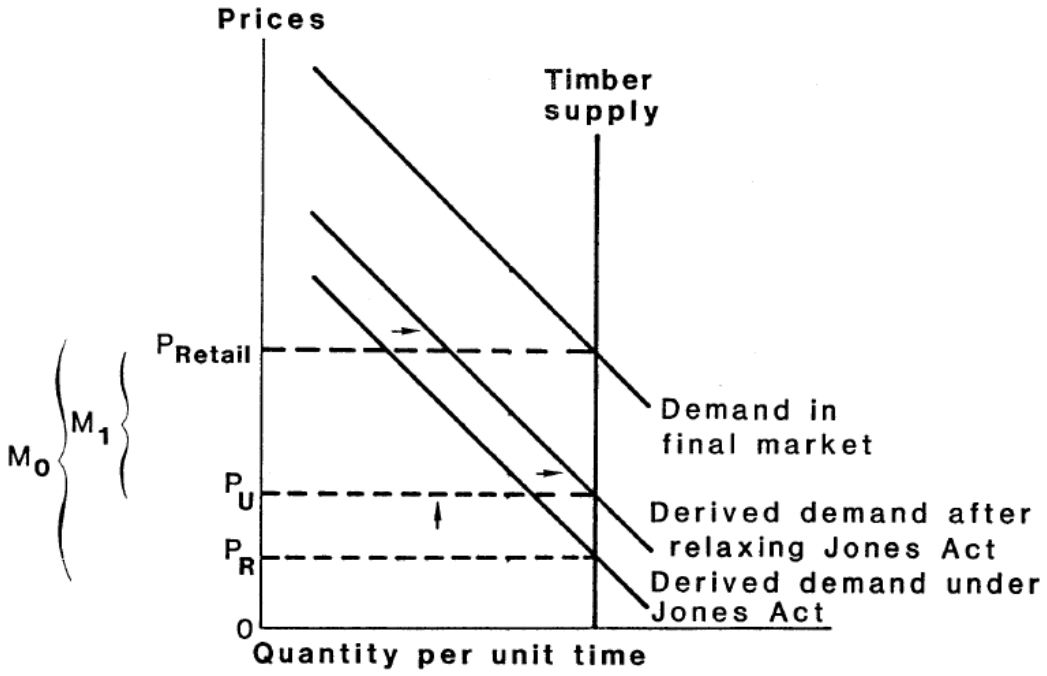
The level of consumption in the final market is a function of product demand and supply. This product demand is a joint demand for all inputs used in the final goods. Likewise, the price-quantity inputs at intermediate production points form the basis for derived demand functions (Tomek and Robinson 1972). These are derived by subtracting the costs of marketing and production (the marketing margin) from demand at each processing step. The demand for a factor of production, such as stumpage, is derived in this way.

Rents on these factors can be measured at a number of levels of the production process: as land value, as stumpage value, or as F.O.B. dock prices. Stumpage value-the difference between the selling price of the exported forest product and the entire industrial stump-to-market cost, including an allowance for profit and risk-is defined as a resource rent (Davis 1966).

The marketing margin between final markets and the last processing step in Alaska is dominated by waterborne transportation costs; the internal transfers between the woods and mills are dominated by those same costs. The Jones Act affects only internal barging and rafting costs for transportation to foreign destinations. Relaxing the Jones Act constraint for shipping to U.S. destinations should decrease shipping costs, thus decreasing both the final marketing and internal transfer margins.

Waterborne transportation costs can be capitalized out of resource values as part of a fixed marketing margin. A decrease in the margin changes F.O.B. prices by the same amount as the stumpage price changes. Thus, F.O.B. changes may be used in the analysis.

When a change in the cost of providing existing services occurs, both retail and producer prices may change. This change in the margin appears as a shift in the derived demand and derived supply functions for the product. The magnitude of the price change at each level depends on the slopes of the supply and demand curves. In the extreme, if the primary supply curve is vertical (figure 2), the entire amount of the margin change (M1 - Me) will accrue to the producers. A decrease in the margin results in an increase in the producer price and a narrower margin.



P_R -Price restricted by effects of the Jones Act

P_u -Price unrestricted by effects of the Jones Act

M_o -High transportation cost marketing margin

M_1 -Low transportation cost marketing margin

Figure 2--Distribution of the gains from a change in the marketing margin.

Assumptions

The basic assumptions necessary to use a partial equilibrium model of the Alaska forest products trade can be grouped into timber supply, transportation supply, and competitive market categories.

All institutional factors, except transportation, that affect timber supply were held constant. These factors included two 50-year timber sales, primary manufacturing regulations on public ownerships, and transportation infrastructure, such as harbors, wharves, and landings. The resource rent model we employed assumed that the supply function of all inputs was fixed at a given level (Friedman 1962). Costs were assumed to be equivalent for all firms. F.O.B. dock prices for any single product were assumed to reflect constant harvesting, primary processing, marketing, energy, and prior transport costs. All price fluctuations were held constant and assumed to have occurred outside the 1982 analysis period.

We assumed that timber harvests would be no less than 1982 recorded levels. This was supported by poor market conditions and by indications that the southeast Alaska timber economy was close to shutting down. Total timber supply was assumed to be greater than total shipments on all routes. Because Alaska is a small-volume supplier, total price responsiveness exists in the roundwood supply curve in the short term.

The long-run Alaska timber supply curve equals regional timber capacity (Rideout 1984). This is compatible with the theory and behavior of market-run timber supply curves (Gregory 1972). Inventories were held constant to constrain producers to supply at or above the 1982 level.

The fixed-input proportion assumption means transportation services and shipping capacity, by route, were held proportional to the volume traded. Economies of scale in the shipping industry were acknowledged, but were held constant at 1982 levels. Container movements in the Jones Act trade represented movements on existing vessel types-smaller bulk carriers, container ships, and tug-barge systems. The probable entry of larger vessels or the possible use of advanced technology in coastwise trade was not included because of data limitations.

The supply of shipping services was assumed to be sufficient to satisfy demand. If increased service was required owing to changing restrictions, the same types of foreign-built, U.S.-flag vessels were allowed entry. Retention of the ownership, manning, insurance, and repair constraints implies that existing shipping firms will reduce costs by purchasing foreign hulls but that the actual firms involved may not change. Repair services are already located in Pacific Northwest and Alaska ports and are not expected to shift to foreign ownership.

Assuming perfect competition in the Alaska forest products marketplace requires that certain conditions hold. Changing the price structure facing Alaska timber producers could alter equilibrium behavior, however. Perfect knowledge of flows and prices may be as unavailable to all participants as it was to us. Free entry and exit of business firms was difficult to superimpose on an industry dominated by two long-term timber sale contracts. In the actual Alaska shipping and forest products industries, margins may not be perfectly constant; however, most Alaska forest products are a small part of world markets. We therefore considered these conditions sufficiently constant for testing our Jones Act hypotheses.

The above assumptions, combined with resource rent theory, allowed the complete transfer of changes in the transportation costs to F.O.B. product prices. These prices served as a proxy for an increase in stumpage prices in tests of relaxing the Jones Act. The entire amount of a reduction in Jones Act freight rates thus caused a corresponding increase in the resource rent of Alaska stumpage.

Data Collection and Freight Rate Estimation

A preliminary review of Alaska's forest products trade indicated that timber production, processing, trade, and price information were required. Several sources for this information were used. The Alaska forest industries and Native Corporations provided most of the information. Federal agencies and port authorities provided most of the trade statistics. Private shipping interests and forest industries in the Pacific Northwest and British Columbia were reluctant to participate, although they did provide some freight rates.

Information on freight rates and product prices was difficult to obtain. Most firms quoted confidentiality as the barrier to sharing this information. Another limiting factor was the state of the economy in southeast Alaska. Several firms were either not operating in 1982 or were producing at levels below normal. This meant that several routes were inactive and that less data were available. Some information was available on major modes and stowage factors. Table 2 contains information on shipments of the main Alaska products, vessel capacity, stowage factors, and sample 1982 costs per unit of cargo. To prevent individual disclosures, we aggregated values into representative product groups and used an average of the sometimes wide-ranging values.

Because much information was missing or incomplete, we used four data sources as limited substitutes for actual market data. Forest product prices, volume flows, and aggregate demand were extracted from the U.S. Department of Commerce (1982), Statistics Canada (1982), Ruderman (1982), and the U.S. Army, Corps of Engineers (1982), data bases. Our final set of costs and prices was sent back to the sources for review during December 1983. Their responses helped identify and repair any inconsistencies in the data.

Most harvested timber moves by water at least once before processing or export. Each of the products under analysis-logs, pulpwood, lumber, pulp, and chips--requires different transportation services. Also, the vessels used vary between routes to the lower 48 States and routes to foreign destinations. Information on each product-route-vessel combination was collected for the model and is presented in appendix 1. Sample 1982 F.O.B. rent estimates are included with this trade flow data. We also collected data on transportation costs from the woods to the mill (or the deepwater landing site) to calculate the barging and rafting costs for internal southeast Alaska movements.

Table 2-Vessel dead weight tonnage, stowage factors, and cost per unit cargo for the major vessel types used in the Alaska forest products trade, 1982

Type of vessel	Products	Vessel dead weight tonnage	Stowage factor	Cost per unit cargo
Log carrier	Logs	16,000-30,000	2.8-5.2 MMBF	$90/MBF
Break-bulk	Lumber/cants	16,000-18,000	6-9 MMBF	$70/MBF
Container	Lumber/cants	16,000-18,000	13-15 MBF/40 ft	1,500/40 ft
Chip carrier	Wood chips	20,000-50,000	15,000-39,000 MT	$48/MT
Pulp carrier	Pulp bales	13,500 avg.	11,500 MT avg.	$66/MT
Container	Pulp bales	15,600 avg.	13,000 MT avg.	$75/MT

The largest cost penalties imposed by the Jones Act occur in capital costs, insurance, labor, fuel, repairs, and maintenance. Figure 3 shows cost differences for U.S.- and foreign-flag vessels in the tug and barge and the bulk carrier trades. The Simat study (1982) methodology uses cost data for U.S.- and foreign-flag vessels to calibrate freight rates on eight services. After we collected 1982 freight rates on three of these services, Cathcart (1984) calibrated costs for both U.S.- and foreign - flag vessels with the Simat rates. We used a Seattle-to-Anchorage container ship service to model the movement of consumer items and building products. A tug and barge service operating between Seattle and Whittier also represented the transport of building materials and general cargo from the the lower 48 States. Shipment of logs to the lower 48 States was modeled using bulk carrier service from Ketchikan to Seattle.

The rate differentials that we used to calculate changes in freight rates on each route are listed in table 3. These are lower than the differentials by country of registry as estimated for international grain trade. They are consistent, however, with estimates from other sources for the Alaska forest products trade, which ranged from 13 to 43 percent with the most frequent being 30 percent.

The Simat study (1982) cost differentials for each forest product trade route were applied to our 1982 freight rates to determine the changes that would result from relaxing the Jones Act. Each change was also added to the resource rent to transfer the change to the timber producers. Any gains in resource rents due to altering the Jones Act eventually showed as increased stumpage prices, given constant selling prices at the delivery point.

The Partial Equilibrium Model

The partial equilibrium model used in this analysis of the Jones Act maximizes rent in the standard linear programming format (Dorfman 1958). A description of the model is provided in appendix 2. Rent maximization, rather than transportation cost minimization, was chosen for several reasons. Direction of trade is a function of delivered price as well as of transport cost. F.O.B. product prices can be used as a proxy for stumpage prices in a rent maximization model. Financial implications for the Alaska economy also may be directly aggregated and interpreted using resource rents.

The model maximized Alaska resource rents that resulted from Pacific Rim trade. The supply and demand regions used in the model are listed in appendix 2. Supply and demand constraints placed some restrictions on rent optimization, including requiring all volume flows to be nonnegative. Shipments from each supplier could not exceed the 1982 capacity of that supplier. The total supplied from all producers had to be less than the total capacity of all producers. The last constraint was that total shipments to each demand region had to equal the quantity consumed in that region. Regional consumptions in 1982 were inflated by 10 percent, under constant 1982 prices, to allow the model to reach new equilibrium. Capacity constraints in the model effectively bounded supply between low-level movements in 1982 and the regional capacity of southeast Alaska.

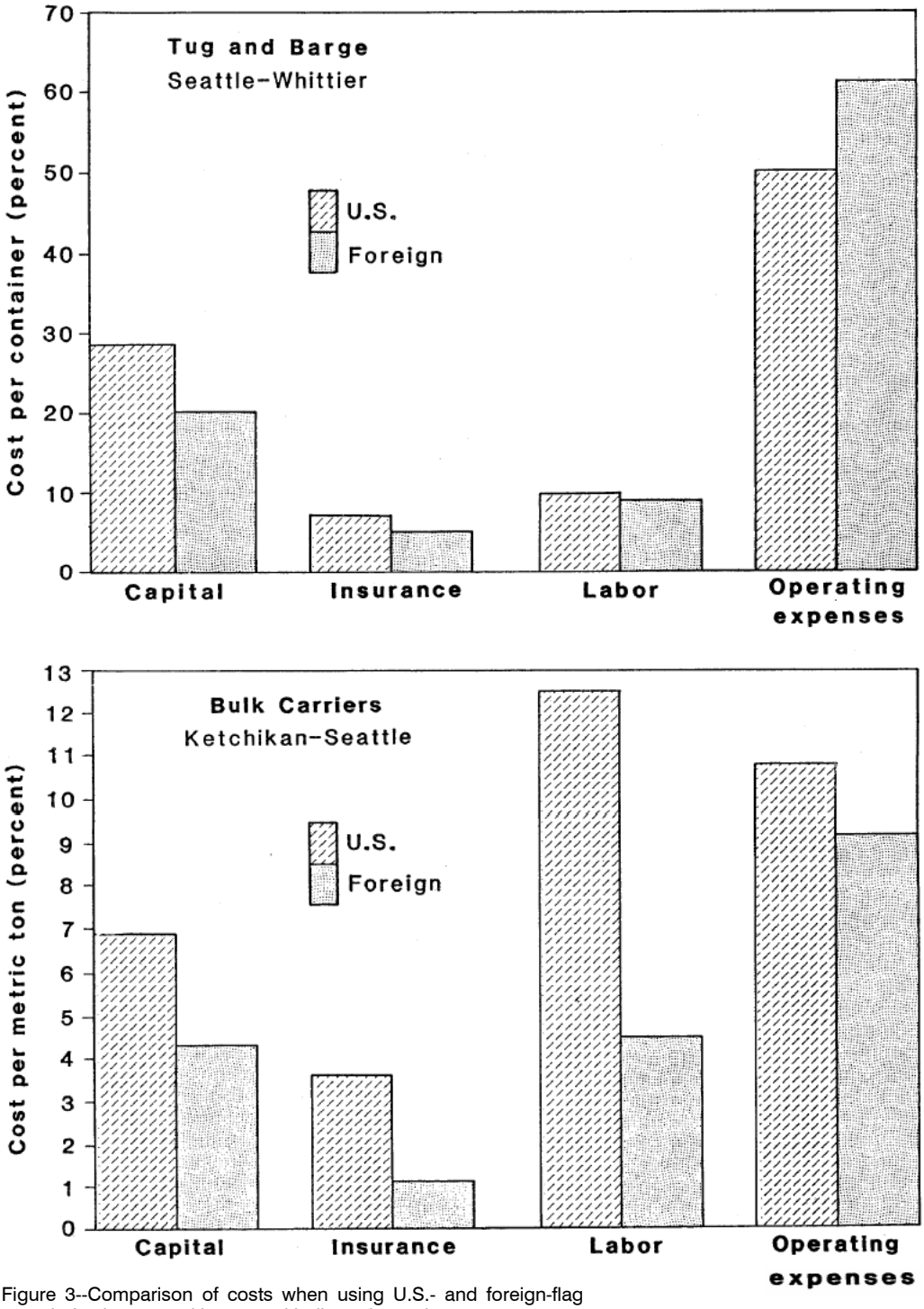


Figure 3--Comparison of costs when using U.S.- and foreign-flag vessels *for* the tug and barge and bulk carrier trades.

Table 3-1982 trade routes, Jones Act freight rates, rate differentials, and changes in Jones Act freight rates for logs, pulpwood, lumber, wood chips, and wood pulp, by shipping mode, in the domestic timber trade in Alaska, as a result of relaxing the Jones Act

Shipping mode	Trade route	Jones Act freight rate	Rate differential	Change in freight rate
		$/unit	percent	$/unit
		LOGS (MBF)		
Tug and barge	SE-PNW	64.00	19.0	12.16
Tug and barge	SE-INT	52.80	19.0	10.03
Tug and log barge	SE-SE	45.08	26.6	11.99
Tug and raft	SE-SE	17.70	6.4	1.14
		PULPWOOD (MBF)		
Tug and barge	SE-PNW	72.13	19.0	13.70
Tug and log barge	SE-SE	50.81	26.6	13.52
Tug and raft	SE-SE	19.95	6.4	1.27
		LUMBER (MBF)		
Tug and barge	SE-PNW	27.00	19.0	5.13
Tug and barge	SE-SE	7.26	19.0	1.38
Tug and barge	SE-INT	29.04	19.0	5.52
Tug and barge	PNW-SE	32.00	19.0	6.08
Tug and barge	PNW-INT	72.00	19.0	13.68
Container ship	SE-PNW	43.38	13.4	5.81
Container ship	PNW-INT	95.00	13.4	12.73
		WOOD CHIPS (MT)		
Tug and barge	SE-PNW	19.46	19.0	3.71
Tug and barge	PNW-SE	19.46	19.0	3.71
Tug and chip barge	SE-SE	12.00	13.1	1.57
		WOOD PULP (MT)		
Tug and barge	SE-PNW	19.00	19.0	3.61

SE = southeast Alaska; INT = interior Alaska; PNW = Pacific Northwest.

Sources: Simat, Helliesen and Eichner, Inc., 1982; Cathcart 1984.

Domestic routes were defined in two ways. The actual volume of trade defined the majority of routes between the British Columbia supply region and the Alaska and Pacific Northwest demand regions. Forest products trade between Alaska and the Pacific Northwest was minimal. The only viable routes were northbound shipments of lumber and building products and southbound shipments of pulp. Consequently, potential routes had to be created to test altering of the Jones Act. Local movements in Alaska were treated in the calculations for internal barging and rafting.

The major Alaska ports involved in forest products shipments are Ketchikan, Wrangell, Sitka, Metlakatla, Haines, Kodiak, and the ports supplying interior Alaska. The first five are active, individual timber export facilities, but were grouped as a single supply region, southeast Alaska, in the model. Kodiak is also an export port serving south-central Alaska. The major ports serving interior Alaska are Anchorage, Whittier, Seward, and Palmer where waterborne shipments of building supplies are transferred to either truck or rail service for land transport.

Internal Barging and Rafting Calculations

Primary movements, including log and chip transfers, within southeast Alaska and to the interior were originally included in the data matrix. This resulted in the model double-counting volumes and in biased results. To correct this problem, local barging and rafting calculations were separated from the main model. Barging and rafting are the only transportation choices for Alaska roundwood, as even most export logs move by water to deepwater landings. These movements are subject to Jones Act regulation. Changing the Jones Act will directly affect resource rents at stumpage price levels in addition to other changes measured in F.O.B. values after processing.

We assumed that 1982 represented the lower limit of roundwood flows for Alaska and that volumes barged and rafted were constant for the 1982 period of analysis. Changes in the cost per mile of barging and of rafting services may actually result in quantity transfers between the two modes. The barging and rafting calculations are described in Cathcart (1984).

The same rate estimation techniques were applied in the main model and in the barging and rafting calculations. This was consistent with our assumption that trade within southeast Alaska would retain the comparative advantages of U.S. ownership and labor without the Jones Act restrictions on construction.

No volume shifts were permitted in the barging and rafting calculations because of data limitations. The change in rent was calculated as the change in the freight rate multiplied by the volume moved on that route. In reality, lower transport costs on internal Alaska routes could shift roundwood to different end products. As further research provides better information, this model could be expanded to better represent changes in volume flows and product shifts.

The routes representing interior and southeast Alaska lumber sales were retained in the main model. These local movements occur on commercial barge services and are final transportation movements. Pulpwood movements in southeast Alaska are retained in the main model and also in calculations of the internal movements. These two entries were considered distinct because movements in the main model represented a supply of pulpwood currently unused on Native Corporation lands. The hypothesis was that a shift in rents could make use of pulpwood profitable as Native harvests are exempt from export restrictions. Including pulpwood in the main model allowed for movements out of Alaska; the internal movements described transfers to processing sites within the State.

Indirect and Induced Effects

Our estimation of impacts from the Jones Act were limited to direct effects only. Changes in wealth were assumed to return to timber growers and forest products consumers to the detriment of the domestic shipping industry. Although the Alaska economy is small and very dependent on imports and exports, a complex set of economic interactions between industrial sectors still exists. Changes in the Jones Act that would benefit the forest products sector would indirectly impact other sectors in addition to marine transportation, forest products, and construction.

Input-output (I/O) models are one tool that can be used to trace an economy's transactions and how changes affect each sector. We estimated the secondary effects of relaxing the Jones Act within the Alaska economy in 1982 by using the Alaska input-output model (IPASS) as developed by the USDA Forest Service (Olson and others 1984). The IPASS model forecasts selected economic indicators over time from initial I/O relationships. Our results were used to adjust the IPASS transportation cost coefficients for forest products movements to simulate the effects on Alaska gross outputs and services.

All economic change takes time, and a change in the Jones Act in one sector would dynamically affect investment rates, subsequent final demands, and employment elsewhere. We used a set of alternative IPASS scenarios to measure the combined direct, indirect, and induced impacts. Our baseline scenario presumed no changes in the Jones Act. The impact scenario assumed that our estimated Jones Act effects began in 1982. Both scenarios were forecast to 1987 for comparison. In both cases, we assumed that the 1977 economic relationships that define the I/O matrix were also representative, in real terms, of our 1982 starting point.

Impacts of the Jones Act

Impacts of the Jones Act on the Alaska forest products industry were measured in several areas. To satisfy the first objective of this study, the effects on freight rates were measured to establish baseline rates. Shifts in the direction of trade were estimated for the first objective, as were the impacts on rents on both coastwise and internal routes. The penalties placed on imports of forest products from the Pacific Northwest were also estimated. Finally, the effects on the Alaska economy as a whole were estimated to show the total impact of the Jones Act and to meet all three objectives.

Freight Rate Differentials

A Jones Act-induced freight rate differential does exist for all domestic waterborne carriers in the Alaska forest products trade. Calculated values of these differentials for the vessels used in each trade are reported in table 3. The magnitude of the freight rate differential (the change in the margin) was interpreted as an increase in the resource rent for timber producers.

The greatest gain after relaxing the Jones Act was on the local southeast Alaska tug and log barge route. A 26.6-percent reduction in the freight rate indicated that significant savings can be realized once existing U.S.-built tugs and barges are replaced by foreign-built vessels. Resource rents increased by $11.99/MBF (thousand board feet) for saw logs and $13.52/MBF for pulpwood, on average routes, after relaxing the Jones Act in 1982. With access to lower tug capital costs, rafting of logs showed a 6.4-percent decrease in the freight rates. This would increase resource rents for rafting saw logs by $1.14/MBF and for rafting pulpwood by $1.27/MBF.

The large savings indicated in the tug and barge mode were limited by the differences between the costs for rafting logs and for barging logs (table 2) within southeast Alaska and by the cost-minimizing actions of the timber producers. Regardless of the size of the rate reduction, barging will substitute for rafting only when the total transportation cost is less.

Shippers using commercial barge services in the Seattle-Alaska lumber trade would realize an overall savings of 19 percent if foreign-built vessels were allowed in the trade. This results in a savings of $6.08/MBF for northbound cargo and $5.13/MBF for lumber moving from southeast Alaska to the Pacific Northwest. The difference between these two rates is due to the backhaul effect.

Container ships are the current alternative to tugs and barges in the coastwise lumber trade. They could be 13.4 percent cheaper if the Jones Act constraint were relaxed. Again, comparison of total freight rates, and not just changes in the margin, indicated that few modal shifts would occur. Container ship rates are higher and are unlikely to drop enough to truly compete with barging systems. No tramp bulk trade exists between the Pacific Northwest and Alaska, but elsewhere, rates are comparable to barging. If foreign-built bulk vessels are allowed on the southeast Alaska-Pacific Northwest route, forest products savings would be similar to savings under barging where suitable ports exist.

Direction of Trade

A reduction in the freight rate created a cost savings that translated to higher resource rents for Alaska timber producers and lower costs to Alaska consumers. The savings were too small, however, to change trade flow patterns in Alaska markets. The most notable result was that little trade shifted by quantity, by destination, or by mode of carriage. After relaxing the Jones Act, Alaska resource rents showed only small changes in the domestic flow of Alaska forest products. These changes are summarized in table 4.

Table 4-Shifts in quantities traded, transportation mode, and final destination of southeast Alaska forest products due to changes in freight rates caused by relaxing the Jones Act

Product	Final destination	Transportation mode	Reduction in freight rate	Change in quantity traded
			$/MBF	MBF
Spruce cants	Pacific NW	Tug and barge	5.13	-2,918
Spruce cants	Pacific NW	Container ship 1/	5.81	2,918
Hemlock cants	Pacific NW	Tug and barge	5.13	-4,968
Hemlock cants	Pacific NW	Container ship 1/	5.81	4,968
Pulpwood	SE Alaska	Tug and raft	1.27	-69,150
Pulpwood	Pacific NW	Tug and barge	13.70	69,150

1/ Shift from tug and barge to container ship based solely on the change in F.O.B. values. Modal selection based on total cost will favor the tug and barge mode at 1982 freight rates.

Initial inspection *of* foreign and domestic product prices (appendix 1) suggested that existing market price differentials could exceed any penalties imposed by the Jones Act on domestic trade routes. Model simulation proved this to be the case. The direct *effect of* the Jones Act was limited to movements along existing domestic routes and to internal movements *of* barged and rafted logs. Sensitivity analysis revealed that the price differential necessary to shift trade was too great for most products. With two exceptions, trade was unaffected even though freight rates decreased on all existing and potential coastwise routes.

The first shift in trade flows was a small-volume switch from barge service to container ships in the spruce and hemlock can't trade from southeast Alaska to the Pacific Northwest. The higher freight rate for container ships caused a larger change in the margin, although the percentage *of* change was less. This incorrectly raised the resource rent for that trade route. Given unequal freight rates on the same route, volume will actually shift into the mode with the lowest freight rate, not the one with the largest change in the margin. When the relative freight rates were analyzed, with and without the Jones Act, barge traffic was still the preferred mode for the same product.

Insufficient trade on the route from southeast Alaska to the Pacific Northwest occurred in 1982 on break-bulk vessels for any data to be included in the model. Foreign-built vessels would have a comparative advantage here, and this route may be long enough for them to exercise that advantage over barges. Bulk cargo freight rates could decrease as much as 21 percent if the Jones Act were relaxed. Break-bulk freight rates were between barge rates and container ship rates in magnitude. Other factors, such as the necessity for multiple-site loading, still weigh against coastwise break-bulk movements. Because changing barge and container ship freight rates did not change the level of volume traded, using break-bulk carriers should not either. As. modal shifts occurred between barges and container ships, it was more likely that changes in break-bulk rates would affect modal choices.

The second, significant trade flow shift was a change in destination for southeast Alaska pulpwood logs. The greater change in the tug and barge resource rent (+$13.70/MBF) for the Pacific Northwest route over the internal (+$13.52/MBF) route was partially due to the longer distance involved. Within southeast Alaska, Native Corporation pulpwood shifted from internal rafting to southbound barge movement (table 3). We interpreted this shift as increased production from Native lands because utility volume is currently left in the woods, because British Columbia sources are increasing their southeast Alaska market shares, and because Native Corporations may legally export unprocessed roundwood.

This shift in pulpwood movements was significant, as it was the only change in a trade route that resulted from relaxing the Jones Act. This should not be viewed as sufficient evidence for initiating profitable trade on this route. Our analysis used generalized, representative data and was not designed to give precise estimates of feasibility.

Rents for Alaska Forest Products

The primary impacts of a cost differential on the resource rents accruing to Alaska forest products were relatively small in the coastwise trade. The total estimated rent of the Alaska forest products trade was $504,015,880 under the Jones Act. Without the Jones Act constraint, this increased to $505,417,017. The difference, $1,401,137, was the total calculated change in the margin. After correcting for errors in modal choice, resource rents increased by $1,355,319 as a result of relaxing the Jones Act on these routes. This represented an impact of 0.3 percent on the total wholesale (FO.B.) value of Alaska forest products exports to all destinations and 6.5 percent of the value of existing exports to the Pacific Northwest.

The internal shipments of southeast Alaska forest products are pulpwood and saw logs moving by raft or log barge, and wood chips moving on chip barges. If the Jones Act were relaxed, the entire change in resource rent would result from changes in freight rates. Because volumes moving on given routes were assumed to remain constant, the change in rent was simply the change in the dollar-per-unit freight rate multiplied by the volume moved. Residual rents for pulpwood increased by $320,676; by $373,255 for saw logs; and by $328,951 for wood chips (table 4). The requirement that all forest products moved within Alaska be on Jones Act vessels increased freight rates by $1,022,881 in 1982. Under improved market conditions, this impact would increase as more volume leaves the woods and is transported to processing sites.

The effect of the Jones Act on 1982 Alaska resource rents of primary products was almost as great as the effect on coastwise trade. The rate differential was less owing to shorter routes, but the penalty was greater because all logs and chips moved from the forest to the primary processing site by water. A double penalty under the Jones Act also exists for final products exported to the lower 48 States, but because most Alaska wood exports were transported to foreign markets in 1982, the impact was small.

If the Jones Act constraint were relaxed, the relative advantage of log barging would be improved. Although barge rates would still be higher than those for rafting, the use of more barge routes could become economically feasible. Lower freight rates would also extend the distances that would be economical for towing and barging and increase the feasibility of gaining access to more remote supply areas.

Effects on calculated internal movements added $1,022,881 to the $1,355,319 coastwise savings in trade costs; the total resource rents after relaxing the Jones Act increased to $2,378,200 for the 1982 analysis period. Although measured by F.O.B. values, the difference in resource rents accrued to, and was realized by, stumpage owners, including the Forest Service, Native Corporations, and the State of Alaska. Table 5. reports the estimated increases in resource rent accruing to each Alaska forest product export on all modes as a result of relaxing the Jones Act.

Imported Forest Products

The effect of relaxing the Jones Act on movements of imported forest products is much simpler. Assuming a fixed demand for finished wood and construction materials allowed the volumes shipped and consumed to be held constant. The tug and barge cost savings of 19 percent translated into a $6.08/MBF price reduction for lumber on the shorter and lower volume (34,565 MBF) Pacific Northwest to southeast Alaska route and $13.68/MBF reduction on the Pacific Northwest-interior route (159,149 MBF). Neither change was more than 3 percent of the delivered price.

The impact of the Jones Act on Alaska imports was calculated by multiplying each change in the margin by the respective volume of trade. The total effect in 1982 on forest products imported into Alaska was $2,387,313 (table 5). If shipping responds competitively and our assumptions hold, this savings could accrue to the Alaska consumer.

The Total Impact

The total 1982 Jones Act impact on forest products trade, as summarized in table 5, was $4.77 million. Half of the annual effect was borne by Alaska timber growers ($2.38 million) and half by Alaska consumers of forest products that were imported from the lower 48 States ($2.39 million).

The significance of results generated by this type of analysis may be misleading. The estimate is reliable only to three significant figures. Given the nature of the data base, no confidence intervals can be calculated.

Table 5-Changes in resource rent, by product, mode, and trade route, after relaxing the Jones Act, 1982

Product	Units	Final destination 1/	Transportation mode	Volume moved	Change freight rate	Total resource rent
				unit	$/unit	1982 dollars
			PULP			
Dissolving pulp	MT	Pacific NW	Tug and barge	24,177	3.61	87,279
Sulphite pulp	MT	Pacific NW	Tug and barge	5,427	3.61	19,591
Total pulp						106,870
			WOOD CHIPS			
Wood chips	MT	Pacific NW	Tug and barge	73,487	3.71	272,637
Wood chips	MT	SE Alaska	Tug and barge	209,523	1.57	328,951
Total wood chips						601,588
			LUMBER AND CANTS SHIPPED FROM SOUTHEAST ALASKA			
Spruce dimension	MBF	Interior	Tug and barge	88	5.52	486
Spruce dimension	MBF	SE Alaska	Tug and barge	157	1.38	217
Spruce cants	MBF	SE Alaska	Tug and barge	4,940	1.38	6,817
Hemlock dimension	MBF	SE Alaska	Tug and barge	494	1.38	682
Hemlock cants	MBF	SE Alaska	Tug and barge	8,185	1.38	11,295
Total lumber shipments						19,497
			LUMBER AND CANTS SHIPPED FROM PACIFIC NORTHWEST			
All species dimension	MBF	Interior	Tug and barge	159,149	13.68	2,177,158
All species dimension	MBF	SE Alaska	Tug and barge	34,565	6.08	210,155
Total lumber receipts						2,387,313
Total lumber trade						2,406,810
			LOGS			
Saw logs	MBF	SE Alaska	Log barge	9,980	11.99	119,657
Saw logs	MBF	SE Alaska	Tug and raft	222,454	1.14	253,598
Spruce No. 3	MBF	Interior	Tug and barge	132	10.03	1,324
Spruce No. 1	MBF	Pacific NW	Tug and barge	570	12.16	6,931
Hemlock No. 2	MBF	Pacific NW	Tug and barge	58	12.16	705
Total logs						382,215
			PULPWOOD			
Pulpwood	MBF	SE Alaska	Log barge	14,522	13.52	196,340
Pulpwood	MBF	SE Alaska	Tug and raft	97,902	13.52	124,336
Pulpwood	MBF	Pacific NW	Tug and barge	69,150	13.70	947,355
Total pulpwood						1,268,031
Total change in resource rent						4,765,514

NW = northwest; SE = southeast.

1/ All movements originate in southeast Alaska unless otherwise indicated.

The Alaska Economy

The IPASS I/O model indicates that changes in the forest products industry after relaxing the Jones Act are minimal when taken in the perspective of the entire Alaska economy. Stumpage gains are mostly transferred to the U.S. treasury, minus payments to local governments. The gains for wood consumers in Alaska are such a small proportion of total expenditures in the construction sector that the effect is not measurable.

Table 6 shows forecasts of total Alaska employment and gross output over 5 years. Redistribution of employment and gross output after relaxing the Jones Act was predictably concentrated in a few sectors. By 1987, the loss of 9 jobs in water transportation was offset by gains of 134 jobs in logging, 9 in new construction, 27 in wholesale and retail sales, and 27 in Federal, State and local government positions. The $1.7 million 1987 gross output reduction (in 1982 dollars) for the water transport sector was compensated by gains in numerous other sectors: logging increased $10 million, forestry $2.8 million, new construction $1.4 million, and wholesale and retail sales $1 million. These gains were small when dispersed over the entire Alaska economy; about 0.10 percent per year in employment and 0.09 percent per year in gross output. Most of these gains were attributed to the increased pulpwood activity.

Transportation policy changes applied to a single Alaska product had measurable, but small, impacts on the State's economy as a whole. Changing the Jones Act constraint across all sectors was beyond the scope of this study; however, such results should be significant in this geographically isolated, maritime economy.

Table 6-Direct, indirect, and induced effects on total employment and gross output from relaxing the Jones Act for the Alaska forest products trade, 1982-87

	Employment			Gross output		
Year	Jones Act	Non-Jones Act	Total gain	Jones Act	Non-Jones Act	Total gain
	1000 people years			Million 1982 dollars		
1982	193.7	193.7	NA	16,248	16,248	NA
1983	192.2	192.3	+0.1	18,173	18,185	+12
1984	200.6	200.7	+ .1	19,497	19,519	+22
1985	209.4	209.6	+ .2	20,748	20,765	+17
1986	218.8	219.0	+ .2	21,992	22,009	+17
1987	229.3	229.5	+ .2	23,359	23,387	+28
Total gains			+ .8			+96

Qualifying the Analysis

We used sensitivity analysis to calculate the highest market prices for each product. This highlighted which changes in resource rents were necessary to further change the results. These values are listed in table 7 for those products that changed either in mode or volume level.

The shadow price indicated the marginal value of adding one more unit of volume to a route. In this model, it was also the difference between the non-Jones Act resource rent and the highest market price, usually in export markets. The shadow price indicated that several products needed a change of over $100.00 per unit to shift volume from foreign markets to the domestic trade. For example, dissolving pulp moving from southeast Alaska to the Pacific Northwest by tug and barge required a price increase of $141.39 before more dissolviJ1g pulp would shift to that route. If the resource rent rose to the highest market price, the quantity moving on that trade route would increase by the amount listed under volume increase. If this amount were small, the change would be tightly bound by other restrictions. For the dissolving pulp example, only 499 MT could be added to this trade.

Information on the wood-chip trade with the Pacific Northwest indicated that the resource rent could drop $3.71 with no effect on trade levels. This is the difference between the 1982 export price for chips and the resource rent for this trade route. The simulatio.n also indicated that no expansion of trade would occur as a result of low 1982 market activity. Chip trade is largely dependent on the volume of timber processed. In poor market years, most wood chips are used in the pulping process. In better years, chips are available for export as more timber is processed and pulping needs are met.

In contrast, the model's solution for the sulphite pulp barge trade with the Pacific Northwest was at the highest level possible. Trade expansion was fully limited by other constraints. Reducing the volume traded would allow increased trade on other routes, but at reduced rent gains. No better market price existed than this $280.61 resource rent. Any unit reduction after relaxing the Jones Act would decrease the total resource rent by this amount, up to a total change of 1,391 MT.

Table 7-Shadow prices, highest market prices, and increases in volume resulting from sensitivity analysis of the major affected trade flows, 1982

Product	Units	Final destination	Transportation mode	Resource rent	Shadow price 1/	Highest market price	Volume increase
					-$/unit-		unit
Dissolving pulp	MT	Pacific NW	Tug and barge	454.61	141.39	596.00	499
Sulphite pulp	MT	Pacific NW	Tug and barge	280.61	-280.61	0	-1,391
Wood chips	MT	Pacific NW	Tug and barge	64.71	-3.71	61.00	0
Spruce cants	MBF	Pacific NW	Container ship	718.81	-.68	718.13	-2,918
Hemlock dimension	MBF	Interior	Tug and barge	177.52	163.48	341.00	0
Hemlock No. 2 logs	MBF	Pacific NW	Tug and barge	312.16	237.84	549.99	2,324
Pulpwood	MBF	SE Alaska	Tug and barge	140.52	.18	140.70	60,000
Pulpwood	MBF	SE Alaska	Tug and raft	128.70	12.00	140.70	69,150
Pulpwood	MBF	Pacific NW	Tug and barge	140.70	-.18	140.52	-60,000

NW = northwest; SE = southeast.

1/ Represents the necessary change in the non-Jones Act resource rent to change the solution.

The pulpwood trade provided an interesting study of model interactions. The Jones Act simulation moved all the surplus Native pulpwood within southeast Alaska by tug and raft. This was not closely correlated to actual 1982 trade patterns, as harvesting Native pulpwood was uneconomical and much was left in the woods. Local movements are, however, the most probable routes that would be utilized under better economic conditions. Relaxing the Jones Act caused the greatest change in the resource rent in the tug and barge route from southeast Alaska to the Pacific Northwest. Consequently, all 69,150 MBF of Native pulpwood shifted into the Pacific Northwest market at the new resource rent of $140.70. The shadow price revealed that this commodity is very sensitive to price changes. An $0.18 decrease in price would shift pulpwood back into the southeast Alaska market.

Validation of the model was done during the sensitivity analysis. All supply, capacity, and demand constraints were tested to establish their limits. In addition, the highest market price behavior and the barge-container ship modal switches were tested. Details of these test results are presented in Jackson (1984).

Conclusions

All three study objectives were met. Differential freight rates do exist on Alaska transportation routes. These differences were measured for all Alaska forest products on the major modes and routes. Second, the effects of the Jones Act on direction of trade was measured, although at a low level. Finally, the losses incurred by forest products consumers and producers in Alaska were calculated for the analysis period. From this, we can reject the hypothesis that the Jones Act had no effect on forest products trade in Alaska in 1982.

Our major conclusion is that the Jones Act does affect the Alaska forest products trade. The total 1982 reduction in producer and consumer wealth in Alaska was approximately $4.77 million. However, little change in the level of trade of individual products or in final market destinations occurred after relaxing the Jones Act. The effects of the Jones Act were small and transportation rate changes did not appear to be a major factor in market determination.

The results of this study agreed with most of the previous research on the Jones Act. The conclusion that the Jones Act alone does not impede market access was made by Austin and Darr in 1975. Confirming that transportation cost changes can shift markets if no other constraints are binding is consistent with the findings of the U.S. Senate (1970). As Morgan (1980) concluded, the long run response to the Jones Act is to concentrate on unconstrained export markets. Boyd (1981) reached the conclusion that the economic effect of the Jones Act on the softwood lumber industry in the lower 48 States is small and insignificant. Our findings for Alaska concurred.

Low-value products and the longer trade routes exhibited greater sensitivity to changes in transportation costs. These products and routes were more sensitive to rate changes because transportation costs constituted a greater proportion of total costs. Where equal transportation rates existed between two competing modes for the same product-route combination, modal shifts were sensitive to rate changes.

Differences in final market price appeared to have more control over final destination than did transportation cost changes for all but the lowest valued products. High-valued products, such as pulp, lumber, and cants, continued to move overseas, unaffected by the Jones Act. Large price changes in these products were required to divert volume to domestic markets. This supported the theory that Alaska's comparative advantage is in Pacific Rim countries.

As a greater volume of Native timber is harvested and available for export, more pulpwood will be jointly produced (Mehrkens 1983). Reducing the freight rate appeared to increase volumes moving to the lower 48 States. Recent market activity has included shipments of better grades of Alaska "pulpwood" to the Pacific Northwest in response to higher hemlock log prices and shrinking supplies. For the same reasons, chips, spruce cants, and hemlock cants also may have market possibilities there. Relaxing the Jones Act improved Alaska competitiveness only slightly in the Pacific Northwest, but generally not enough to open new markets and shift trade flows.

Any changes in Alaska forest products transportation rates will result in gains to the producers and consumers and losses for the shipping services. We represented these gains and losses as instantaneous: windfall profits to timber growers and consumers in Alaska and losses to the shippers with U.S.-built vessels. Actually, the $4.77-million 1982 effect of the Jones Act, and subsequent annual effects, would appear gradually as competitors offering lower costs enter the transportation market. There would be an instant loss related to the monopoly equity of existing U.S.-built vessels, but full transition to unrestricted domestic trade for the Alaska forest industry and the shipping industry would not be instantaneous.

Our conclusions were drawn from the sample data for 1982, which represented a low volume year. Under improved market conditions, the transportation differential may not change much and should become an even smaller proportion of rising product prices. The major increase in annual impacts from the Jones Act would come from increases in price-responsive internal movements of roundwood.

Testing the effects of the Jones Act under poor market conditions should show the economic conditions that are most likely to generate trade shifts. In better markets, trade diversion may be even more unlikely. However, in the event of constrained timber supplies or other institutional changes in the Pacific Northwest and British Columbia, trade diversion may become possible.

The long-run implications of relaxing the Jones Act in the Alaska forest products trade, although small, are several. Over time, the resource rents returning to timber producers could increase, while those of shippers with existing U.S.-built vessels in their fleets may fall. As these vessels are retired, the operators will again receive returns comparable to those received by their competitors using foreign-built vessels. Thus, altering the Jones Act will favor operators with fleets near retirement age and new entrants in the shipping business.

Alaska consumers will benefit as the prices of construction materials fall with changing freight rates. The short-run effect is to increase consumer savings, while in the long run, housing costs could drop slightly.

Altering the Jones Act could improve service in Alaska trade. As technological innovations become available in world shipping markets, an unrestrained Alaska shipping industry would be free to supply new services, which would improve the well being of both industries. Relaxing the Jones Act would help the Alaska forest products industry become more competitive with adjacent timber supply regions (British Columbia and the Pacific Northwest), and new trade patterns could eventually develop.

Metric and English Equivalents

Logs and lumber:
1,000 board feet, Scribner log scale (MBF) = 4.53 cubic meters (m^3)
1,000 board feet, Scribner lumber tally (MBF) = 2.36 cubic meters (m^3)
1,000 board feet, Scribner lumber tally (MBF) = 1.7 Brereton MBF
1,000 board feet, Scribner lumber tally (MBF) = 0.521 MBF, log scale
1 40-foot container = 13-15 MBF, lumber tally
1 20-foot container = 6-8 MBF, lumber tally

Pulp and chips:
1 air-dry short ton (ADST) pulp = 2,000 pounds (lb)
1 metric ton (MT) = 0.90718 short ton
1 ADST = 1.1023 air dry metric ton pulp (AOMT)
1 bone-dry ton pulp (BDT; ALP) = 2,000 pounds (lb)
1 BDT = 1.0886 metric ton
1 bone-dry unit pulp (BDU; LPK, Canada) = 2,400 pounds (lb)
1 BDU = 96 cubic feet (ft^3) western hemlock chips
1 MT western hemlock chips = 2.497 cubic meters (m^3)
1 ADST pulp = 2.06 BDU chips

Other:
1 meter (m) = 3.28 feet
1 square meter (m^2) = 10.76 square feet (ft^2)
1 cubic meter (m^3) = 35.314 cubic feet (ft^3)
1 hectare = 2.47 acres

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Appendix 1

1982 Alaska Forest Products Trade Flows

Examples of 1982 Alaska forest products trade flows are included here (tables 8-14). These tables explain the trade flows for the active 1982 product-route combinations. Each table contains the route distance, the 1982 Jones Act freight rates for all active modes, the average product price, and the total volume moved in 1982. The aggregated product price is the resource rent proxy used in the analysis, as is the volume moving at this price.

Table 8-1982 freight rates, product prices, and volumes moved, for western hemlock No.2 logs, on bulk carriers

Route	Route distance	Bulk carrier freight rate	Product price	Volume moved in 1982 1/
	miles	$/MBF	$US F.O.B.	MBF
Alaska to Japan	4,055	90	350	119,927
Alaska to Republic of Korea	4,015	94	2/ 434	4,134
Alaska to Pacific Northwest	728	3/ 72	300	58
British Columbia to Republic of China	4,650	4/ 93	5/ 199	887
British Columbia to Japan	4,293	87	5/ 235	51,389
British Columbia to Pacific Northwest	252	3/4/ 25	5/ 199	23,241
Pacific Northwest to People's Republic of China	5,185	99	300	18,984
Pacific Northwest to Republic of China	4,650	4/ 97	253	2,721
Pacific Northwest to Japan	4,293	93	380	647,002
Pacific Northwest to Republic of Korea	4,520	100	260	206,183
Pacific Northwest to British Columbia	252	3/4/ 25	230	1,841
Southeast Alaska 6/	150	7/ 18	NA	144,595
Southeast Alaska 6/	150	3/ 45	NA	6,487

NA = not available.

1/ Volume includes all log grades.
2/ Source: U.S. Department of Commerce (1982).
3/ Tug and barge movement.
4/ Estimate based upon actual market situation.
5/ Source: Statistics Canada (1982).
6/ Internal movements calculated for the submodel.
7/ Tug and raft movement.

Table 9-1982 freight rates, product prices, and volumes moved, for Sitka spruce cants, on bulk carriers and container ships

Route	Route distance	Bulk carrier freight rate	Container ship freight rate	Product price	Volume moved in 1982
	miles	$/MBF	$/MBF	$US F.O.B.	MBF
Alaska to People's Republic of China	4,295	1/ 80	1/ 80	2/ 344	3/ 9,846
Alaska to Japan	4,055	57	81	410	3/ 83,966
Alaska to Republic of Korea	4,015	107	107	520	3/ 993
Southeast Alaska (internal)	150	4/5/ 7	NA	347	3/ 4,491
Alaska to Pacific Northwest	728	5/ 27	27	713	3/ 2,653
British Columbia to People's Republic of China	5,185	80	50	426	6/ 624
British Columbia to Japan	4,293	66	57	426	6/ 64,706
Pacific Northwest to Japan	4,293	70	81	548	4,844
Pacific Northwest to Republic of Korea	4,520	90	93	548	2,593
Pacific Northwest to British Columbia	252	5/ NA	NA	6/ 363	164

NA = Not available.

1/ Estimate based upon actual market conditions.
2/ Source: U.S. Department of Commerce (1982).
3/ Volume includes all rough lumber (clears and cants).
4/ Calculated for analysis.
5/ Tug and barge movement.
6/ Volume includes rough and dressed lumber (clears, dimension, and cants).

Table 10-1982 freight rates, product prices, and volumes moved, for western hemlock dimension lumber, on bulk carriers and container ships

Route	Route distance	Bulk carrier freight rate	Container ship freight rate	Product price	Volume moved in 1982
	miles	$/MBF	$/MBF	$US F.O.B.	MBF
Alaska to Japan	4,055	57	81	341	1/ 453
Alaska to Republic of Korea	4,015	107	107	2/ 495	1/ 1,001
Southeast Alaska to interior Alaska	610	3/ 29	NA	4/ 172	1/ 0
Southeast Alaska (internal)	150	3/5/ 7	NA	172	1/ 49
British Columbia to People's Republic of China	5,185	80	50	361	6/ 28,877
British Columbia to Japan	4,293	66	57	361	6/ 771,181
British Columbia to Pacific Northwest	252	3/ NA	NA	188	6/ 683,888
Pacific Northwest to Japan	4,293	70	81	271	1/ 142,574
Pacific Northwest to Republic of Korea	4,520	90	93	350	1/ 50
Pacific Northwest to British Columbia	252	3/ NA	NA	335	1/ 5,008

NA = not available.

1/ Volume includes all rough lumber (clears and cants).
2/ Source: U.S. Department of Commerce (1982).
3/ Tug and barge movement.
4/ Estimate based upon actual market situation.
5/ Calculated for analysis.
6/ Volume includes rough and dressed lumber (clears, dimension, and cants).

Table 11-1982 freight rates, product prices, and volumes moved, for dissolving pulp, on bulk carriers and container ships

Route	Route distance	Bulk carrier freight rate	Container ship freight rate	Product price	Volume moved in 1982
	miles	$/ADMT	$/ADMT	$US F.O.B.	ADMT
Alaska to People's Republic of China	4,925	1/ 75	1/ 80	2/ 419	14,449
Alaska to Republic of China	3,895	65	1/ 77	2/ 505	7,249
Alaska to Japan	4,055	66	1/ 70	596	94,278
Alaska to Republic of Korea	4,015	81	77	677	339
Alaska to India	8,834	99	1/ 100	2/ 458	7,525
Alaska to British Columbia	476	1/3/ 15	NA	2/ 490	150
Alaska to Pacific Northwest	728	3/ 19	NA	2/ 451	24,177
British Columbia to People's Republic of China	5,185	45	1/ 80	4/ 442	6,294
British Columbia to Republic of China	4,650	42	1/ 77	4/ 416	9,076
British Columbia to Japan	4,293	42	1/ 75	4/ 503	5,695
British Columbia to Republic of Korea	4,520	42	77	4/ 629	427
British Columbia to India	9,148	1/ 50	1/ 90	4/ 425	6,581
British Columbia to Pacific Northwest	252	1/3/ 10	NA	4/ 524	9,740
Pacific Northwest to Republic of China	4,650	60	1/ 77	445	5,805
Pacific Northwest to Japan	4,293	56	75	730	49,572
Pacific Northwest to Republic of Korea	4,520	63	1/ 77	675	10,297

NA = not available.

1/ Estimate based upon actual market conditions.
2/ Source: U.S. Department of Commerce (1982).
3/ Tug and barge movement.
4/ Source: Statistics Canada (1982).

Table 12-1982 freight rates, product prices, and volumes moved, for sulphite pulp, on bulk carriers and container ships

Route	Route distance	Bulk carrier freight rate	Container ship freight rate	Product price	Volume moved in 1982
	miles	$/ADMT	$/ADMT	$US F.O.B.	ADMT
Alaska to Japan	4,055	66	1/ 70	2/ 427	205
Alaska to India	8,834	99	1/ 100	430	1,637
Alaska to British Columbia	476	1/3/ 15	NA	2/ 328	296
Alaska to Pacific Northwest	728	3/ 19	NA	277	4,036
British Columbia to Republic of China	4,650	42	1/ 77	4/ 518	5,271
British Columbia to Japan	4,293	42	1/ 75	4/ 530	5,882
British Columbia to Republic of Korea	4,520	42	77	4/ 519	571
British Columbia--Hong Kong	5,795	1/ 45	1/ 80	4/ 499	75
British Columbia to Pacific Northwest	252	1/3/ 10	NA	4/ 480	9,868
Pacific Northwest to British Columbia	252	1/3/ 10	NA	2/ 441	1,138
Pacific Northwest to Republic of China	4,650	60	1/ 77	2/ 392	4,121
Pacific Northwest to Japan	4,293	56	75	2/ 459	43,381
Pacific Northwest to Republic of Korea	4,520	63	1/ 77	2/ 473	7,567
Pacific Northwest to Hong Kong	5,795	1/ 58	1/ 80	2/ 351	2,088
Pacific Northwest to India	9,148	1/ 60	1/ 90	2/ 509	1,637

NA = not available.

1/ Estimate based upon actual market conditions.
2/ Source: U.S. Department of Commerce (1982).
3/ Tug and barge movement.
4/ Source: Statistics Canada (1982).

Table 13-1982 freight rates, product prices, and volumes moved, for wood chips, on tug and barge and conference carriers

Route	Route distance	Tug and barge freight rate	Conference carrier freight rate	Product price	Volume moved in 1982
	miles	$/ADMT	$/ADMT	$US F.O.B.	ADMT
Alaska to Japan	4,055	NA	217	61	67,280
Alaska to British Columbia	476	1/ 25	NA	61	0
Alaska to Pacific Northwest	728	1/ 50	NA	61	0
British Columbia to Japan	4,293	NA	217	61	396,654
British Columbia to Alaska	476	1/ 25	NA	61	2/ 734,869
British Columbia to Pacific Northwest	252	1/ 25	NA	64	2/ 734,869
Pacific Northwest to Japan	4,293	NA	217	80	2,029,821
Pacific Northwest to British Columbia	252	25	NA	64	4,757
Pacific Northwest to Alaska	728	1/ 50	NA	64	0
Pacific Northwest to Pacific Northwest	150	NA	NA	64	NA
Southeast Alaska (internal)	150	3/ 12	NA	55	209,523

NA = Not available.

1/ Estimate based upon actual market conditions.
2/ Includes exports to Alaska and the Pacific Northwest.
3/ Internal movement calculated for the submodel.

Table 14-1982 freight rates, product prices, and volumes moved, for pulpwood, on bulk carriers

Route	Route distance	Bulk carrier freight rate	Product price	Volume 1/ moved in 1982
	miles	$/MBF	$US F.O.B.	MBF
Southeast Alaska (internal)	150	2/ 27	3/ 127	4/ 14,522
Southeast Alaska (internal)	150	5/ 27	3/ 127	4/ 97,902
Alaska to Pacific Northwest	728	2/ 72	3/ 127	0
British Columbia to Alaska	476	2/ 25	122	6/ 87
British Columbia to Pacific Northwest	252	2/7/ 25	122	6/ 87
Pacific Northwest to British Columbia	252	2/7/ 25	86	1,759

NA = not available.

1/ Volume includes all pulp species.
2/ Tug and barge movement.
3/ Calculated for analysis.
4/ Internal movements calculated for the submodel.
5/ Tug and raft movement.
6/ Estimate based upon actual market situation.
7/ Source: Statistics Canada (1982). Volume shipped to U.S.

Appendix 2

The Partial Equilibrium Model

The partial equilibrium model set X_{ijk} to represent the nonnegative volume of commodity k shipped from supplier i to demand region j. R_{ijk} is the resource rent per unit of commodity k for shipment between the ith supplier and the j^{th} demand region. Only when i = Alaska are these rents other than zero. Thus, R_{ijk} represents the unique rent that can be derived from delivered price and shipping costs for Alaska forest products. The total resource rent is the sum of individual rents for all trade flows across all Alaska suppliers, destinations, and commodities. The effects of relaxing the Jones Act appear in a second simulation where Rijk'S affected by the Jones Act are increased by the cost differential.

The supply and demand regions used in this model are:

Supply region	**Demand region**
Southeast Alaska	Southeast Alaska
British Columbia	Pacific Northwest
Pacific Northwest	British Columbia
	Interior Alaska
	Japan
	Republic of Korea
	People's Republic of China
	Republic of China
	India
	Hong Kong

The form of the resource rent model used in this analysis is as follows:

Maximize Alaska resource rents:

$$Z = \sum_{i=1}^{l} \sum_{j=1}^{m} \sum_{k=1}^{n} R_{ijk} \; X_{ijk};$$

where: i=1 to l suppliers,
j=1 to m demanders, and
k=1 to n commodities.

Subject to:

Supply constraint:

$$\sum_{j=1}^{m} \sum_{k=1}^{n} X_{ijk} \geq S_{ik},$$

where: S_{ik} = production level of supplier i for commodity k.

Capacity constraint:

$$\sum_{j=1}^{m} \sum_{k=1}^{n} X_{ijk} \leq C_{ik}$$

where: C_{ik} = capacity level of supplier i for commodity k.

Demand constraint:

$$\sum_{i=1}^{l} \sum_{k=1}^{n} \quad (1.1) \quad X_{ijk} = D_{jk},$$

where: D_{jk} = requirements of demand region j for commodity k.

Nonnegativity constraint:

The nonnegativity constraint was modified to represent 1982 movements. Thus, shipments were set greater than or equal to the 1982 volume of trade:

$$X_{ijk} \geq M_{ijk}$$

where: M_{ijk} = actual 1982 trade volume from supplier i to demand region j for commodity m.

This did not bias the second simulation, as under the Jones Act, exports to the lower 48 States are almost nonexistant.

Two coefficient matrices were used in the model. The first contained transportation costs affected by the Jones Act; the second tested the effects of an immediate shift to transportation rates unaffected by the Jones Act. Each matrix groups, by commodity, all information for each route. Matrix size is defined by 10 Alaska forest product trade destinations, 6 possible carrier types, 6 commodities, and 2 timber species. Each data matrix contains over 400 route/product/mode variables and about 250 supply, demand, and capacity constraints (Jackson 1984).

Glossary

Backhaul-A return voyage to the home port, often at a reduced freight rate to avoid travel in ballast.

Break-bulk-Cargo packed in separate packages, in many consignments, or as individual pieces of cargo. Packages are loaded, stowed, and unloaded individually; as distinct from bulk cargo.

Bulk carriers-Ship designed to carry bulk, nonliquid cargo.

Cabotage-Coastal maritime transportation within one country and restricted to vessels of domestic registry.

Cant-A log squared on four sides to reduce stowage or to circumvent local manufacturing restrictions. (See also Waney.)

Coastwise-A shipping service between ports on the same coast.

Common carriers-Any vessel or person presented to the general public as ready, able, and willing to engage in interstate or foreign commerce, with passengers or property of any class(es), for compensation.

Conference (liner or steamship)-A combination (technically, a cartel) of shipping companies or owners that sets common liner freight rates on a particular route and that regulates the provision of services.

Constraint-Usually, a mathematical relationship between the decision variables of an optimization problem in which some function of the variable is not equal to a constant. An example is the timber supply constraint on the maximization of lumber production.

Containers-Standard units of cargo packaging similar in size to truck trailers, but lacking wheels. Commonly 20-foot or 40-foot lengths. (See also Break-bulk.)

Container ship-A ship designed to carry containerized cargo.

Derived demand-Demand for a factor of production is derived from the demand for the final goods that the factor cooperates in producing.

Dry bulk-Cargoes that can be placed aboard ship unpackaged, such as wood chips and mineral ores, and that can be handled by highly automated loading equipment; usually carried in full shipload lots.

DWT (dead weight tonnage)-The weight in long tons (2,240 pounds) that a vessel can carry when fully loaded.

Equilibrium-A situation in which, in the aggregate, buyers and sellers are satisfied with the current combination of prices and quantities bought or sold, and so are under no incentive to change their-present actions.

F.O.B. (free on board)--The value of the goods, including the value of packing, when placed on board the vessel. It includes such charges as those the shipper paid to the port, but excludes cargo insurance and freight; roughly corresponds to market value in the exporting country.

Foreign-flag--A vessel licensed and operated under the rules and taxation system of a foreign state. (See also U.S.-flag.)

General cargo-Cargo consisting of individual units or packages (parcels) that are not homogeneous in bulk.

Indirect and induced effects-In an economy, secondary and subsequent effects that result from some primary change in the equilibrium. For example, a change in the Jones Act can result in obvious changes in waterborne transportation employment that "ripple down" to changes in new construction employment.

Input-output (I/O)-A method of analysis in which the economy is represented by a set of linear production functions that describe the interrelationships between all sectors. Thus the total output of each sector is split into the amounts that are used in the production of all other commodities (intermediate production) and those finally consumed.

Intercoastal-Domestic trade between national coasts in two or more seas.

Intermodal-The concept of transportation as door-to-door, rather than point-to-point. The movement of goods is coordinated among different modes to insure rapid and efficient transportation.

Jones Act-Legislation allowing only U.S.-built, U.S.-owned, and U.S.-registered ships in U.S. domestic ocean trades. Specifically, Section 27 of the Merchant Marine Act of 1920.

Jones Act, effects-Increased costs of U.S. domestic waterborne trade due solely to the enforcement of the Jones Act.

Linear programming-A technique for formalizing and analyzing constrained optimization problems in which the objective function is a linear function and is to be maximized or minimized subject to a number of linear inequality constraints.

Margin change-A shift in the derived demand and derived supply functions for a product resulting from a change in the cost of providing existing marketing service and subsequent changes in both retail and producer prices. An increase will cause declines in derived demand (downward shift) and derived supply (upward shift), resulting in an increase in retail price, a decrease in the producer price, and a wider margin.

Net returns (profits)-That portion of total profits that remains after the deduction of taxes and depreciation provisions.

Partial equilibrium-The study of a market for a commodity in isolation. Given the prices of all other commodities, the conditions for equilibrium in a single market are examined.

Raft (log raft)-A form of water transport of logs where boom sticks (logs) are chained together so as to surround the logs being towed. Flat rafts and bundle rafts are the most common types. Flat rafts allow the logs to float freely within the boom sticks and are often used in lakes or large rivers. In adverse conditions, a truckload or group of logs is bundled prior to rafting. These bundle rafts are used in the ocean to prevent log loss, to carry along sinkers, and to move small logs more efficiently.

Resource rent-A payment to a natural resource in excess of what is necessary to keep it in its present usage. This is the difference between what the resource currently receives and the next best alternative.

Sensitivity analysis-Changing the parameters of a problem and studying how this affects the outcome. The purpose is to identify the important assumptions the analysis is based on-those to which the outcome is sensitive.

Shadow price-A calculated valuation of a commodity that has no market price. Shadow prices represent a commodity that is generally not traded in the economy. To the extent that market prices do not reflect opportunity costs, shadow prices may be substituted.

Simulation-A form of forecasting that generates a range of alternative projections based on various assumptions about future situations, specifically to answer the question, "What would happen if?" rather than "What will happen?"

U.S.-flag-A vessel owned and operated under the rules and taxation system of the United States of America. Such a vessel is subject to the Jones Act when engaged in domestic trade.

Waney-A log squared on two sides to facilitate storage onboard ship or to meet local manufacturing requirements. (See also Cant.)

Jackson, Kristine C.; McKetta, Charles W. Impacts of the Jones Act on the Alaska forest products trade. Gen. Tech. Rep. PNW-196. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station; 1986. 39 p.

Alaska forest products trade flows for 1982 were studied to determine the effects of the Merchant Marine Act of 1920 (the Jones Act). Information was collected from timber producers, forest product industries, and waterborne shippers in Alaska, British Columbia, and the Pacific Northwest. Trade flows were simulated, using a partial equilibrium model based on resource rents, with and without the Jones Act restrictions.

Results indicate that $4.77 million in additional costs were incurred in 1982 because of the Jones Act. These effects appeared small, however, relative to the wholesale value of trade. Further, the Jones Act cost differential was not a major factor in market determination, although low-value products and longer trade routes were more sensitive to cost changes. Primary movements of logs and chips and iumber imports from the Pacific Northwest showed the greatest potential for cost savings after relaxing the Jones Act.

Keywords: Jones Act, trade balance, markets (external), forest products carriers, economics (forest transport), Alaska (southeast). southeast Alaska.

Pacific Northwest Research Station
319 S.W. Pine St.
P.O. Box 3890
Portland, Oregon 97208

U.S. Department of Agriculture
Pacific Northwest Research Station
319 S.W. Pine Street
P.O. Box 3890
Portland, Oregon 97208

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