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Transportation Costs for Forest Products From the Puget Sound Area and Alaska to Pacific Rim Markets

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Abstract

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Ocean freight rates to Pacific Rim markets for softwood logs, cants, and wood pulp from Alaska were compared with rates from the Puget Sound area by using analysis of covariance and analysis of variance techniques. The results did not support the hypothesis that lower freight rates for Alaska result from shorter shipping distances. In many cases, ocean freight rates for Alaska are higher than ocean freight rates from Puget Sound to the same markets. When Alaska rates were lower, distance did not seem to be the reason for the lower rates.

Keywords: Transportation costs, freight rates, logs, cants, wood pulp, forest products, exports, international trade, Alaska, Pacific Northwest, Pacific Rim, Japan, South Korea, Taiwan, Hong Kong.

Summary

The objective of this study was to determine whether the closer proximity of Alaska to Pacific Rim markets compared with the Puget Sound area gives Alaska a transportation-cost advantage. The conventional belief is that transportation costs are determined by distance traveled. This belief ignores, however, factors such as volume of trade, backhaul opportunities, and weather conditions that can reduce or eliminate distance advantages.

Ocean freight rates for softwood logs, cants, and wood pulp from Alaska to Japan, South Korea, Taiwan, and Hong Kong were compared with rates from the Puget Sound area by using analysis of covariance and analysis of variance techniques. The analyses of freight rates did not support the hypothesis that freight rates for Alaska were lower than those for the Puget Sound area because of shorter shipping distances from Alaska to Pacific Rim markets.

Often, Alaska rates are higher than the Puget Sound area rates to the same markets, and when Alaska rates were lower, distance did not seem to be the reason for the lower rates. The small volume of trade, the lack of backhaul opportunities, and adverse weather were important factors offsetting differences in distance. Alaska also has lower inland-transportation and port-handling costs.

Contents

Introduction

The Economics of Ocean Transportation

The question addressed by this study is whether the closer proximity of Alaska to Pacific Rim markets gives it a transportation-cost advantage over competing regions, such as the Puget Sound. The idea that transportation cost should be closely related to the distance traveled is intuitively appealing and widely accepted by the general public and market analysts. It reflects the belief that longer routes should have higher transportation costs than do shorter routes. When rate differences do not reflect distance differences, however, the likely reaction is that either rates are set irrationally, or one or more of the parties involved has market power sufficient to distort their normal rate-to-distance relation (Koten 1989).

In sharp contrast to the conventional belief, transportation experts, supported by empirical research, argue that rates often legitimately bear little relation to distance traveled. Indeed, efforts by the airline industry to return to a system of rates closely related to distance is considered as evidence that the airline industry is becoming less competitive and is starting to behave like an oligopoly—able to impose prices with little regard for competitive forces (Koten 1989).

Distance traveled is important, but demand factors and the competitiveness of the transportation industry also influence rate determination and may offset the influence of distance. Long, heavily traveled, competitive routes, may have substantially lower rates than short, lightly traveled, non-competitive routes (Branch 1982). Empirical research on ocean transportation costs for forest products confirms that freight rates for forest products are determined by several factors besides distance (Wisdom and Jones 1986). These include commodity-unit value, commodity-stowage factor, quantity shipped, volume of trade on a route, and trade balance on a route.

Whether Alaska has a transportation-cost advantage depends on whether the distance factor outweighs other factors that might put Alaska at a disadvantage, such as volume of trade, backhaul opportunities, and weather. The net effect of these sometimes conflicting factors is an empirical matter that can be answered only by comparing rates from the Alaska and Puget Sound area to Pacific Rim countries by using appropriate statistical methods. That is the purpose of this study.

Procedure—The analysis was conducted in two stages and was repeated for three products, logs, cants and wood pulp. The first stage used analysis of covariance (ACOV) to test whether distance is an important determinant of transportation cost. A statistically significant and positive coefficient for the distance variable in the ACOV model would indicate that Alaska has a transport-cost advantage over the Puget Sound area in Pacific Rim markets; an insignificant coefficient would indicate that distance is not an important determinant of rates. Alaska might, however, have a rate advantage for reasons other than distance. The second stage used analysis of variance to test whether there is a significant difference between Alaska and Puget Sound area rates for those products for which distance is not a significant rate determinant. If rate differences are statistically significant, then Alaska could have either an advantage or disadvantage, depending on the type of difference.

Data Sources

Ocean Freight Rates

A large representative sample of rates actually paid by shippers for each product under investigation on each route of interest for a representative period of time is ideal; in practice, however, it is not possible to obtain such an ideal data set because (1) private sources are reluctant to provide information on actual rates, (2) rates are set by negotiation between carrier and shipper and are proprietary information, and (3) divulging rates would encourage competitors and clients to negotiate for similar rates.

It often is possible to get quotes of a few actual rates from cooperative shippers or carriers. Spot quotes such as these are not adequate, however, for compiling the kinds of statistical analyses required by this study. Quoted rates may be accurate for a particular company, commodity, and market but may be greatly misrepresentative of rate levels on other routes, commodities, or time periods; rates can differ greatly by season, for example. In addition, rates from different sources may not be comparable because of differences in carrier efficiency, the bargaining power of shippers, or route characteristics.

Transpacific Westbound Rate Agreement rates—Rates used in this study were taken from tariffs published by the Transpacific Westbound Rate Agreement conference (TWRA) in San Francisco, California (Transpacific Westbound Rate Agreement 1988). These tariffs are available from TWRA in both hardcopy and on-line computer database formats. These rates are comprehensive both in commodity and route coverage. Because the data are available from a single source for both commodities and routes, TWRA rates provide a basis for statistical comparison of rates among commodities and routes, something that cannot be done with spot rate quotes. TWRA data also provide several observations on the same commodity and route because tariffs typically are available from several carriers. These are enormous advantages over spot quotes supplied by two or three carriers or shippers.

The TWRA rates have shortcomings, however, which must be considered. Most important, the posted rates do not necessarily reflect actual rates charged. Large-volume shippers in particular are likely to negotiate substantially lower rates. Actual shipping agreements often include special considerations such as loading and handling charges at port of discharge. For these reasons, TWRA rates likely overstate actual rates, especially charter rates.

The shortcomings of TWRA rates are common, however, to most or all published price data. Volume discounts and price reductions reflecting the bargaining power of buyer groups are fairly common practices and represent statistical problems for virtually all published price information. In any case, the absence of alternatives leaves us with little choice but to use the TWRA rates and to apply caution when interpreting the results.

The TWRA rates were collected for the last quarter of 1988 for softwood logs, softwood cants, and wood pulp. The rates were taken from TWRA's exempt tariff schedule of U.S. Pacific coast shipments, including Alaskan, to Northeast Asia. The 1984 U.S. Shipping Act exempts mandatory posting of forest products rates by shipping conferences, but TWRA chose to continue posting these rates as a service to its customers. Rates were collected by carrier and westcoast port, including Alaska, for cargo bound to Japan, South Korea, Taiwan, and Hong Kong. The TWRA member carriers are shown in appendix table 10.

Of 706 rates collected, 363 were for softwood logs, cants, and lumber, and 353 were for wood pulp. Only one rate, a pulpwood rate, was found for shipments to the People's Republic of China (hereafter referred to as China). That rate was more than twice as high as rates to the other Pacific Rim countries, indicating shipment to China entails special costs. Shipments to China probably are negotiated on an individual-case basis.

A total of 336 usable rates were identified (appendix tables 11 and 12). The primary criteria used to identify acceptable rates were similarity of terms of shipping, and destination port. Only rates to the major port in each of the four markets were used. The major ports were Yokohama, Inchon, Taichung, and Hong Kong. Most of the discarded rates either were for shipments to secondary ports or had special conditions attached to them. Some carriers quoted general rates that apply to all west coast ports; these rates are substantially higher than rates quoted for specific major ports, such as Seattle. Carriers quote rates based on either weight or volume, whichever produces the greatest revenue. The reason for this dual-rate basis is that heavy cargo immerses a vessel to its loadline before its holds are full, and light cargo fills the hold of the vessel before reaching its draught limit. Because both capacities are unlikely to be fully used, the unused capacity, whether it be weight or volume, represents a loss to the carrier, and carriers compensate by charging light cargo by volume and heavy cargo by weight.

The TWRA rates for softwood logs, cants, and lumber for the Puget Sound area are quoted by weight or dollars per 1,000 kilograms, whereas rates from Alaska are quoted by volume or dollars per 1,000 board feet. Puget Sound area shipments are primarily in the heavier species, such as western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) and Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), whereas Alaska shipments contain a larger proportion of the lighter species, such as Sitka spruce (*Picea sitchensis* (Bong.) Carr).

Converting TWRA rates—Because TWRA log rates are figured differently for the Puget Sound area than they are for Alaska, it was necessary to convert Puget Sound log rates to the same log rate used for Alaska, that is, dollars per 1,000 board feet. Conversion factors were taken from Hartman and others (1976). Western hemlock was used as the basis of comparison because a sizeable amount of this species is exported from both regions. Other species would have different board-feet rates because of differences in their volume-to-weight ratios.

The average weight of a western hemlock log, according to Hartman and others (1976) is 10,190 pounds per 1,000 board feet. There are 2.205 pounds per kilogram. Combining these two ratios yields a factor of 4.622 to convert dollars per 1,000 kilometers into dollars per 1,000 board feet for western hemlock logs. Board feet equivalent rates for western hemlock logs are shown in appendix table 13.

Lumber scale is different from log scale, and a cant has a different board-foot-to-weight ratio. Thus, board-foot rates for cants will be different than board-foot rates for logs even though rates are the same weightwise. The TWRA rates were converted to board feet, by using a factor of 3.124. This factor was derived from the relation between cubic feet and board feet (78.9 ft3/MBF) for 14 by 14 rough green western hemlock, its weight per cubic feet (87.3 lb/ft3), and the kilograms-to-pound factor of 2.2046 (Hartman and others 1976). Board-foot equivalent rates for western hemlock cants are shown in appendix table 14.

Rates per 1,000 board feet for western hemlock cants are about two-thirds less than rates for western hemlock logs; this suggests a difference in the transport-cost burden of logs compared to cants in the two regions. This has interesting implications for trade modeling and underscores the importance of distinguishing between both species and product in specifying transportation-cost functions in trade models.

Distances Between Ports

Table 1 shows distances from Alaska and Puget Sound ports to the four Pacific Rim markets. These distances were taken from a Defense Mapping Agency document (Defense Mapping Agency 1976). In some cases, distances between ports are listed directly in the document; in other cases, it was necessary to combine the distance from ports at both ends of a route to a common point, called a junction point. For Alaska and Puget Sound routes to Pacific Rim countries, the common junction point is Dutch Harbor, Alaska, in the Aleutian Islands. The distances in table 1 are least-time routes. Figure 1 shows typical trade routes to Pacific Rim counties from Alaska and Seattle.

Routes actually traveled by a carrier may be longer than those shown in table 1. For example, westbound routes may differ from eastbound routes as carriers take advantage of prevailing currents. Similarly, a longer route may be preferred during the winter months to avoid bad seas and ice. Table 2 shows how sensitive trip distances are to winter and summer routings. Winter-trip distances from Seattle to Alaska are up to 1,300 miles, 31 percent longer than summer trips.

Table 1—Estimated distances between ports[a]

Origin	Japan	South Korea	Taiwan	Hong Kong
	Market			
	Nautical miles			
Port Townsend	4,195	5,211	5,341	5,718
Everett	4,215	5,231	5,361	5,738
Port Angeles	4,175	4,191	5,321	5,698
Seattle	4,245	5,261	5,391	4,768
Tacoma	4,265	5,281	5,411	5,788
Bellingham	4,245	5,261	5,391	5,768
Cosmopolis	4,345	5,361	5,491	5,868
Grays Harbor	4,345	5,361	5,491	5,868
Portland	4,323	5,339	5,469	5,525
Eureka	4,536	5,552	5,611	6,044
Samoa	4,536	5,552	5,611	6,044
San Francisco	4,536	5,552	5,611	6,044
Los Angeles	4,838	5,855	5,985	6,380
Anchorage	3,368	4,384	4,514	4,570
Petersburg	3,766	4,782	4,912	4,968
Haines	3,767	4,783	4,913	4,969
Sitka	3,620	4,636	4,766	5,095
Wrangell	3,790	4,806	4,936	5,265
Ketchikan	3,795	4,811	4,941	5,270

[a] Source: Defense Mapping Agency (1976).

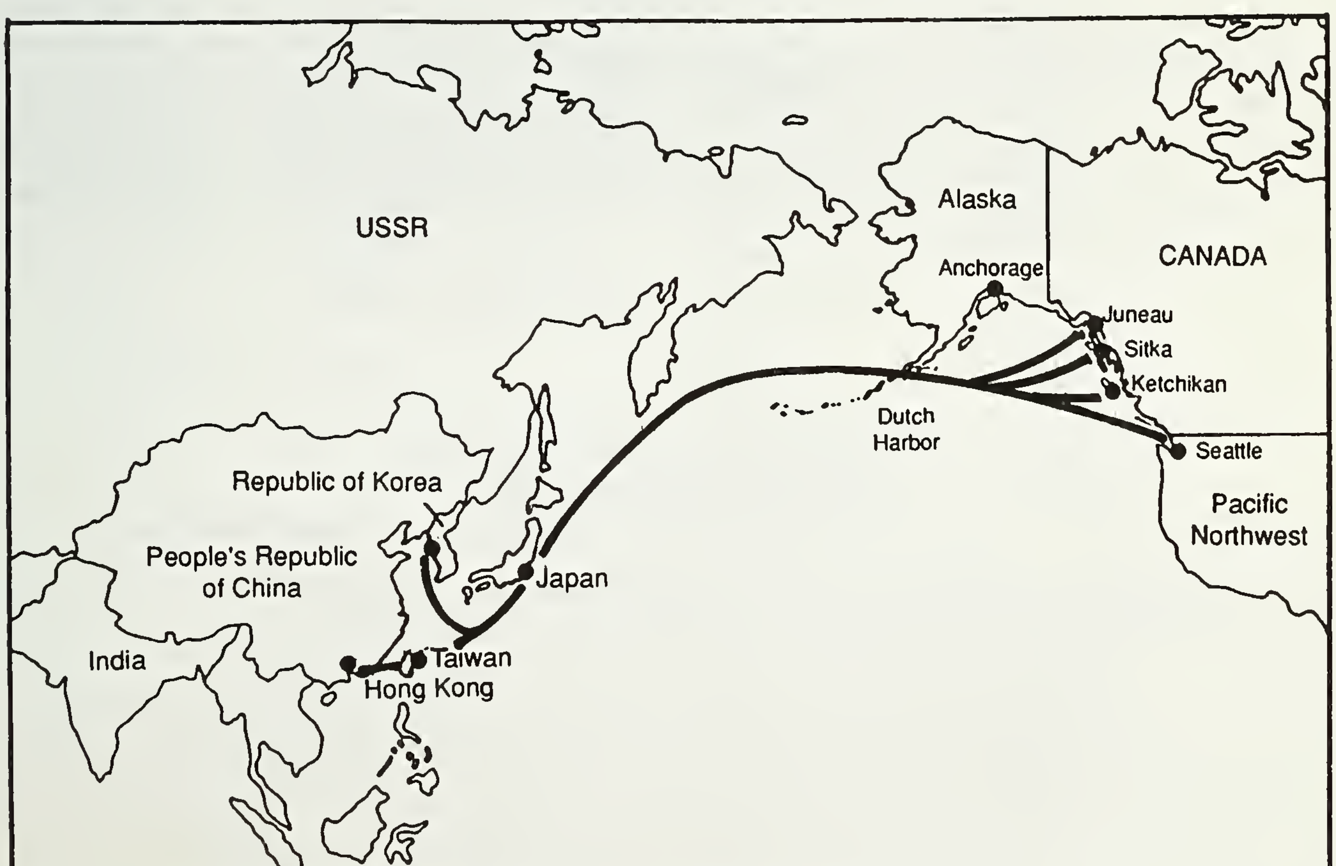

Figure 1—Ocean trade routes from U.S. Pacific Coast to Pacific Rim markets.

Table 2—Summer and winter route distances from Seattle to Asian ports[a]

Route	From Seattle to: Yokohama	Shanghai
Summer route	4,245	5,101
Route November-March	5,370	6,270
Alternate winter route	5,545	6,401
Maximum distance difference	1,300	1,169

[a] Source: Defense Mapping Agency (1976).

Statistical Analyses of Freight Rates

Western Hemlock Logs

Analysis of covariance—The objective of this phase of the study was to test whether differences between Alaska and the Puget Sound area freight rates for softwood logs to the Pacific Rim can be explained by differences in distance to these markets. Separate regressions relating rates to distance could be run (one for Alaska and one for Puget Sound), but it could not be determined whether the two regressions were estimated from the same rate population. The regressions would indicate whether distance is an important determinant of freight rates for each of the two regions, but because of differences in equation intercepts and slopes, rates from Alaska could be greater, equal to, or less than rates from Puget Sound to the same market. Only if the rates are from the same population and if the relation between rate and distance is positive and significant can we conclude that closer proximity to markets provides Alaska with a transport-cost advantage. Thus, we need to test both sensitivity of rates to distance and similarity of the two rate regressions.

The relation between rate and distance and the difference between the Alaska and the Puget Sound area regressions can be tested by adding two dummy variables to a regression of rate against distance. The first dummy variable, the intercept variable, tests for similarity of intercept. The second dummy variable, the slope differential variable, tests for similarity of slope. The regression equation including dummy variables, called analysis of covariance (ACOV) (Guijarati 1988), has the following general form:

$$RATE_i = a_1 + a_2 + D_i + b_1 \; DIST_i + b_2 \; (D_i * DIST_i) + u \, , \qquad (1)$$

where

$RATE_i$ = ocean freight rate in dollars per mbf,
$DIST_i$ = distance in nautical miles, and
D_i = dummy variable (one for Alaska and zero for Pacific coast).

The D_i variable tests for sameness of intercept, and the D_i*DIST variable tests for sameness of slope. Coefficients to be estimated are a_1, a_2, b_1, b_2, and u is the disturbance term. The differential intercept is a_2, and b_2 is the differential slope indicating by how much the intercept and slope coefficients of the Alaska equation differ from the intercept and slope of the Pacific coast equation. If both differential coefficients are statistically significant, we can conclude that Alaska rates are from a population different than Pacific coast rates.

The covariance model for western hemlock log rates was estimated by using pooled Pacific coast and Alaska rates. Other Pacific coast rates were pooled with the Puget Sound area rates to increase the degrees of freedom, however. Both linear and log-linear models were tested. The log-linear model gave the best fit. The estimated equation is:

$$\begin{aligned} \ln Rate &= -1.88 + \underset{(3.25)}{9.36D} + \underset{(5.94)}{0.84 \ln DIST} - \underset{(-3.34)}{1.14D^{*}\ln DIST} \\ \text{Adj } R^2 &= 0.556 \quad F = 34.6 \quad DF = 81 , \end{aligned} \tag{2}$$

where all variables are as before, but in natural logs (ln). Values in parentheses below the equation are t-values. The adjusted coefficient of determination is Adj R^2, F is the F-value, and DF is the degrees of freedom.

All coefficients were significant at the 1-percent level. The coefficients for D and lnDIST had the expected signs, but the negative sign associated with the slope differential variable, D*lnDIST, was counter intuitive. The regression explained 56 percent of the variation in rates. The F-value indicates that the regression as a whole is significant.

Distance is an important determinant of ocean freight rates for the Puget Sound area routes. The negative sign on the differential slope variable suggests a problem with the Alaska rate-distance relation. The significance of the intercept and slope-differential variables at the 1-percent level leads us to conclude that the Alaska and Pacific coast regressions are estimated from two different populations. The problem with the Alaska relation can be seen more clearly if we decompose the combined equation into its Alaska and Pacific coast components, permitting us to focus on the Alaska relation.

Alaska:

$$\begin{aligned} \ln RATE &= 7.48 - 0.34 \ln DIST \\ \text{Adj } R^2 &= 0.114 \quad DF = 13 \end{aligned} \tag{3}$$

There is no significant statistical relationship between rate and distance for the Alaska data as indicated by the low coefficient of determination, 11.4 percent.

Figure 2 shows Alaska rates superimposed upon a graph of the regression line of the estimated Pacific coast equation and confidence intervals at the 95-percent level. Actual rates from the northern tier of Alaska ports fall outside the upper confidence interval of the regression of Pacific coast rates. Use of the regression equation to estimate Alaska rates would significantly underestimate actual rates. Clearly, something other than distance explains the differences in the Puget Sound area and northern Alaska rates. Rates for the more southern Alaska ports all fall within the regression confidence intervals. From this we conclude that these rates are not statistically different from the Puget Sound area rates once differences in distance are taken into account; that is, southern Alaska rates seem to belong to the same population as do the Puget Sound area rates.

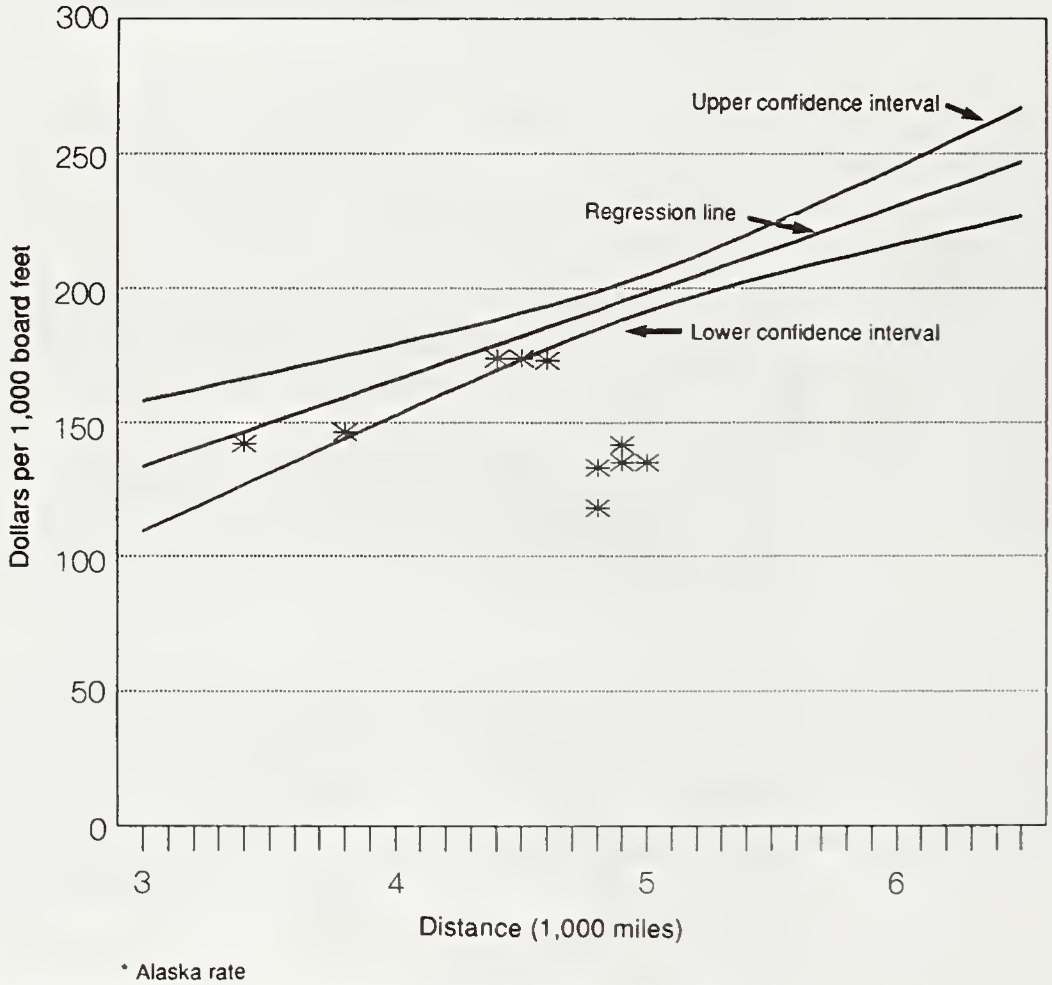

Figure 2—Alaska log rates compared with estimated regression line and 95 percent confidence intervals for Puget Sound western hemlock log rates.

Because Alaska rates are not sensitive to differences in distance, the question is whether Alaska rates are significantly different from the Puget Sound area rates for differences other than distance. For example, TWRA carriers might simply apply the Puget Sound area rates to Alaska shipments or adjust Puget Sound rates to account for differences between Alaska and Puget Sound nondistance-related costs, such as weather, volume of trade, and backhaul opportunities, to reflect perceived disadvantages, or advantages, of shipping out of Alaska as compared with the Puget Sound area. It is important to note that neither differences in distances from Alaska ports to Pacific Rim countries nor differences between distances from Alaska and the Puget Sound area are particularly great in terms of global shipping (table 3). Additional statistical tests were made to test whether Alaska rates differ significantly from Puget Sound area rates to the same markets for reasons other than distance.

Analysis of variance—The first step was to conduct a two-way analysis of variance of the combined Puget Sound area and Alaska ocean freight-rate data. Only Puget Sound area rates were used. Western hemlock rate data were arranged by origin (rows) and markets (columns). The objective was to test whether Alaska rates differ significantly from Puget Sound area rates. The regression-with-dummy variables technique was used because of unequal observations in cells (Kleinbaum and Kupper 1987). The results are shown in table 4. Rates differ significantly by origin and market. Alaska rates are significantly different from the Puget Sound area rates at the 1-percent level. Rate variation by market is significant at the 1-percent level also but not as strikingly so. There does not seem to be interaction between origin and market.

The analysis of variance indicates that log rates differ significantly by both origin and market but does not tell us which markets are significantly different. It is possible that Alaska and Puget Sound rates are significantly different for some markets but similar for others. Difference-between-means tests were made of Alaska and the Puget Sound area rate variation for each market. Unfortunately, segmenting the data by market reduces the degrees of freedom in the individual-country models, thereby reducing the reliability of the statistical tests. Hong Kong rates were dropped because of insufficient observations, and the paucity of observations for South Korea means that those results must be interpreted with caution.

Table 3—Distances from Alaska and Puget Sound ports to Pacific Rim countries[a]

From:	To: Japan	South Korea	Taiwan	Hong Kong
	Nautical miles			
Alaska	3,620	4,636	4,766	5,095
Seattle	4,245	5,261	5,391	5,768
Difference	625	625	625	673

[a] Source: Defense Mapping Agency (1976).

Table 4—Results of analysis of variance of western hemlock log rates, Puget Sound compared with Alaska, 1988

Source	Degrees of freedom	Sums of squares	Mean square	F-value
	Number			
Origin	1	$20,060	$20,060	33.3
Destination	3	10,630	3,550	5.9
Interaction	3	1,476	492	.8
Error	40	2,409	602	
Total	47	34,574		

Table 5—Results of differences-between-means test of western hemlock log rates, Puget Sound and Alaska, by market, 1988

Item	Japan	South Korea	Taiwan
Number of observations:			
Puget Sound	12	3	8
Alaska	7	5	7
Mean rate:			
Puget Sound	$174	$199	$203
Alaska	141	150	150
Difference	33	49	53
Confidence interval of difference (95-percent level):			
Lower	–$47	–$61	–$42
Upper	–14	14	–1
T-test	–3.93	–1.64	–2.32
Degrees of freedom	16	5	10

Differences between means—The difference between means for the Puget Sound area and Alaska log rates were significant for both Japan and Taiwan at the 1-percent level (table 5). The confidence interval for differences between means of the Puget Sound area and Alaska rates to Japan range from –$14 to –$47, with a mean difference of –$31. In the case of Taiwan, the confidence interval for difference between means is from –$1 to –$42, with a mean difference of –$21. Rate differences to South Korea were significant at the 10-percent level but not at the 5-percent level. Because so few observations were made, it is prudent to view these results with caution.

Western Hemlock Cants

Analysis of covariance—Analysis of covariance of the relation between western hemlock cant rates and distance was compiled using pooled Alaska and Pacific coast rates. The results were:

$$\ln RATE = -2.27 + 9.82D + 0.84\ln DIST - 1.14D^{*}\ln DIST$$
$$(3.41) \quad (5.94) \quad (-3.34)$$

$$Adj\ R^2 = 0.38\ F = 17.8\ DF = 81\ . \qquad (4)$$

The statistical significance of the variables are essentially the same as for the western hemlock log model because the only difference between the two data sets is a scaling factor for Pacific coast rates. The coefficient of determination and F-values are slightly different because the Pacific coast rates were adjusted downward, whereas the Alaska rates remained the same. Again, Alaska rates are negatively related to distance. The equation for Alaska rates is:

$$\ln RATE = 7.55 - .30\ln DIST$$
$$Adj\ R^2 = 0.051\ F = 1.80\ DF = 15\ . \qquad (5)$$

The relation between the regression equation for Pacific coast rates and actual Alaska rates is shown in figure 3. Only 3 of the 10 Alaska rates fall within the confidence interval of the Pacific coast equation. Thus, Alaska rates seem to be significantly different from Pacific coast rates to the same market.

Analysis of variance—It has been demonstrated that Alaska cant rates are not a function of distance and that most Alaska rates fall above the upper confidence interval for the Pacific coast rate equation. The question remains whether Alaska rates are significantly different from Pacific coast rates to the same market; that is, are there factors other than distance causing Alaska rates to differ from Pacific coast rates?

A one-way analysis of variance was made of the variance of Alaska and Pacific coast rates by market. The results are summarized in table 6. Alaska rates are significantly different from Pacific coast rates to Japan and Taiwan at the 5-percent level. Rates to South Korea were virtually identical for Alaska and the Pacific coast. There are an insufficient number of observations to place much confidence in the Hong Kong results, although rates for the two regions seem to be quite different.

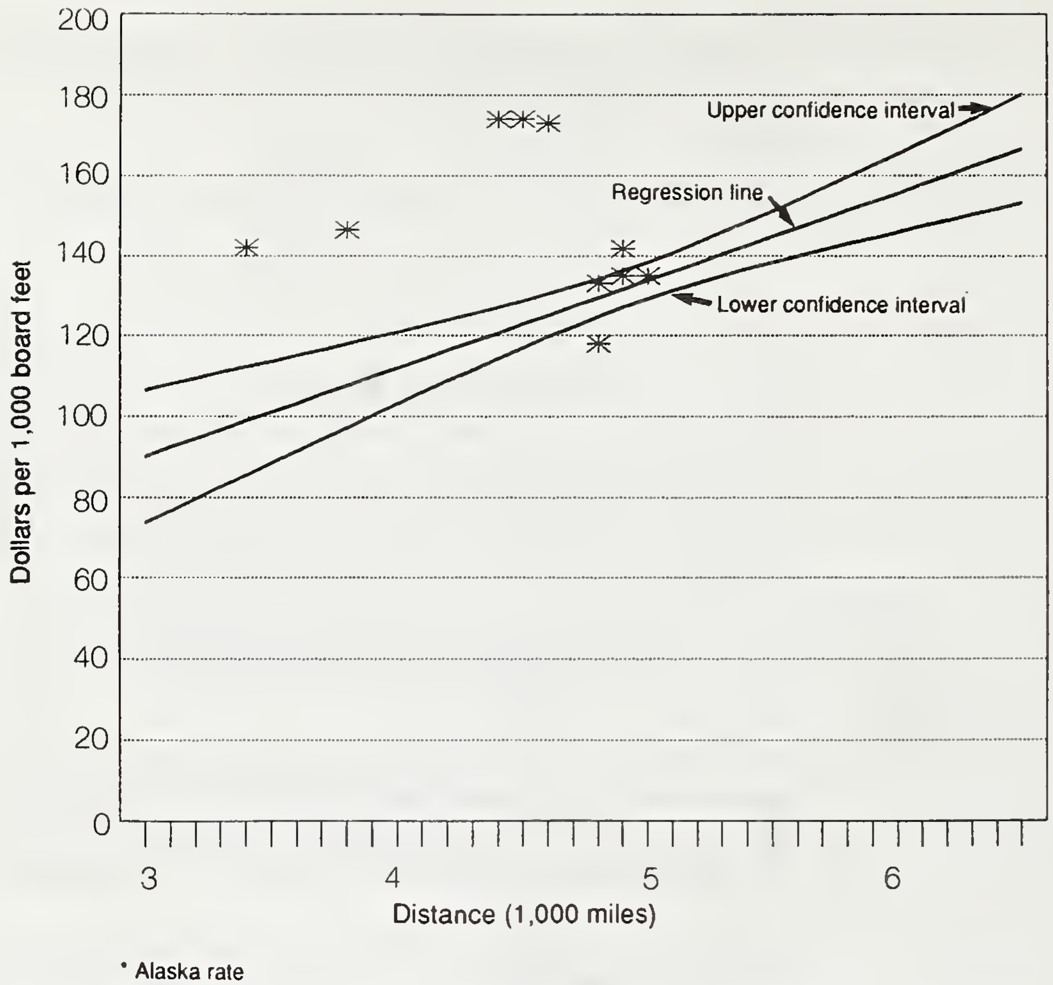

Figure 3—Alaska cant rates compared with estimated regression line and 95-percent confidence intervals for Puget Sound western hemlock cant rates.

Table 6—Results of analysis of variance of western hemlock cant rates, for Puget Sound and Alaska, by market, 1988

Item	Japan	South Korea	Taiwan	Hong Kong
Observations:				
Pacific Coast	12	4	8	3
Alaska	7	5	7	2
Mean rate:				
Pacific Coast	$118	$157	$137	$151
Alaska	150	160	160	199
Standard deviation:				
Pacific Coast	$23.5	$47.6	$14.9	$1.9
Alaska	12.8	25.8	21.6	21.1
F-value	11.4	0.01	5.68	18.3

Wood Pulp

Analysis of covariance—Wood pulp freight rates were regressed against distance by using the analysis-of-covariance model. An alternative model, which excluded Alaska rates but included dummy variables for each of the four markets, was also estimated. Both linear and log-linear models were tested. The linear model with dummy variables for markets yielded the best results. The estimated model is:

$$RATE = 83.13 - \underset{(-1.19)}{0.004DIST} + \underset{(0.15)}{0.54KOR} + \underset{(0.47)}{2.72TWN} + \underset{(2.10)}{12.20HKG}$$

$$\text{Adj } R^2 = 0.115 \text{ DF188} , \qquad (6)$$

where

RATE	=	wood pulp freight rate in dollars per 1,000 kilograms,
DIST	=	distance in nautical miles,
KOR	=	dummy variable (equal to one when South Korea, otherwise zero),
TWN	=	dummy variable (equal to one when Taiwan, otherwise zero), and
HKG	=	dummy variable (equal to one when Hong Kong, otherwise zero).

The equation does a poor job of explaining variations in ocean freight rates, accounting for less than 12 percent of total rate variation. Only the coefficient on the Hong Kong variable is significant at the 5-percent level. Because Japan is the base variable, the results imply that distinguishing South Korea and Taiwan rates from Japan does not add to the explanatory power of the equation. On the other hand, Hong Kong rates seem to be sufficiently distinct from rates for the other three routes so as to warrant separate treatment. The distinction is not, however, a strong one. Most important, for our purposes, is the low t-value and negative sign attached to the distance variable. Distance is not a significant determinant of wood pulp ocean freight rates. What little explanatory power the equation has is attributable almost entirely to route characteristics other than distance.

Because there were only seven rate observations for Alaska, it was not possible to estimate a meaningful Alaska freight-cost equation, as was done for logs and cants. Instead, confidence intervals were computed for Puget Sound rates to each of the Pacific Rim markets, and Alaska rates were then compared with these confidence intervals. This is not a particularly powerful test, but it is the best that can be done given the limits of the data.

Confidence Intervals—Table 7 shows average wood pulp rates from Washington and Alaska ports to Pacific Rim markets. Figure 4 compares average wood pulp rates from major Puget Sound rates with average rates from Alaska. Alaska rates are substantially higher than Washington rates to the same markets; the question is whether they are significantly higher. Confidence intervals were estimated for Puget Sound and Grays Harbor, and actual Alaska rates compared with them for each of the four markets. The results are shown in table 8. The results confirm that Alaska pulp rates are substantially greater than the upper confidence interval of both the Puget Sound area and Grays Harbor rates.

Table 7—Average wood pulp rates per 1,000 kilograms from Washington and Alaska to Pacific Rim markets, 1988

Port of origin	Market: Japan	South Korea	Taiwan	Hong Kong
Port Angeles	$66	$65	$65	$82
Port Townsend	65	61	62	83
Bellingham	78	71	81	73
Everett	62	61	61	59
Seattle	78	72	60	76
Tacoma	63	59	63	86
Grays Harbor	70	68	67	68
Alaska (Average)	97	101	83	

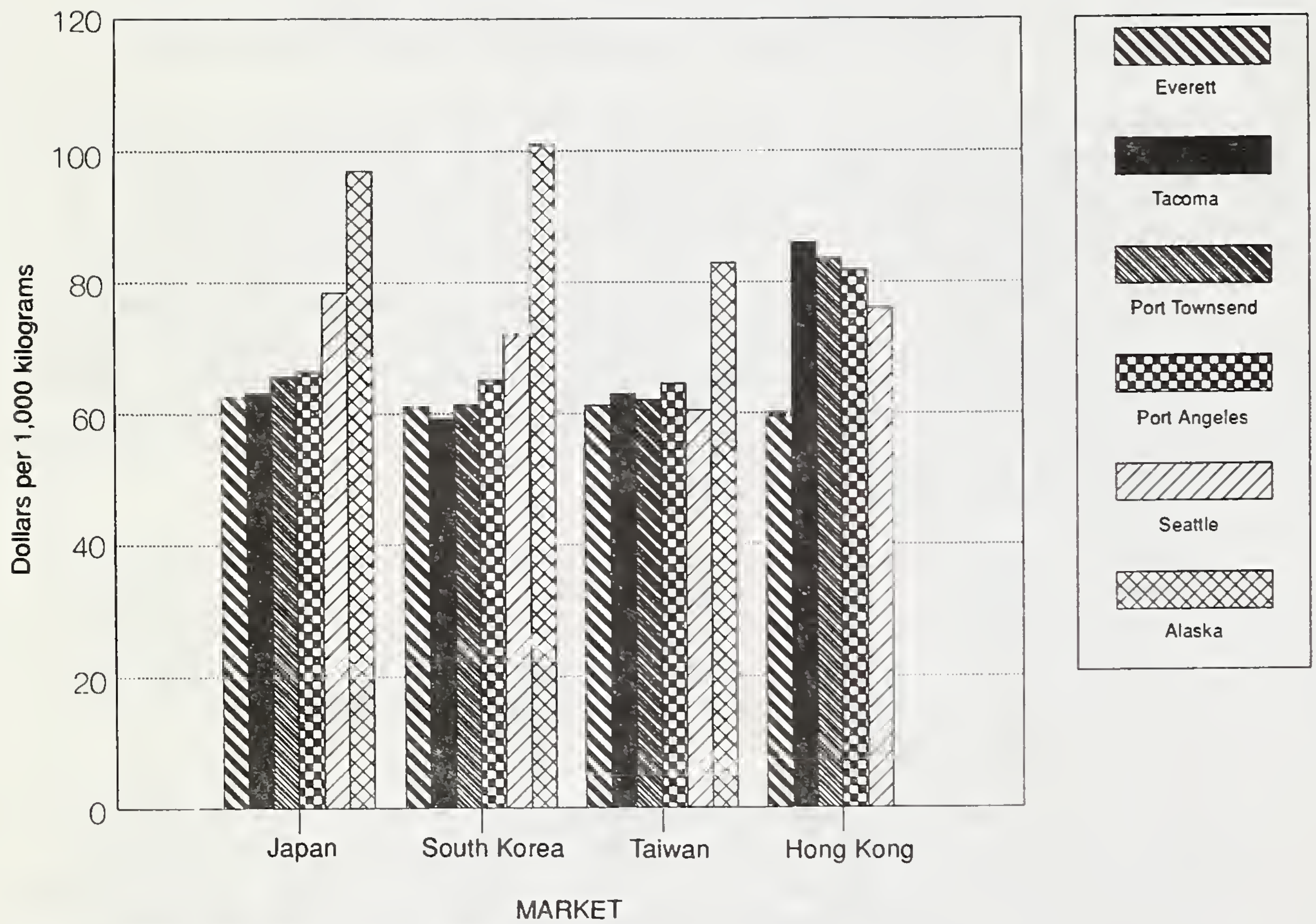

Figure 4—Average wood pulp rates from Washington ports to Pacific Rim markets.

Table 8—Number of observations, means and confidence intervals for wood pulp rates from Puget Sound

	From Puget Sound				From Alaska	
			Confidence interval (95 percent)			
Market	Number	Mean rate	Lower	Upper	Number	Mean rate
Japan	43	$66	$63	$68	2	$97
South Korea	34	63	59	68	4	101
Taiwan	46	62	60	65	1	83
Hong Kong	31	74	85	79		

In summary, Alaska wood pulp rates are not determined by distance. Greater proximity to Pacific Rim markets does not provide Alaska with a transport-rate advantage over the Puget Sound area. Indeed, Alaska wood pulp rates are significantly higher than Puget Sound rates to the same markets. Alaska wood pulp rates are significantly different than Puget Sound rates, but the difference is due to factors other than distance.

Conclusions

Summary of Results

The primary objective of this study was to determine whether closer proximity to Pacific Rim markets provided Alaska with a transportation-cost advantage compared to Puget Sound. The results do not support this argument. We found no instance of cost advantage to Alaska that can be attributed to shorter trip distances. Western hemlock log rates for Puget Sound seem to be higher than for Alaska, whereas cant rates seem to be lower (table 9 and figure 5), at least to Japan and Taiwan markets; however, distance is not the reason for these differences.

The positive and statistically significant relation between distance and ocean freight rates for logs and cants shipped out of Pacific coast ports supports the belief that ocean transport costs are influenced by route distance; however, the failure of Alaska rates to be sensitive to distance underscores the importance of differences in route characteristics.

Differences in distance among Alaska ports to Pacific Rim markets and even between Alaska and Puget Sound ports to these same markets is modest and is overshadowed by factors such as weather, volume of trade on routes, and backhaul opportunities.

The pattern of ocean freight rates among routes resembles zone pricing, wherein the price-distance gradient is not a smooth curve, but instead, increases in a steplike fashion with movement from one market zone to another. This can be seen quite clearly in the TWRA tariff schedules. The cost of administering and maintaining tariffs for thousands of commodities to and from many ports discourages adjusting tariffs to account for minor differences in distance. The flat gradient of the cost-distance relation for ocean transport reinforces the tendency to establish rate zones.

Table 9—Summary statistics of softwood log and cant rates per mbf from Puget Sound and Alaska to Pacific Rim markets, 1988

	Market			
From:	Japan	South Korea	Taiwan	Hong Kong
Puget Sound:				
Western hemlock logs:				
Minimum	$139	$171	$171	$222
Average	174	199	203	224
Maximum	222	222	222	227
Standard deviation	33	21	20	2
Western hemlock cants:				
Minimum	$94	$115	$115	$150
Average	118	134	137	151
Maximum	150	150	150	153
Standard deviation	23	15	14	2
Alaska:				
Softwood logs and cants:				
Minimum	$118	$131	$125	$173
Average	148	157	157	194
Maximum	165	202	202	215
Standard deviation	13	23	20	16

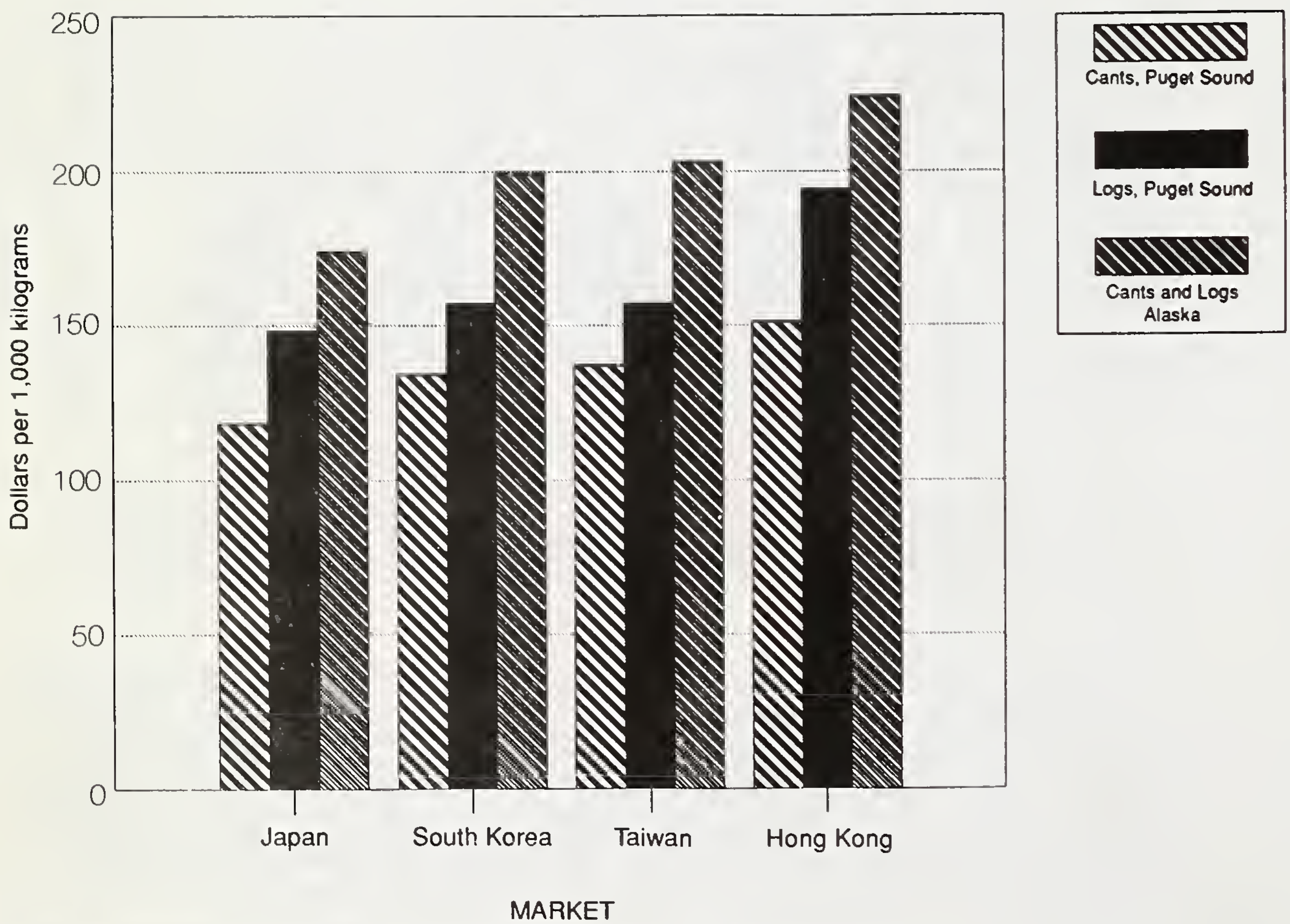

Figure 5—Average western hemlock log and cant freight rates to Pacific Rim markets.

Competitive practices and the difficulty of determining marginal cost for an additional mile traveled mitigate against an unduly complex freight tariff system. Instead, carriers prefer to account for nondistance factors by attaching surcharges to major trade routes. Higher rates for cargo bound to outports within a market zone is an example.

There were significant differences in rates among logs and cants when rates were based on board feet because of volume-weight differences between logs and cants. The use of a single-rate equation to represent all commodities is not appropriate.

Charter Rates

Logs, cants, and wood pulp exports from Alaska are shipped mainly on chartered carriers, although pulp is shipped in less-than-shipload quantities to smaller markets, especially out of Ketchikan. Charter rates are lower than liner rates, reflecting the ability of large volume shippers to negotiate lower rates and the advantages to carriers of securing shipload contracts.

Charter rates are set by short-term demand-and-supply conditions in the ocean transportation market and are subject to wide fluctuations reflecting changes in world demand. Global economic expansions and contractions tend to be accompanied by expansion and contraction of international trade, which in turn induce severe swings in the demand for ocean transportation services. During periods of slack demand, shippers can negotiate favorable charter rates, and during periods of tight demand, carriers have the advantage in rate setting (Abrahamsson 1980). Because ocean transport supply is relatively inelastic, the result is wide swings in freight rates. The mid-1988 expansion of trade, exaggerated by large wheat shipments to Russia, for example, led to sharp increases in charter rates, which declined quickly once the wheat was shipped. In contrast, conference rates are relatively stable, exhibiting the upward and downward step increases typical of imperfectly competitive prices.

Although most logs, cants, and pulp are shipped on chartered vessels, the number of companies involved is very small. These are located at different points along southeastern Alaska, and each company ships different combinations and quantities of logs, cants, and pulp and have different arrangements with steamship companies.

In Sitka, logs, cants, and pulp are shipped mainly to Japan under shipping arrangements made by the buyers. In Ketchikan, pulp is shipped to about 19 or 20 countries all over the world, in smaller quantities than from Sitka, with the seller making shipping arrangements. The Ketchikan mill has the advantage of a large marketing organization through its parent corporation, Louisiana-Pacific Corporation. Rates for the two Alaska pulp mills are negotiated under quite different conditions and depend on the bargaining strengths of both shippers and buyers in each situation. In such a situation, it is not meaningful to talk about an average charter rate from Alaska.

Charter rates quoted by shippers and carriers involved in exporting forest products from Alaska ranged from $500,000 to $600,000 for a 23,000-25,000 deadweight tonnage vessel. Assuming log stowage at 4 to 5 million board feet, this yields a rate of between $120 and $150 per thousand board feet. One industry representative quoted a charter rate of $300,000. Others indicated that this was the going rate in 1987, but grain shipments to the U.S.S.R. pushed up rates in 1988 to about twice the 1987 rate. In any case, it is clear that the rate per 1,000 board feet of a charter differ greatly simply because of differences in stowage. For example, Alaska logs, with greater taper, have poorer stowage than Puget Sound logs and, consequently, will have higher unit rates for the same charter rate.

Port and inland transport costs—Ocean freight rates cover only the voyage and ship loading and handling portions of total transportation costs. Not accounted for are port charges, insurance, and inland transportation costs. Because our concern was with the role of distance in the determination of freight rates, these costs were properly ignored; however, a complete accounting for transportation costs should address these costs. Because mills in Alaska are located at the port and because the mills own the port facilities, these costs are lower in Alaska than in the Puget Sound area; on the other hand, stevedoring costs may be higher in Alaska.

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Appendix 1

Carrier Codes

Table 10—Transpacific Westbound Rate Agreement (TWRA) carriers[a]

Symbol	Carrier	Nationality
AP	American President Lines	USA
HJ	Hanjin Container Lines	South Korea
HY	Jyundai Merchant Marine Company	South Korea
KL	Kawasaki Kisen Kaisha	Japan
MK	A.P. Moller - Maersk Line	Denmark
MO	Mistui Steamship Lines	Japan
NL	Neptune Orient Lines	Singapore
NS	Nippon Yesen Kaisha	Japan
OO	Orient Overseas Container Line	Hong Kong
SL	Sea-Land Services	USA
YS	Yamashita-Shinnihon Steamship	Japan
TWRA	Transpacific Westbound Rate	

[a] Source: Transpacific Westbound Rate Agreement (1988).

Appendix 2

Transpacific Westbound Rate Agreement Ocean Freight Rates for Softwood Logs, Cants, and Wood Pulp, 1988

Table 11—Ocean freight rates for softwood logs and cants shipped from U.S. Pacific Coast to Pacific Rim markets, 1988[a]

		To:			
From:	Carrier	Japan	South Korea	Taiwan	Hong Kong
		Per 1,000 kilograms			
Seattle	MO	$32	$48	$48	$48
Seattle	AP	32		39	
Seattle	HJ	32	44	37	
Seattle	HY	44	37	48	
Seattle	KL	32		39	
Seattle	MK	41			
Seattle	NL				49
Seattle	NS	48		47	
Seattle	NY	32			
Seattle	OO	48			
Seattle	TWRA	30			
Seattle	YS	48		47	
Tacoma	HJ		72		
Tacoma	MK	32		46	48
Aberdeen	HJ		69		
Longview	HJ		71	67	
Portland	AP	36		48	46
Portland	HJ	38	59	43	46
Portland	HY	41	54	45	48
Portland	JL	36			
Portland	KI	36	54	43	

Table 11—continued

From:	Carrier	To: Japan	South Korea	Taiwan	Hong Kong
		Per 1,000 kilograms			
Portland	MK	$36			
Portland	MO	36	$48	$43	$41
Portland	NS	36			
Portland	NY	36	48	42	
Portland	OO	54			
Portland	SL	54	54	45	
Portland	TWRA	34			
Portland	YS	36			
Sacramento	AP	58			
Oakland	AP	32	66	48	
Oakland	HJ	60			
Oakland	HY	54			
Oakland	KL	42			
Oakland	MO	42			
Oakland	NL			38	
Oakland	NY	32		38	
Oakland	OO	76			
Oakland	SL	32			
		Per 1,000 board foot			
Anchorage	TWRA	133	160	160	173
Haines	TWRA	150	135	150	
Klawock	TWRA	141		141	
Metlaktla	TWRA	118	135	135	
Palmer	TWRA	151	188	188	201
Petersburg	TWRA	145		125	
Wrangell	TWRA	150	131	150	

[a] Source: Transpacific Westbound Rate Agreement (1988).

Table 12—Ocean freight rates for wood pulp shipped from U.S. Pacific Coast to Pacific Rim markets, 1988[a]

		To:			
From:	Carrier	Japan	South Korea	Taiwan	Hong Kong
		Per 1,000 kilograms			
Port Angeles	TWRA	$74	$74	$74	$69
Port Angeles	KL	69	58	59	
Port Angeles	SL	59	58	59	
Port Angeles	NS	69		69	88
Port Angeles	OO	69			
Port Angeles	AP	59	58	59	
Port Angeles	HJ	59	58	59	
Port Angeles	YS	69		69	88
Port Angeles	NL		91		
Port Angeles	MK	69	58	69	
Port Townsend	NY	67			
Port Townsend	HJ	57	57	57	
Port Townsend	NL	86		67	81
Port Townsend	TWRA	72	72	72	93
Port Townsend	SL	57	57	57	81
Port Townsend	KL	57	57	57	
Port Townsend	NS	67		67	81
Port Townsend	MK	67	67	57	
Port Townsend	YS	67		67	81
Port Townsend	AP	57	57	57	
Bellingham	NY	68			
Bellingham	TWRA	95	98	93	86
Bellingham	OO	68		70	
Bellingham	AP		57		
Bellingham	KL		57		66
Bellingham	HJ		57		
Bellingham	HY		84		66
Everett	YS	65		65	65
Everett	AP	55	54	55	55
Everett	MK	65	54	65	65
Everett	HY			65	
Everett	TWRA	70	70	70	70
Everett	HJ	55	54	55	55
Everett	NL	65	65	65	55
Everett	OO	65		55	55
Everett	SL	55	54	55	55
Everett	KL	65	54	55	55
Everett	JL			65	
Everett	NS	65		65	65
Seattle	KL			56	
Seattle	NY	88		60	
Seattle	HY		84	66	
Seattle	OO		63	56	59
Seattle	TWRA	69	69	69	93

Table 12—continued

From:	Carrier	To: Japan	South Korea	Taiwan	Hong Kong
		Per 1,000 kilograms			
Seattle	HJ			$56	
Tacoma	YS	$64		64	$88
Tacoma	SL	54	$53	54	78
Tacoma	MK	64	53	64	88
Tacoma	NS	64		66	88
Tacoma	OO	67		54	
Tacoma	HY		55		
Tacoma	AP	54	53	54	78
Tacoma	TWRA	69	69	69	93
Tacoma	MO	64		64	67
Tacoma	HJ	54	53	54	78
Portland	HY	66	84	82	69
Portland	AP			59	59
Portland	KL			59	59
Portland	HJ			59	59
Portland	TWRA		84		
Portland	MO	66			
Aberdeen	TWRA	95	98	93	93
Cosmopolis	SL	57	56	57	57
Cosmopolis	KL	67	56	57	57
Cosmopolis	TWRA	72	72	72	72
Cosmopolis	NL	67	67	67	67
Cosmopolis	OO	67		57	57
Cosmopolis	AP	57	56	57	57
Cosmopolis	NS	67		67	67
Cosmopolis	HJ	57	56	57	57
Cosmopolis	HY			67	
Cosmopolis	YS	67		67	67
Cosmopolis	JL			67	
Cosmopolis	MK	67	56	57	67
Grays Harbor	TWRA	95	98	93	93
Eureka	HY	76	86	67	
Eureka	SL			84	
Eureka	OO			95	
Eureka	HJ		83		
Eureka	NL	76	86	84	
Eureka	KL		83		
Samoa	MO			74	
Samoa	HJ			74	
Samoa	KL			74	
Samoa	NL			79	
Oakland	AP			79	
Oakland	MO		69		

Table 12—continued

From:	Carrier	To: Japan	South Korea	Taiwan	Hong Kong
		Per 1,000 kilograms			
Los Angeles	MO	$63			
Ketchikan	MO	80	$98	$83	
Ketchikan	NY	114	120		
Sitka	MO		83		
Sitka	NY		104		

[a] Source: Transpacific Westbound Rate Agreement (1988).

Appendix 3

Board Feet Equivalent Rates for Western Hemlock Logs and Cants

Table 13—Ocean freight rates for western hemlock logs converted to dollars per 1,000 board feet[a]

From:	Carrier	To: Japan	South Korea	Taiwan	Hong Kong
Seattle	MO	$148	$222	$222	$222
Aberdeen	HJ		319		
Seattle	AP	148		180	
Seattle	HJ	148	203	171	
Seattle	HY	203	171	222	
Seattle	KL	148		180	
Seattle	MK	189			
Seattle	NL				226
Seattle	NS	222			
Seattle	NY	148			
Seattle	OO	222			
Seattle	TWRA	139			
Seattle	YS	222			
Tacoma	HJ		333		
Tacoma	MK	148		213	222
Longview	HJ		328	310	
Portland	AP	166		222	213
Portland	HJ	176	273	199	213
Portland	HY	189	250	208	222
Portland	JL	166			
Portland	KI	166	250	199	
Portland	MK	166			
Portland	MO	166	222	199	189
Portland	NS	166			
Portland	NY	166	222	194	
Portland	OO	250			
Portland	SL	250	250	208	
Portland	TWRA	157			
Portland	YS	166			

Table 13—continued

From:	Carrier	Japan	South Korea	Taiwan	Hong Kong
Sacramento	AP	$268			
Oakland	AP	148	$305	$222	
Oakland	HJ		277		
Oakland	HY	250			
Oakland	KL	194			
Oakland	MO	194			
Oakland	NL			176	
Oakland	NY	148		176	
Oakland	OO	351			
Oakland	SL	148			
Los Angeles	AP	194	305		
Los Angeles	KL	194			

[a] Source: Transpacific Westbound Rate Agreement (1988).

Table 14—Ocean freight rates for western hemlock cants converted to dollars per 1,000 board feet[a]

From:	Carrier	Japan	South Korea	Taiwan	Hong Kong
Aberdeen	HJ		$216		
Seattle	AP	$100		$122	
Seattle	HJ	100	137	116	
Seattle	HY	137	116	150	
Seattle	KL	100		122	
Seattle	MK	128			
Seattle	MO	100	150	150	$150
Seattle	NL				153
Seattle	NS	150		147	
Seattle	NY	100			
Seattle	OO	150			
Seattle	TWRA	94			
Seattle	YS	150		147	
Tacoma	HJ		225		
Tacoma	MK	100		144	150
Longview	HJ		222	209	
Portland	AP	112		150	144
Portland	HJ	119	184	134	144
Portland	HY	128	169	141	150
Portland	JL	112			
Portland	KI	112	169	134	
Portland	MK	112			
Portland	MO	112	150	134	128

Table 14—continued

		To:			
From:	Carrier	Japan	South Korea	Taiwan	Hong Kong
Portland	NS	$112			
Portland	NY	112	$150	$131	
Portland	OO	169			
Portland	SL	169	169	141	
Portland	TWRA	106			
Portland	YS	112			
Sacramento	AP	181			
Oakland	AP	100	206	150	
Oakland	HJ		187		
Oakland	HY	169			
Oakland	KL	131			
Oakland	MO	131			
Oakland	NL			119	
Oakland	NY	100		119	
Oakland	OO	237			
Oakland	SL	100			
Los Angeles	AP	131	206		
Los Angeles	KL	131			

[a] Source: Transpacific Westbound Rate Agreement (1988).

Wisdom, Harold W. 1990. Transportation costs for forest products from the Puget Sound area and Alaska to Pacific Rim markets. Res. Pap. PNW-RP-425. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 25 p.

Ocean freight rates to Pacific Rim markets for softwood logs, cants, and wood pulp from Alaska were compared with rates from the Puget Sound area by using analysis of covariance and analysis of variance techniques. The results did not support the hypothesis that lower freight rates for Alaska result from shorter shipping distances. In many cases, ocean freight rates for Alaska are higher than ocean freight rates from Puget Sound to the same markets. When Alaska rates were lower, distance did not seem to be the reason for the lower rates.

Keywords: Transportation costs, freight rates, logs, cants, wood pulp, forest products, exports, international trade, Alaska, Pacific Northwest, Pacific Rim, Japan, South Korea, Taiwan, Hong Kong.

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