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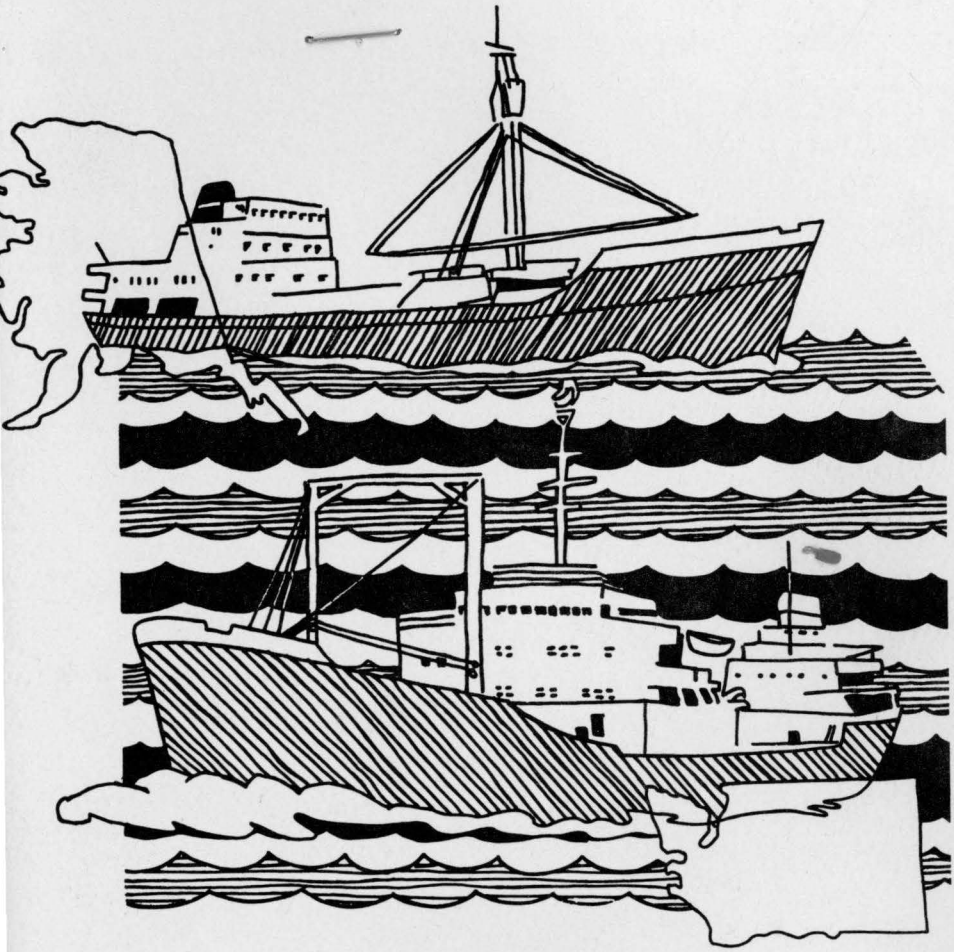

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Background

Geographic isolation, a subarctic climate, large size, and a regionally diverse landscape make Alaska a unique part of the United States. The factors that make Alaska so unique also contribute to her present lack of industrial and agricultural production, which requires shipment into the state of most of the goods necessary for life. In filling the need for such goods, the state of Washington has been, and continues to be, the principal marketing and transportation center for Alaska-associated trade.

This mutual interdependency between Alaska and Washington has become even more critical with the substantial resource development occurring in Alaska. The corresponding increase in demand for consumer and industrial goods has put additional strain on the physical distribution system serving both states. Thus, it has become important to have an accurate projection of the level and composition of this increased demand and the impact such increased trade might have on the economy of Washington.

A study was undertaken to estimate the impact Alaskan oil development will have on the Washington economy. A Location Quotient-Derived Input-Output model for Alaska formed the basis of the study. Results indicated Washington's total output in 1980 would increase, between 5.3% and 10.6% due to oil-induced Alaskan trade, with the greatest impact being felt in the agricultural areas of the state in conjunction with Seattle's continuing role as the transportation, financial, and trade center for Washington.

The model used in the study was the first input-output model constructed for socioeconomic situations in the state and the impact of each industry on the economy's gross income, gross output, and gross employment were examined.[1] As a result, the study encompassed

[1]Other economic models of Alaska are available. See *A Forecast of Industrial and Occupational Employment in Alaska,* by Human Resources Planning Institute, prepared for the Man in the Arctic Program, ISEGR Research Report No. 43, University of Alaska, April 1974; Kresge, David, "Projections of Alaska's Growth to 1990." *Alaska Review of Business an Economic Conditions,* ISEGR, University of Alaska, January, 1976; Seiver, Dan, "Alaska Economic Growth: A Regional Model with Induced Migration," paper presented at the Regional Science Association Meetings, Cambridge, Massachusetts, November 1975; and Tuck, Brad, "An Aggregate Income Model of the State of Alaska," Federal Field Committee for Development Planning in Alaska, 1967.

somewhat more than just an examination of the impact of economic activity in Alaska on the Alaska-Washington trade.[2]

Objectives

The specific objectives of this publication are to: (1) present a first look in specific detail at the input-output tables of the Alaskan economy, thereby examining Alaskan interindustry interactions and dependencies; and (2) indicate, via relevant examples, how the information contained in these typical input-out tables can be used by private and public policymakers.

Limitations

There are basic assumptions inherent in any input-output model that qualify and temper the implications that should be drawn from the results. These qualifications apply to the input-output tables presented in this publication. Technical relations are assumed to be static among industries, as such each industry is assumed to have a

[2]The reader desiring indepth examination of these techniques or studies is referred to:

A. Input-Output Modeling
   1. Miernyk, William H., *The Elements of Input-Output Analysis,* Random House, New York, New York, 1965.
   2. Leontief, Wassily, *Input-Output Economics,* Oxford University Press, New York, 1966.

B. Location Quotient Input-Output
   1. Mustafa, Gholoam, and L.L. Jones, *Regional Input-Output Model Using Location Quotients, Program and Model Documentation,* Texas Agricultural Experimentation Station, Texas A & M University, 1971.
   2. Fort, John W., and James C. Hite, *Possibilities for Synthesizing Input-Output Coefficients for Small Areas in Rural Development Research,* paper presented at joint meetings of American Agricultural Economics Association, Canadian Agricultural Economics Association, and the Western Agricultural Economics Association at the University of Alberta, Edmonton, Alberta, Canada, August, 1973.
   3. Logsdon, Charles L., and Kenneth L. Casavant, *The Impact of Alaskan Oil Development on the Washington-Alaska Trade, The Annals of Regional Science,* July, 1976. Vol. 10, No. 2 p. 104-115.

C. Alaska-Washington Trade
   1. The Federal Maritime Commission, *The Alaska Trade Study,* prepared for the Bureau of Domestic Regulation, Washington, D.C., July, 1967.
   2. Thomas, W., M. Waananen, C. Marsh, and K. Casavant, *Alaska-Washington Trade: Problems Potentials,* in Agricultural Experiment Station, University of Alaska, Fairbanks, Alaska. (in press)
   3. Waananen, M., W. Thomas, C. Logsdon, and K. Casavant, *Alaska-Washington Trade Profile, Part I: Waterborne Commerce* Agricultural Experiment Station, University of Alaska, Fairbanks, Alaska. (in press)

linear production function and to be operating at full capacity at all times with constant returns to scale. Further, unlimited factor availability is assumed; this is an unrealistic assumption in industries constrained by biological productivity, e.g., fish processing activities. These constraints will be discussed in the tabular presentation.

The Location Quotient was used to derive the Gross Flows Table for this study. The Washington State economy was used as the model for developing the Alaska input-output model presented here. Using a model developed for the economy of one state to generate a model for another state assumes a similarity in the economic structures of the two, even as modified by the appropriate location quotients. This weakness, while minimized by use of extensive secondary[3] data modifications of control totals, does limit this publication of results to only a "first look" at the Alaskan economy.

Finally, the input-output tables presented in this publication are constructed for 1972. By the very nature of the assumptions mentioned earlier, these tables depict a snapshot rather than a motion picture of the Alaskan economy. Given the current pipeline-induced economic activity imposed on such an immature economy as Alaska's, it would be extremely naive to expect that the economic interaction depicted by the tables for 1972 would match tables developed to depict 1975. They do, however, illustrate some basic relations in an export-based, spatially isolated economy and do provide clues to those economic sectors having the greatest impact on the state now and in the future.

INPUT-OUTPUT MODEL OF ALASKAN ECONOMY

Basic information on industry interaction and structure of the Alaskan economy is always useful to state and local government officials and other decision makers. Input-output analysis, one type of economic model, is a method of describing the flow of goods and services in the Alaskan economy. It allows the interdependencies of industries within the economy to be examined relative to potential impact on the overall economy of various policies. It is a powerful tool, provided that the limitations are always considered in its use.

[3]Alaska information for data modification may be found in numerous reports. Three are listed below:

State of Alaska, Department of Economic Development, *Alaska Statistical Review.* Juneau, 1973.

_____. *A Performance Report of the Alaska Economy, Mid-Year Review,* Juneau, 1974.

Alaska Crop and Livestock Reporting Service. *Alaska Agricultural Statistics.* Palmer, 1973.

The Gross Flows Table

In simplest terms, the Gross Flows Table (often called basic transactions) shows the purchases and sales of identified economic sectors or industries in the economy. (See appendix for sector identification.) This data is presented by constructing a matrix in which there is both a column and a row for all economic sectors. By reading across a particular industry row, sales of that industry to other industries, households, government, and exports can be read. Reading down an industry column allows identification of purchases by that particular industry from other industries, households (generally in the form of wages and salaries), and imports to the economy. Households, government, exports, and imports comprise final demand (demand for final product goods and services) while purchases between industries comprise intermediate demand or demand for factors for production.

Table 1 presents such information for the 1972 Alaskan economy. For example, by reading across the row for transportation, it can be seen that this industry sold $100,000 worth of transportation services to the Agriculture and Fur sector, $710,000 to Fisheries, $250,000 to Forest, $3.0 million to Mining, $1.0 million to Oil and Gas, $1.5 million to Lumber, etc., with the largest amounts, $192.21 million and $21.66 million of output (transportation services), being sold to the Export and Government sectors, respectively. This table does allow identification of those industries or sectors heavily dependent on, in this example, transportation services.

Conversely, by reading down the Transportation column, the amount and source of inputs (purchases) into Transportation can be read. In this case, Transportation purchases the largest amount of inputs from the Import sector, $143.44 million. Value Added for the Transportation sector is equal to $120.98 million where Value Added is an estimate of sales minus purchases, associated with the industry. This exercise can be done for any of the industries in the state model.

In addition to interindustry interaction, other useful information is available in the Gross Flows table. First, the Value Added row is essentially an estimate of Gross State Product by industry, indicating which industries are contributing most to the state's economy. Secondly, Alaska's balance of trade for 1972 can be computed by subtracting imports from exports, suggesting Alaska had a negative trade balance in that year of about $730 million.

TABLE 1

Alaskan Economy Gross Interindustry Flows, 1972 (million $)

Selling Industry	Purchasing Industries																Final Demand				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	HH[1]	Fed[2]	I[3]	Exp[4]	Sales
1 Ag. & Fur	.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.28	.01	.01	0.0	0.0	0.0	0.0	.02	5.72	0.0	0.0	0.0	10.10
2 Fish	0.0	1.78	0.0	0.0	0.0	0.0	0.0	77.06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.72	0.0	0.0	4.46	85.02
3 Forest	0.0	0.0	.10	0.0	0.0	2.42	2.29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.34	0.0	0.0	.33	5.47
4 Mining	.02	.36	0.0	2.91	0.0	0.0	.02	1.55	.09	29.15	.10	5.50	0.0	.02	.07	.30	.47	1.29	0.0	8.00	49.89
5 Oil & Gas	0.0	0.0	0.0	5.4	0.0	0.0	.01	0.0	.06	3.95	0.0	0.0	0.0	0.0	0.0	3.16	.44	.26	0.0	309.75	323.04
6 Lumber	0.0	0.0	0.0	.01	0.0	.47	.32	0.0	.01	4.27	.39	.08	0.0	0.0	0.0	.93	3.18	.46	.84	20.45	31.41
7 Pulp	.01	0.0	0.0	.24	0.0	.05	6.14	0.0	.22	.04	.16	.20	.19	.86	.19	.44	.08	.05	0.0	80.43	89.30
8 Fish Prod.	0.0	.71	0.0	0.0	0.0	0.0	0.0	.55	0.0	0.0	0.0	0.0	0.0	.01	.11	.72	14.64	3.65	0.0	178.60	199.00
9 Manuf.	.01	.24	0.0	.02	.23	.01	.06	.62	.05	.73	.45	.03	.02	.11	.06	.15	47.41	7.10	2.48	0.0	59.78
10 Constr.	.04	0.0	0.0	.05	.47	.04	.14	.38	.06	.04	4.05	1.48	.59	.19	.32	217.33	5.26	181.31	54.26	0.0	466.00
11 Trans.	.10	.71	.25	3.03	1.09	1.49	2.10	12.95	.44	8.61	14.34	.72	.52	21.24	.12	2.29	16.22	21.66	1.01	192.21	301.11
12 Com./Util.	.16	.36	.02	2.37	2.19	.38	2.21	3.76	.83	3.84	4.78	13.10	1.34	5.18	4.75	11.74	53.63	6.61	0.0	34.38	151.63
13 FIRE[5]	.04	0.0	.02	.17	2.78	.13	.29	.94	.17	2.04	4.93	.77	3.29	2.77	.96	1.36	186.05	.22	.68	0.0	207.61
14 Trade	.09	.90	.02	.32	.56	.27	.85	8.21	.16	6.54	1.90	1.80	.67	1.48	.46	2.50	332.53	2.01	21.26	0.0	380.87
15 Service	.16	0.0	.03	.56	10.95	.12	.19	2.45	.34	5.52	2.79	2.82	1.99	4.00	2.82	1.62	252.88	4.16	0.0	0.0	293.38
16 State	.01	0.0	0.0	.24	45.37	.60	.15	2.10	.23	143.73	2.87	5.67	.75	.84	.46	5.00	146.90	187.20	73.10	37.28	652.48
Imports	4.01	31.65	2.62	2.20	43.50	4.61	39.23	32.13	26.04	7.33	143.44	14.56	12.05	56.23	95.86	106.26	239.37	475.26	268.00	-1420.19	189.66
Value Added	5.40	48.31	2.41	32.37	215.90	20.82	35.30	56.30	26.80	250.20	120.90	104.90	186.20	288.20	187.20	301.20	205.06	350.28	0.0	0.0	2437.75
Total Purchases	10.10	85.02	5.47	49.89	323.04	31.41	89.30	199.00	59.78	466.00	301.11	151.63	207.61	380.87	293.38	652.48	1511.90	1241.52	421.60	-548.70	5106.52

Table Source: Logsdon, Charles Louis, *A Structural Analysis of the Alaska-Washington Trade: An Input-Output Study*, unpublished Master of Arts thesis, Department of Agricultural Economics, Washington State University, Pullman, Washington, 1975.

[1] HH - Households
[2] Fed - Federal
[3] I - Imports
[4] Exp - Exports
[5] FIRE - Finance, Insurance, and Real Estate

The Direct Requirements Table

The Gross Flows Table, Table 1, can be used to generate Table 2, a direct requirements table. These coefficients show what inputs are needed in order to produce $1.00 of output in a given industry. Essentially, these coefficients are simply the ratio of purchases of one industry from another industry by total output of the purchasing industry. For example, Mining purchases $5.4 million worth of inputs from the Oil and Gas sector; this is 10.8 percent of its total output of $49 million. The coefficient, .108, means that for every dollar of output produced by Mining, 10.8 cents must be spent on inputs from the Oil and Gas sector.[4]

This table is particularly interesting in that it gives information on the strength of interindustry inteactions in the economy. By summing the coefficients in each column, the percentage of input requirements each industry purchased from other industries and households within Alaska, rather than outside of Alaska, is determined. For example, purchases by Transportation from Alaskan industries comprise 12.21 percent of total purchases with the other 87.79 percent coming from Imports or accounted for by Value Added. These interindustry purchases are commonly referred to as backward linkages where a high percentage backward linkage reflects high industry interaction and is usually an indicator of a mature economy. The backward linkages for the Alaskan economy are indicated in Table 3. Only one industry, Fish Processing, purchases more than 50% of its inputs within the state, meaning that Alaska's economy is very dependent on trade from non-Alaskan sources. This indicates that expansion of any particular industry's output will not have large secondary economic effects. This further suggests that, in light of the 1972 industry structure, as growth occurs in Alaska, trade areas outside the state will receive substantial impact from increased Alaskan economic activity.

[4]These coefficients are often called the technical coefficients since they essentially specify a production function for that particular industry.

TABLE 2

Direct purchases per dollar of gross outlay, 1972

Selling Industries	Purchasing Industries																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Agric	.005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.072	.00002	.00003	0.0	0.0	0.0	0.0	.00003	.003
2. Fish	0.0	.021	0.0	0.0	0.0	0.0	0.0	.387	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.001
3. Forest	0.0	0.0	.018	0.0	0.0	.077	.026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.0002
4. Mining	.002	.004	0.0	.058	0.0	0.0	.0002	.008	.002	.063	.0003	0.0	0.0	0.0	.0002	.0005	.0003
5. Oil & Gas	0.0	0.0	0.0	.108	0.0	0.0	.0001	0.0	.001	.008	0.0	0.0	0.0	0.0	0.0	.005	.0003
6. Lumber	0.0	0.0	0.0	.0002	0.0	.015	.004	0.0	.0002	.009	.001	.0005	0.0	0.0	0.0	.001	.002
7. Pulp	.001	0.0	0.0	.005	0.0	.002	.069	0.0	.004	0.0	.0005	.001	.001	.002	.001	.001	.00005
8. Fish Proc	0.0	.008	0.0	0.0	0.0	0.0	0.0	.003	0.0	0.0	0.0	0.0	0.0	0.0	.0004	.001	.0097
9. Manuf	.001	.003	0.0	.0004	.0007	.0003	.0007	.003	.0008	.002	.001	.0002	.0001	.0003	.0002	.0002	.0314
10. Constr	.004	0.0	0.0	.001	.001	.001	.001	.002	.001	.0001	.013	.009	.003	.0005	.001	.333	.0035
11. Trans	.009	.008	.046	.061	.003	.047	.024	.065	.007	.018	.048	.005	.003	.056	.0004	.004	.0107
12. Com/Util	.016	.004	.004	.048	.007	.012	.025	.019	.014	.008	.016	.086	.006	.014	.016	.018	.0355
13. FIRE	.004	0.0	.004	.003	.009	.004	.003	.005	.003	.004	.016	.005	.016	.007	.003	.002	.1231
14. Trade	.009	.011	.004	.006	.002	.009	.01	.041	.003	.014	.006	.012	.003	.004	.002	.004	.2199
15. Service	.016	0.0	.005	.011	.033	.004	.002	.012	.006	.011	.009	.019	.009	.011	.009	.002	.1673
16. State	.001	0.0	0.0	.005	.140	.019	.002	.010	.004	.308	.009	.037	.004	.002	.002	.008	.0972
17. Households	.198	.176	.367	.106	.116	.882	.198	.173	.373	.366	.282	.447	.208	.452	.433	.225	.7735

Table Source: Logsdon, Charles Louis, *A Structural Analysis of the Alaska-Washington Trade: An Input-Output Study*, unpublished Master of Arts thesis, Department of Agricultural Economics, Washington State University, Pullman, Washington, 1975.

Table 3:
Backward Linkages, Alaskan Economic Sector, 1972
(Households excluded)

Sector	% Purchased in Alaska
Fish Processing	55.56
Construction	44.51
State Government	37.17
Mining	29.86
Oil & Gas	19.57
Lumber	19.03
Com/Util	17.47
Pulp	16.70
Transportation	11.98
Manufacturing	11.80
Trade	9.68
Forest	8.10
Agriculture	6.83
Fish	5.95
FIRE	4.51
Service	3.52

Source: Logsdon, Charles L., *A Structural Analysis of the Alaska-Washington Trade: An Input-Output Study,* unpublished Master of Arts thesis, Department of Agricultural Economics, Washington State University, Pullman, Washington, 1975.

The Direct and Indirect Requirements Table

An additional table can be constructed which will provide even more specific information about the Alaskan economy. The direct requirements for input for every dollar of output were indicated earlier (Table 2). Given an increase in final demand of one dollar for any given sector, the direct requirement purchases necessary to increase industry output are known. The effect on the economy does not stop here though, for in order to meet the increased demand of the purchasing industry, the selling industries must increase their output, thereby increasing their demand for inputs. The final result of these round-by-round effects, generated by a given change in demand, is indicated by the coefficients in Table 4.[5]

The coefficients in this table are also useful. For example, the Services sector purchases a significant amount of inputs from Communications-Utilities. The direct and indirect effect of an increase in final demand of one dollar for Services, is a total increase in purchases by Services from the Communications-Utilities alone of 5.37 cents. The importance of the direct and indirect effect on an economy is even more noticeable since the direct requirements were only 1.6 cents. As another example, consider Agriculture's purchases from the Service sector. The direct requirements are 1.6 cents (Table 2) for every dollar increase in output and the direct and indirect effect per dollar increase in final demand is a 7.92-cent (Table 4) increase in purchases from Services.

These direct and indirect requirements in Table 4 are especially useful because they relate changes in demand for any sector to total impact on the economy. As such, this table can be used to construct industry impact multipliers and forecasts of total economic output given potential changes in demand.

Resource Multipliers

The direct and indirect requirements and backward linkages are closely associated. Tables 2 and 3 can be used to construct resource multipliers, an extremely informative tool for policy makers as they examine direction for potential investment. Multipliers measure the total change in resource requirements throughout the economy resulting from a one-unit change in resource requirements for that given sector. Income and employment are examples of economic

[5]This table is mathematically constructed by inverting a I-A matrix where I is an n x n identity matrix and A is the direct coefficients matrix (n x n).

TABLE 4

Alaska economy, direct and indirect requirement per dollar of final demand, households included in processing sector, 1972.

Selling Industries	Purchasing Industries																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Agric	1.0070	.0020	.0145	.0019	.0019	.0100	.0020	.0033	.0759	.0054	.0033	.0051	.0022	.0045	.0043	.0042	.0096
2. Fish	.0018	1.0263	.0121	.0016	.0017	.0064	.0023	.4005	.0033	.0045	.0026	.0043	.0016	.0039	.0038	.0039	.0081
3. Forest	.0002	.0002	1.0197	.0003	.0002	.0805	.0286	.0003	.0004	.0013	.0004	.0005	.0002	.0004	.0004	.0007	.0007
4. Mining	.0057	.0050	.0084	1.0639	.0048	.0065	.0021	.0125	.0043	.0774	.0035	.0048	.0015	.0029	.0028	.0272	.0099
5. Oil & Gas	.0009	.0010	.0038	.1158	1.0021	.0029	.0009	.0021	.0023	.0206	.0013	.0020	.0007	.0013	.0012	.0125	.0026
6. Lumber	.0011	.0009	.0067	.0014	.0016	1.0200	.0053	.0016	.0020	.0134	.0031	.0033	.0010	.0023	.0020	.0070	.0044
7. Pulp	.0016	.0004	.0029	.0060	.0006	.0038	1.0745	.0009	.0048	.0019	.0013	.0026	.0014	.0034	.0016	.0019	.0018
8. Fish Proc	.0038	.0116	.0236	.0031	.0033	.0165	.0045	1.0111	.0064	.0089	.0052	.0084	.0035	.0076	.0074	.0079	.0156
9. Manuf	.0123	.0127	.0754	.0105	.0108	.0528	.0152	.0202	1.0212	.0291	.0181	.0268	.0113	.0247	.0226	.0222	.0499
10. Constr	.0211	.0138	.1045	.0257	.0688	.0821	.0238	.0301	.0315	1.1555	.0427	.0639	.0203	.0363	.0330	.4055	.0634
11. Trans	.0213	.0191	.1151	.0782	.0145	.1014	.0417	.0899	.0269	.0535	1.0656	.0305	.0129	.0804	.0204	.0329	.0436
12. Com/Util	.0363	.0211	.1248	.0743	.0279	.0989	.0531	.0511	.0494	.0656	.0455	1.1390	.0255	.0551	.0537	.0616	.0791
13. FIRE	.0503	.0398	.3102	.0464	.0500	.2184	.0630	.0707	.0859	.1173	.0846	.1137	1.0617	.1071	.0943	.0912	.2020
14. Trade	.0892	.0802	.5361	.0782	.0737	.3801	.1130	.1583	.1472	.2103	.1236	.2010	.0827	1.1761	.1600	.1603	.3517
15. Service	.0792	.0542	.4219	.0726	.0906	.2948	.0832	.1016	.1196	.1669	.1016	.1677	.0720	.1457	1.1340	.0640	.2749
16. State	.0448	.0361	.2751	.0641	.1956	.2147	.0572	.0727	.0799	.4510	.0772	.1466	.0464	.0928	.0849	1.2053	.1811
17. Households	.3563	.3068	.5923	.3110	.3135	1.6525	.4556	.4971	.6405	.8578	.5185	.8339	.3536	.7659	.7059	.6716	1.5703

Table Source: Logsdon, Charles Louis, *A Structural Analysis of the Alaska-Washington Trade: An Input-Output Study,* unpublished Master of Arts thesis, Department of Agricultural Economics, Washington State University, Pullman, Washington, 1975.

variables for which multipliers are commonly constructed. Algebraically, the multiplier is simply the direct and indirect effect on income or employment divided by the direct effect for the resource being examined.[6] Employment and income multipliers relevant for the Alaskan economy are indicated, ranked by strength, in Table 5.[7]

The income multiplier measures the total change in income throughout the economy as a result of a one-dollar increase in income in a particular sector. For example, for each one-dollar increase in final demand (demand by households, government, or export markets) for Agricultural products the state economy would experience a $1.80 increase in income. Since the income multipliers are calculated with the household sector endogenous to the model, simply divide the direct and indirect requirements coefficient for households by the direct requirements coefficient by industry. In the case of construction, this would be done by dividing .8578 by .363 which gives an income multiplier of 2.34.

The employment multipliers are calculated in terms of physical units of labor per dollar of output, therefore the slightly different calculation technique developed by Werner Hirsch is used.[8] In this technique, households are exogenous. A vector of labor output ratios by industry (see Table 6) is multiplied by the interdependence matrix to get the direct and indirect effect by industry—in this case, the labor output ratio—to get the employment multipliers. The employment multiplier indicates the total change in employment as a result of a one-unit increase in employment in a particular industry.[9]

[6]By making households endogenous to the model, that is, adding a households row and column to the interindustry sales and purchaes matrix, the induced effect of income in the hands of consumers is included in the multiplier analysis, thus providing a more complete evaluation of probable impacts.

[7]For a discussion on construction of various multipliers, see Miernyk, William H., *The Elements of Input-Output Analysis,* Random House, New York, New York, 1965.

[8]Werner Z. Hirsch, Interindustry Relations of a Metropolitan Area, *The Review of Economics and Statistics,* XLI, November, 1959, p. 364-365.

[9]Again, this assumes a linear production function and constant labor-output ratios for all industries. This is often unrealistic, especially where productivity per laborer in the Fish Processing sector has been declining as well as the pronounced inability of the Fish, Lumber, and Minerals industries to expand their production constantly.

Table: 5
Multiplier analysis of the Alaska economy by impact ranking, 1972

Gross Income Multiplier		Employment Multiplier	
State	2.98	Fish Processing	6.03
Mining	2.93	Construct	3.53
Fish Processing	2.87	State	3.17
Oil & Gas	2.70	Manuf	2.82
Construct	2.34	Pump	1.92
Pulp	2.30	Lumber	1.47
Lumber	1.87	Transport	1.25
Com/Util	1.87	Mining	1.25
Transport	1.84	Oil & Gas	1.19
Agric	1.80	Com/Util	1.19
Fish	1.74	Trade	1.10
Manuf	1.72	FIRE	1.07
FIRE	1.70	Service	1.04
Trade	1.69	Fish	1.03
Service	1.63	Forest	1.02
Forest	1.61	Agric	1.01

Source: Logsdon, Charles L., *A Structural Analysis of the Alaska-Washington Trade: An Input-Output Study,* unpublished Master of Arts thesis, Department of Agricultural Economics, Washington State University, Pullman, Washington, 1975.

State Government, Fish Processing, Mining, and Oil and Gas sectors have the largest income impact in Alaska while Fish processing, Construction, State Government, and Manufacturing have the largest impact on employment. With the exception of Fish Processing, which is constrained by biological productivity (unless aided by extensive fish rehabilitation programs), these sectors are all highly affected by public policy. Hence, the future of the Alaskan economy will no doubt

depend on private investment decisions but also, to a considerable degree, upon decisions made in the political sphere and on decisions made on environmental, social, and economic concerns of Alaskan citizens.

Table 6:
Labor Output Ratios for Alaskans
Industrial Sectors 1972
(per million $ output)

Sector	L/O Ratio
Agriculture	99.01
Fish	90.73
Forest	200.18
Mining	11.86
Oil & Gas	5.52
Lumber	21.01
Pulp	12.36
Fish Processing	17.93
Manufacture	23.49
Construction	16.95
Transportation	21.25
Communications/Utilities	23.74
FIRE	17.82
Trade	44.90
Service	47.73
State Government	35.56

Source: Logsdon, Charles L. (see Table 5 for full reference).

Model Refinement

Currently, there are a number of economic models of the Alaskan economy. As a consequence of increased national interest in development of oil and gas resources, as well as the desire of the Native Corporations for regional development scenarios, modeling activities can be expected to continue. The input-output technique described in this publication is relatively simple to understand and interpret and, as a first look, offers much information useful to decision-makers.

Additional refinement of the Alaska Input-Output Model can be accomplished. As decision-makers are faced with particular problems, the level of aggregation in the model can be changed, thereby allowing the researcher to focus specifically on the sector under analysis as well as on the general model. Further, additional resource impact multipliers for energy requirements, water supply, and other infrastructural needs could be computed on a regional as well as a statewide basis.

Finally, the Input-Output economic model lends itself to continual updating as the industry structure in Alaska changes. Data generation techniques are available which suggests that inexpensive modification of these input-output tables can be accomplished in response to Alaskan growth and economic maturity, thus allowing them to keep pace with the changing economic structure.

Appendix: Alaska industry classification and corresponding S.I.C. codes

Industry Number	Alaska Industry	Description	S.I.C. Classification
1	Agriculture & Furs	Primary agricultural production and fur harvested	01-07
2	Fisheries	Fish harvest	09
3	Forest	Timber harvest	08
4	Mining	All mining, except gas and oil	321-329
5	Oil and Gas	Petroleum and natural gas extracted	10-14
6	Lumber	Export cants, lumber and export logs manufactured	2421-2433, 244, 249, 25
7	Pulp	Pulp and paper products	261-262
8	Fish Processing	Fish canneries	205-207, 209
9	Manufacturing	All manufacturing except lumber, pulp, and fish processing	201-209, 22, 23, 27-289, 29, 33, 34, 35, 36, 37
10	Contract Construction	New construction	15, 16, 17
11	Transportation	Rail, air, water, motor transportation	40-47
12	Communications and Utilities	Gas companies, water, electricity, and communications	48, 49
13	Finance, Insurance, and Real Estate	Finance, insurance, real estate	60, 67
14	Trade	Wholesale and retail trade	50, 52-29
15	Services	Personal and business services	73, 81, 89, 70, 71, 72, 75-80, 82-87