This file was created by scanning the printed publication.
Text errors identified by the software have been corrected;
however, some errors may remain.

United States
Department of
Agriculture

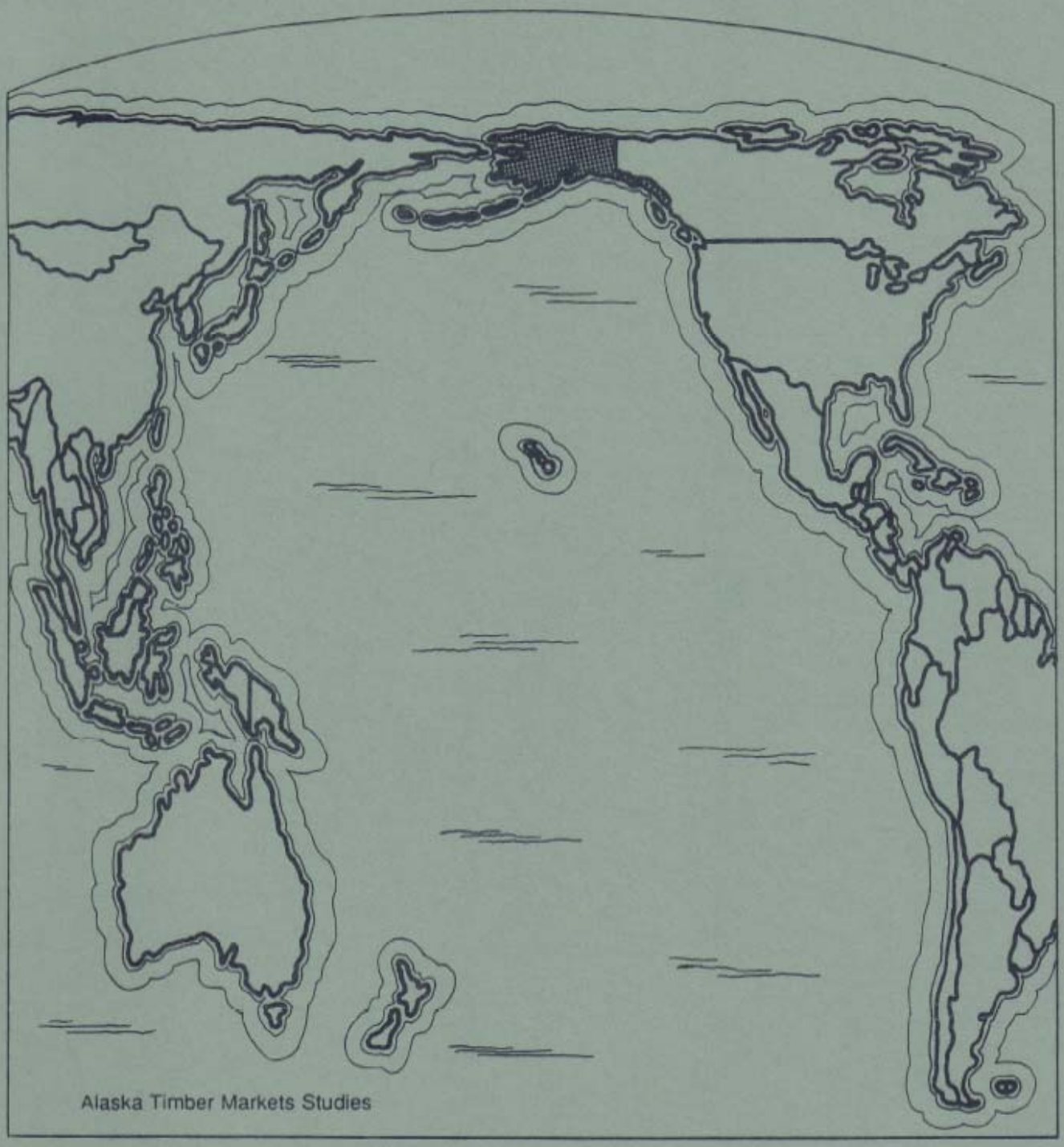
Forest Service

Pacific Northwest
Research Station

General Technical
Report
PNW-GTR-261
December 1990

Timber Products Output and Timber Harvests in Alaska: Projections for 1989-2010

David J. Brooks and Richard W. Haynes



Authors

DAVID J. BROOKS and RICHARD W. HAYNES are research foresters, Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, OR 97331, and Forestry Science Laboratory, P.O. Box 3890, Portland, OR 97208-3890, respectively.

Abstract

Brooks, David J.; Haynes, Richard W. 1990. Timber products output and timber harvests in Alaska: projections for 1989-2010. Gen. Tech. Rep. PNW-GTR-261. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 48 p.

Projections of Alaska timber products output and timber harvest by owner were developed by using a detailed, trend-based analysis. Historical data for 1965-88 were the basis for projections for 1989-2010. Projections of timber products output for each major product (export logs, sawn wood, and market pulp) were used to compute the derived demand for timber. The assumptions these projections depend on include the level of harvest by Alaska Native corporations, sawn-wood consumption in Japan, and exports of market pulp. Potential harvest from Alaska National Forests (primarily the Tongass National Forest) Is calculated as the volume of timber that balances the derived demand, given harvest by other owners. Total harvest in Alaska is expected to average 660 million board feet per year during the early 1990s and 545 million board feet per year between 1995 and 2005. Projected) demand is such that. harvest from Alaska National Forests can remain roughly constant at 400 million board feet per year from 1990 to 2010. The sensitivity of these projections to changes in major assumptions is examined.

Keywords: Supply and demand, production, trade, Pacific Rim, National Forests.

Contents

1 **Introduction**

3 **Methodology**

6 **Production and Export of Alaska Forest Products**

6 Sawn Wood

13 Market Pulp

15 Export Logs

16 Wood Chips

16 **Derived Demand for Timber**

25 **Timber Harvest**

34 **Sensitivity Analysis**

37 **Literature Cited**

39 **Appendix 1**

39 Conversion Factors and Calculations for Sawn-Wood and Residue Production

39 **Appendix 2**

39 Expanded Projections of Conditions in Japanese Sawn-Wood Markets

Introduction

Careful consideration of future demand and markets for timber products is one component of sound stewardship decisions. Nowhere more than in Alaska have managers of public forest resources been challenged to ensure that the mix of products satisfies public needs and that costs are balanced by present or future returns. Managers must base decisions to manage forests for timber production on likely developments in timber markets. This report provides detailed background information to supplement an outlook for the demand for Alaska timber and timber products (Haynes and Brooks 1990). That analysis of the timber situation in Alaska was done in support of the Tongass National Forest land management planning process. Haynes and Brooks (1990) review current conditions and summarize recent research on major issues related to Alaska timber markets. In a logical extension of this review, we translated findings into specific projections of future production and timber harvest in Alaska.

These projections are conditioned on several assumptions and indicate only prospective demand for National Forest timber. Managers of Federal lands also may make long-range plans based on objectives other than producing timber. We are neither predicting future timber harvests nor suggesting what they ought to be. We simply calculate the quantity and type of timber necessary to meet projected demand given certain assumptions.

Table 1 summarizes our projections and the historical data for 1970-88. Data are shown as 5-year averages centered on the midpoints and end points of decades. Although data in table 1 focus on items of particular interest, they are the product of assumptions about several factors and a methodology for combining these assumptions consistently and logically. We describe in detail these assumptions and how they interact We also examine the sensitivity of projected demand for National Forest timber to changes in major assumptions.

Table 1—Summary of historical and projected periodic Alaska timber harvest by owner, harvest by product, and production of forest products, 1970-2010[a]

1A–Timber harvest by owner

		Owner			
Period[b]	Total	National Forest	Native	Other public	Timber imports
		Million board feet			
1970	596.2	539.5	56.7		0
1975	554.7	489.4	17.7	54.6	0
1980	537.4	411.0	133.8	46.1	25.5
1985	572.7	280.7	266.2	25.8	34.5
1990	793.0	382.0	376.0	30.0	13.7
1995	595.5	403.5	162.0	30.0	15.0
2000	538.2	403.2	105.0	30.0	15.0
2005	527.1	397.1	100.0	30.0	15.0
2010	530.8	400.8	100.0	30.0	15.0

1B-Harvest by product

		Product		
Period[b]	Total	Export logs	Lumber	Pulp
	Million board feet, roundwood equivalent			
1970	591.5	47.8	274.6	
1975	561.1	42.9	292.8	225.5
1980	535.1	149.5	188.5	197.1
1985	567.7	318.4	114.2	135.2
1990	788.7	403.8	170.3	214.6
1995	595.5	181.4	192.7	221.4
2000	538.2	123.5	227.6	187.1
2005	527.1	117.0	227.6	182.5
2010	530.8	117.0	225.8	188.0

Table 1—continued

1C-Production of forest products

	Product			
Period[b]	Export logs	Lumber	Pulp	Wood chip exports
	Million board feet		*Thousand short tons*	
1970	47.8	302.0	288.5	8.0
1975	42.9	341.2	298.8	56.5
1980	149.5	239.9	324.9	83.7
1985	318.4	125.7	296.1	4.6
1990	403.8	187.5	379.6	35.8
1995	181.4	217.8	387.5	44.5
2000	123.5	262.8	362.0	51.2
2005	117.0	268.5	353.2	49.8
2010	117.0	270.9	356.3	48.3

[a] Data are summarized from tables 3, 8, and 11.
[b] Data are averages centered on the year given, except 2010 reports the average for 2008 to 2010.

Methodology

Our development of the derived demand for Alaska National Forest timber is best thought of in three stages: (1) estimates of Alaska forest products output (by product) were derived; (2) the raw material requirements necessary to support this production were calculated by using explicit product recovery and conversion factors; and (3) total raw material requirements (the derived demands for timber) were compared with projections of timber harvest by private owners and harvest by non-National Forest public owners. The result was an estimate of the volume of National Forest timber necessary to balance demand, given our explicit assumptions about markets and our implicit assumptions about prices.

The process used was one of assembling historical data that describe relevant components of the Alaska forest sector and computing possible future timber harvests by using an analysis of trends in factors that determine harvests. The historical period 1965 to 1988 was used as the basis for a projection of nearly comparable length. This effort to balance hindsight and foresight may help to avoid undue emphasis on the short-term cycles—both boom and bust—that the Alaska market is subject to. Darr and others[1] comment on the cyclic nature of Alaska timber markets.

Data for the historical period also were used to confirm our estimates of conversion factors and to validate our methodology for computing derived demand. In table 2, estimated demand (net of imports) is compared to reported harvest. If both data and methods are correct, these will be equal. In fact, errors in annual estimates for 1970-88 range from 0.4 percent to 7.6 percent, and average 3.1 percent for the entire period. Along with confirmation of individual data series, we take this as validation of our estimates of production and our methods of accounting for conversion of timber to products.[2]

The method used to make these projections did not compute equilibrium values for prices and quantities; in fact, no explicit reference is made to prices. This is an elaborate trend-based projection of quantities, in which trends in consumption (of sawn wood in Japan, for example) or trends in exports (of dissolving pulp, to all destinations) are the driving assumptions. Alaska markets (or any other) will adjust, through changes in consumption and supply by private owners, to any level of supply by public owners. Prices are the mechanism through which the need for these adjustments is indicated. Because planned timber harvests from public lands generally do not depend on prices, but are dependent on policies and multiple objectives, we computed as a residual the quantity of public (National Forest) timber necessary to balance the market.

The major assumptions used in developing these projections followed from the historical data and drew heavily on recent analyses of Pacific Rim and Alaska forest products markets, including other studies done as part of the

---

[1] Darr, David; Glass, Ronald; Ellis, Thomas; Schmiege, Donald. 1977. An overview of some economic options for southeast Alaskan timber. Working Draft. Juneau, Alaska: U.S. Department of Agriculture, Forest Service, Alaska Region. 219 p. On file with the Forest Investment, Marketing, and Trade Research Project, Forestry Sciences Lab, Pacific Northwest Research Station, P.O. Box 3890, Portland, Oregon 97208.

[2] Although it is possible that compensating errors would produce reasonable (net) results, it is unlikely that this would occur consistently over nearly 20 observations.

Table 2—Alaska timber harvest, estimated net demand, and percentage error In the estimate, 1970-88[a]

Year	Total harvest	Estimated net demand	Error[b]
	Million board feet		*Percent*
1970	628.0	621.2	1.1
1971	574.9	558.4	2.9
1972	606.2	595.0	1.9
1973	655.9	644.8	1.7
1974	630.6	628.4	.4
1975	468.4	480.3	2.5
1976	531.0	540.0	1.7
1977	487.5	512.0	5.0
1978	445.0	413.7	7.0
1979	495.3	510.6	3.1
1980	589.1	610.3	3.6
1981	564.3	564.8	.1
1982	593.2	575.8	2.9
1983	525.7	485.8	7.6
1984	491.6	482.4	1.9
1985	543.0	526.2	3.1
1986	590.1	578.5	2.0
1987	713.2	765.9	7.4
1988	908.9	887.4	2.4

[a] Data are from table 8 (estimated derived demand) and table 11 (harvest by owner).

[b] Expressed In absolute terms.

Alaska Timber Market Studies (ATMS).[3] One important assumption we made was that no shifts in relative prices will occur, including prices of forest products and competing products and prices of forest products from competing regions. We did incorporate, however, implicit assumptions about trends in relative prices; for example, our assumptions about changes in relative abundance of forest resources imply change In prices of timber.

Production and Export of Alaska Forest Products

Sawn Wood

Annual data for production and export of _sawn wood (lumber and cants) are shown in table 3. Few sources consistently report sawn-wood production for Alaska; therefore for both historical data (1965-88) and projected data, we estimated production from export data. Data for. Alaska sawn-wood exports are compiled by the U.S. Department of Commerce and reported by Warren (1989), among others. For all years, we assumed that exports represent 95 percent of total production. The reasonableness of this assumption is confirmed by data on Alaska sawn-wood production from 1980 to 1986 as reported by the U.S. Department of Commerce (1987). From this, it is clear that sawn wood production and, ultimately, saw-log harvest depend on conditions in offshore markets.

Our projections began with forecasts of Japanese sawn-wood consumption (table 4). Data for 1989-2000 are from the Food and Agriculture Organization (1986); the approximate rate of growth from 1995 to 2000 (0.7 percent per year) is continued in projections for 2000 to 2010. The softwood share of total Japanese sawn-wood consumption averaged 82 percent in 1980-84 and 83 percent in 1985-88; this share is assumed to remain at 83 percent for 1990-94 and to increase by two percentage points per decade from 1995 to 2010. Sawn softwood consumption in 1989-2010 was computed as the softwood share multiplied by total consumption. In spite of rising prices for tropical timber and supply disruptions for tropical logs, there has been relatively little trend in the softwood share of total consumption. We expect tropical timber supplies will not increase, but that this will have only a modest impact on the pattern of sawn-wood consumption in Japan.[4]

The share of sawn softwood consumed in Japan that must be imported was assumed to increase, from 23 percent in 1988 to 33 percent in 1998—rate of one percentage point per year (table 4). This is intended to reflect the results of continuing pressure from exporting countries (such as the United States) for the reduction of tariffs and the removal of barriers to trade in processed

[3] Haynes and Brooks (1990) describe the reports in the ATMS series.

[4] Appendix 2 provides additional information on projected developments in Japanese sawn-wood markets.

Table 3—Alaska forest products output, by product for1965-88, and projected output for 1989-2010

Year	Export logs	Sawn wood		Pulp	Wood chip exports
		Exports	Production		
	- - - - Million board feet - - - -			*Thousand short tons*	
1965	11.0	78.1	82.2	na	0
1966	15.8	135.3	142.4	na	0
1967	39.5	203.9	214.6	na	0
1968	47.1	245.6	258.6	na	0
1969	31.9	285.9	300.9	na	0
1970	51.5	315.6	332.2	281.1	0
1971	42.6	247.4	260.4	294.3	19.6
1972	65.8	340.2	358.1	290.1	20.2
1973	71.7	404.8	426.2	255.6	0
1974	34.9	362.4	381.5	332.0	34.8
1975	29.0	313.3	329.8	274.0	32.4
1976	26.2	290.0	305.3	305.9	107.7
1977	52.4	250.0	263.2	326.4	107.4
1978	68.0	237.8	250.3	308.5	31.8
1979	128.6	278.5	293.1	333.3	83.7
1980	160.5	255.4	268.8	346.7	151.3
1981	149.2	196.0	206.3	367.0	77.6
1982	241.1	172.0	181.1	269.1	74.2
1983	262.2	136.7	143.9	311.1	6.6
1984	231.5	120.4	126.7	271.3	16.5
1985	299.2	87.1	91.7	255.9	0
1986	345.8	120.0	126.3	292.6	0
1987	453.1	133.1	140.1	349.7	0
1988	519.5	167.5	176.3	392.3	11.5
1989	643.1	183.8	193.4	383.8	46.6
1990	366.0	182.9	192.6	370.0	41.4
1991	269.5	182.2	191.8	373.2	40.8
1992	221.0	174.4	183.6	378.6	38.7
1993	205.4	189.9	199.9	387.5	41.7
1994	194.5	199.1	209.6	387.5	43.3
1995	183.9	196.7	207.0	387.5	42.3
1996	169.0	219.5	231.0	387.5	46.8
1997	154.5	229.5	241.6	387.5	48.5
1998	140.2	267.7	281.8	341.1	56.0
1999	126.2	253.6	266.9	362.7	52.5
2000	117.0	227.5	239.5	368.8	46.6

Table 3—continued

Year	Export logs	Sawn wood Exports	Sawn wood Production	Pulp	Wood chip exports
	---- Million board feet ----			Thousand short tons	
2001	117.0	252.9	266.3	368.8	51.3
2002	117.0	246.6	259.5	368.8	49.6
2003	117.0	275.8	290.4	341.1	54.9
2004	117.0	251.4	264.6	356.3	49.5
2005	117.0	244.6	257.5	356.3	47.7
2006	117.0	248.2	261.2	356.3	47.9
2007	117.0	255.6	269.0	356.3	48.9
2008	117.0	255.5	268.9	356.3	48.4
2009	117.0	257.4	271.0	356.3	48.3
2010	117.0	259.2	272.9	356.3	48.1

na = not available.

Sources: Sawn-wood production data are estimated from export data; export data are from Warren (1989). Total pulp production is estimated from export data (see table 6). Pulp export data are from unpublished compilations of U.S. Department of Commerce data, and Garrett and Dykstra (Garrett, Lawrence D.; Dykstra, Dennis. 1988. Demand for Stumpage and Wood Products from the Tongass National Forest,Alaska:-1988-2000. Final Report. Juneau, Alaska: U.S. Department of Agriculture, Forest Service, Alaska Region, 190 p. This report and the Department of Commerce data tabulations are on file with the Forest Investment, Marketing, and Trade Research Project, Forestry Sciences Lab, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, Oregon 97331). Chip export data 1965-88 are from Warren (1989); data 1989-2010 are estimated from total, residue production (see table 9).

forest products. After 2000, the import share of consumption was held at 33 percent., We assumed that domestic pressure in Japan would prevent greater dependence on foreign sources of sawn softwood. Softwood imports for 1989-2010 were computed as softwood consumption multiplied by the import share (expressed as a proportion).

Table 5 shows total North American shipments of sawn softwood to Japan, and the North American share of Japanese sawn softwood imports. In the recent past (1980-88), North America has, on-average, accounted for 87 percent of Japanese softwood lumber imports. This share is assumed to remain at 87.5 percent for most' of the projection period, after rising from 86 percent at the end of the 1980s. North American shipments to Japan for 1989-2010 are computed from total Japanese sawn softwood imports (table 4) and the assumed share (table 5).

Table 4—Japanese sawn-wood consumption and imports for 1965-88, and projections for 1989-2010

Year	Total consumption	Softwood share	Softwood consumption	Import share	Softwood imports
	Thousand cubic meters	*Percent*	*Thousand cubic meters*	*Percent*	*Million board feet*
1965	33,585	80.4	26,996	3.0	348.3
1966	36,192	80.2	29,010	3.9	483.9
1967	39,754	80.2	31,892	5.8	778.4
1968	42,682	79.1	33,749	7.0	996.9
1969	43,433	78.9	34,254	5.5	793.6
1970	45,428	77.9	35,395	7.6	1,145.8
1971	44,035	75.2	33,118	5.5	765.3
1972	45,495	75.5	34,353	5.9	862.7
1973	48,101	74.3	35,759	9.1	1,375.8
1974	44,092	74.2	32,699	9.7	1,349.6
1975	39,319	75.8	29,789	8.1	1,028.0
1976	42,496	76.9	32,693	9.2	1,276.7
1977	41,695	84.4	35,205	9.1	1,359.3
1978	42,657	80.0	34,134	10.1	1,455.9
1979	44,642	78.9	35,223	12.9	1,927.5
1980	42,436	82.3	34,913	14.1	2,072.9
1981	36,228	80.7	29,244	11.6	1,444.9
1982	37,381	82.2	30,745	13.8	1,798.7
1983	34,232	81.9	28,025	14.0	1,660.2
1984	33,062	83.1	27,475	14.3	1,688.1
1985	33,557	83.4	27,970	15.3	1,830.7
1986	34,198	83.7	28,625	16.6	2,035.2
1987	37,646	83.1	31,274	20.6	2,792.8
1988	38,092	82.5	31,436	23.2	3,182.5
1989	38,400	83.0	31,872	24.0	3,241.2
1990	38,881	83.0	32,271	25.0	3,418.6
1991	39,153	83.0	32,497	26.0	3,580.2
1992	39,427	83.0	32,725	27.0	3,743.9
1993	39,703	83.0	32,954	28.0	3,909.8
1994	39,981	83.0	33,184	29.0	4,077.7
1995	40,245	84.0	33,806	30.0	4,297.3
1996	40,527	84.0	34,042	31.0	4,471.7
1997	40,810	84.0	34,281	32.0	4,648.2
1998	40,810	84.0	34,281	33.0	4,793.5
1999	41,096	84.0	34,521	33.0	4,827.0

Table 4—continued

Year	Total consumption	Softwood share	Softwood consumption	Import share	Softwood imports
	Thousand cubic meters	*Percent*	*Thousand cubic meters*	*Percent*	*Million board feet*
2000	41,657	85.0	35,408	33.0	4,951.2
2001	41,949	85.0	35,656	33.0	4,985.8
2002	42,242	85.0	35,906	33.0	5,020.7
2003	42,242	85.0	35,906	33.0	5,020.7
2004	42,538	85.0	36,157	33.0	5,055.9
2005	42,836	86.0	36,839	33.0	5,151.2
2006	43,136	86.0	37,097	33.0	5,187.2
2007	43,437	86.0	37,356	33.0	5,223.5
2008	43,742	86.0	37,618	33.0	5,260.1
2009	44,048	86.0	37,881	33.0	5,296.9
2010	44,356	86.0	38,146	33.0	5,334.0

Sources: Historical data are from Food and Agriculture Organization (1989) and Wood-products Stockpile Corp. (1989c). Projections to 2000 are from Food and Agriculture Organization (1986). Conversion from cubic meters to board feet is at 2.36 cubic meters per thousand board feet. We adjusted data for Japanese sawn softwood imports for 1984-88 to correct for discrepancies between reported imports (by Japan) and reported exports (from North America). One source of these discrepancies is in the conversion from board feet to cubic meters.

Shipments from Alaska and North America to Japan also are shown in table 5. Alaska's role in this market declined sharply between 1972 and 1985 as a result of trends in the Japanese housing market and increased competition from other suppliers (Haynes and Brooks 1990). We anticipate no significant change in Alaska's share of North American shipments in the future. This expectation is based in part on an estimated relation between Alaska's share of North American exports to Japan and U.S. economic growth. For projections, we took forecasts of U.S. economic growth for 1989-2005 from Wharton Economic Forecasting Associates (1988).

Exports of sawn wood from Alaska to Japan were computed from projections of the Alaska share of North American shipments and total North American shipments. Table 5 shows the Alaska share of Japanese consumption, computed for all years for a comparison. Shipments from Alaska to Japan, and Alaska's share of Japanese consumption are projected to increase during 1989-2010 as a result of increased Japanese consumption and greater Japanese dependence on imported (North American) sawn wood. Alaska

exports to Japan are projected to increase by 57 million board feet (nearly 40 percent) between 1988 and 2000 and by an additional 30 million board feet (15 percent) by 2010.

Dependence of Alaska on exports to Japan was assumed to remain high throughout the projection; it averaged 94 percent (of Alaska production) between 1980 and 1988 and for 1989-2010 was held constant at 95.4 percent (the level in 1988). Our assumption was that Alaska does not diversify its markets for sawn softwood. Minor markets for Alaska sawn wood (notably South Korea) were assumed to remain relatively unimportant. Total Alaska exports were computed as shipments to Japan divided by the proportion shipped to the Japanese market (table 5).

Table 5—North American and Alaska softwood lumber exports and market shares for 1965-88, and projections for 1989-2010

Year	North American share of Japanese imports	North American shipments to Japan	Alaska share of North American shipments	Alaska shipments to Japan	Alaska share of Japanese consumption	Share of Alaska exports that go to Japan	Total exports from Alaska
	Percent	*Million bd. feet*	*Percent*	*Million bd. feet*	*Percent*		*Million bd. feet*
1965	85.7	298.5	26.2	78.1	0.68	100.0	78.1
1966	91.5	443.0	30.5	135.3	1.10	100.0	135.3
1967	95.9	746.7	27.3	203.9	1.51	100.0	203.9
1968	82.9	826.1	29.5	243.6	1.70	99.2	245.6
1969	88.0	698.5	40.9	285.4	1.97	99.8	285.9
1970	94.9	1,087.2	29.0	315.4	2.10	99.9	315.6
1971	92.4	707.1	34.8	246.0	1.75	99.4	247.4
1972	93.1	803.5	41.9	336.8	2.31	99.0	340.2
1973	85.9	1,181.6	34.2	403.9	2.67	99.8	404.8
1974	79.3	1,070.8	33.8	361.7	2.61	99.8	362.4
1975	89.8	922.9	33.9	313.0	2.48	99.9	313.3
1976	86.9	1,109.0	26.1	289.2	2.09	99.7	290.0
1977	84.0	1,142.3	21.5	245.4	1.65	98.2	250.0
1978	81.5	1,185.9	20.0	236.6	1.64	99.5	237.8
1979	85.8	1,653.8	16.5	273.6	1.83	98.4	278.0
1980	82.8	1,716.7	14.6	251.4	1.70	98.4	255.4

Table 5—continued

Year	North American share of Japanese imports	North American shipments to Japan	Alaska share of North American shipments	Alaska shipments to Japan	Alaska share of Japanese consumption	Share of Alaska exports that go to Japan	Total exports from Alaska
	Percent	*Million bd. feet*	*Percent*	*Million bd. feet*	*Percent*		*Million bd. feet*
1981	95.4	1,378.9	11.7	161.8	1.31	82.6	196.0
1982	92.0	1,655.6	9.4	155.8	1.20	90.6	172.0
1983	89.7	1,489.5	8.0	119.7	1.01	87.6	136.7
1984	86.7	1,464.3	8.0	117.4	1.01	97.5	120.4
1985	85.6	1,566.3	5.5	85.9	.72	98.6	87.1
1986	84.9	1,727.2	6.9	118.9	.98	99.1	120.0
1987	86.2	2,408.0	5.4	130.7	.99	98.2	133.1
1988	85.9	2,732.7	5.8	159.8	1.20	95.4	167.5
1989	86.0	2,787.4	6.6	182.7	1.35	95.4	183.8
1990	87.0	2,974.1	5.9	174.5	1.28	95.4	182.9
1991	87.5	3,133.6	5.5	173.8	1.26	95.4	182.2
1992	87.5	3,275.1	5.1	166.4	1.20	95.4	174.4
1993	87.5	3,420.1	5.3	181.1	1.30	95.4	189.9
1994	87.5	3,567.1	5.3	190.0	1.35	95.4	199.1
1995	87.5	3,759.2	5.0	187.6	1.31	95.4	196.7
1996	87.5	3,911.7	5.4	209.4	1.45	95.4	219.5
1997	87.5	4,066.1	5.4	219.0	1.51	95.4	229.5
1998	87.5	4,193.2	6.1	255.4	1.76	95.4	267.7
1999	87.5	4,222.5	5.7	241.9	1.65	95.4	253.6
2000	87.5	4,331.1	5.0	217.0	1.45	95.4	227.5
2001	87.5	4,361.5	5.5	241.3	1.60	95.4	252.9
2002	87.5	4,392.0	5.4	235.2	1.55	95.4	246.6
2003	87.5	4,392.0	6.0	263.2	1.73	95.4	275.8
2004	87.5	4,422.7	5.4	239.8	1.57	95.4	251.4
2005	87.5	4,506.1	5.2	233.3	1.49	95.4	244.6
2006	87.5	4,537.6	5.2	236.8	1.51	95.4	248.2
2007	87.5	4,569.4	5.3	243.8	1.54	95.4	255.6
2008	87.5	4,601.4	5.3	243.7	1.53	95.4	255.5
2009	87.5	4,633.6	5.3	245.6	1.53	95.4	257.4
2010	87.5	4,666.0	5.3	247.3	1.53	95.4	259.2

Sources: Historical data are from Warren (1989) and Ulrich (1988); North America includes the United States and Canada. All Canadian shipments are from British Columbia.

Market Pulp

Historical and projected data for pulp production and exports (by pulp type) are shown in table 6. As for sawn wood, production data were estimated from export data for all years. The share of pulp production exported was generally lower than was the case with sawn wood and averaged roughly 80 percent. In our projections, exports were assumed to remain at this level, except for years when slow growth is forecast for the U.S. economy (Wharton Econometric Forecasting Associates 1988); for these years, the export share was increased.

Dissolving grades dominate Alaska pulp production and exports, and we assumed that this will continue. In 1988, both Alaska pulp mills operated at capacity; we assumed that for most of the 1990s (through 1997) they will operate close to this level.[5] Exports and production were assumed to drop during years of slow economic growth (1990, 1998, and 2003) and increase in following years. This is similar to the pattern in the historical data and is consistent with observations by Durbak (see footnote 5). We assume, however, that a gradual weakening of export markets for dissolving grade pulp will occur after 2000; this projection therefore shows total pulp production in 2010 about 10 percent below the peak in 1988.

[5] Durbak. Irene. 1989. Analysis of Market Trends and Prospects for Dissolving Pulp. Madison. WI: U.S. Department of Agriculture, Forest Service, Forest Products Lab. 58 p. On file with the Forest Investment, Marketing. and Trade Research Project, Forestry Sciences Lab. Pacific Northwest Research Station. 3200 SW Jefferson Way, Corvallis, Oregon 97331.

Table 6—Alaska pulp exports by type, estimated total production, and pulp recovery from roundwood for 1970-88, and projections for 1989-2010

Year	Pulp exports: Dissolving grades	Pulp exports: Other grades	Pulp exports: Total	Export share of production	Estimated total production	Pulp recovery[a]
	Thousand short tons			*Proportion*	*Thousand short tons*	
1970	194.3	25.0	219.3	0.78	281.1	1.0500
1971	181.0	25.0	206.0	.70	294.3	1.0500
1972	204.2	25.0	229.2	.79	290.1	1.1000
1973	174.4	25.0	199.4	.78	255.6	1.1000
1974	234.0	25.0	259.0	.78	332.0	1.1150
1975	183.2	25.0	208.2	.76	274.0	1.1200
1976	207.5	25.0	232.5	.76	305.9	1.1286
1977	229.6	25.0	254.6	.78	326.4	1.1286
1978	206.4	25.0	231.4	.75	308.5	1.1560
1979	251.7	25.0	276.7	.83	333.3	1.1606
1980	244.3	67.7	312.0	.90	346.7	1.1364
1981	246.4	39.8	286.2	.78	367.0	1.1567
1982	199.1	10.8	209.9	.78	269.1	1.2065
1983	238.1	4.5	242.6	.78	311.1	1.1860
1984	177.4	34.2	211.6	.78	271.3	1.1136
1985	192.7	6.9	199.6	.78	255.9	1.1547
1986	220.7	7.5	228.2	.78	292.6	1.1160
1987	253.1	26.7	279.8	.80	349.7	1.2000
1988	275.4	30.6	306.0	.78	392.3	1.2000
1989	277.0	30.0	307.0	.80	383.8	1.2000
1990	266.0	30.0	296.0	.80	370.0	1.2000
1991	271.6	27.0	298.6	.80	373.2	1.2000
1992	274.4	28.5	302.9	.80	378.6	1.2000
1993	280.0	30.0	310.0	.80	387.5	1.2000
1994	280.0	30.0	310.0	.80	387.5	1.2000
1995	280.0	30.0	310.0	.80	387.5	1.2000
1996	280.0	30.0	310.0	.80	387.5	1.2000
1997	280.0	30.0	310.0	.80	387.5	1.2000
1998	257.6	25.5	283.1	.83	341.1	1.2000
1999	263.2	27.0	290.2	.80	362.7	1.2000
2000	270.0	25.0	295.0	.80	368.8	1.2000

Table 6—continued

Year	Pulp exports: Dissolving grades	Pulp exports: Other grades	Pulp exports: Total	Export share of production	Estimated total production	Pulp recovery[a]
	Thousand short tons			*Proportion*	*Thousand short tons*	
2001	270.0	25.0	295.0	.80	368.8	1.2000
2002	270.0	25.0	295.0	.80	368.8	1.2000
2003	257.6	25.5	283.1	.83	341.1	1.2000
2004	265.0	20.0	285.0	.80	356.3	1.2000
2005	265.0	20.0	285.0	.80	356.3	1.2000
2006	265.0	20.0	285.0	.80	356.3	1.2000
2007	265.0	20.0	285.0	.80	356.3	1.2000
2008	265.0	20.0	285.0	.80	356.3	1.2000
2009	265.0	20.0	285.0	.80	356.3	1.2000
2010	265.0	20.0	285.0	.80	356.3	1.2000

[a] Air-dry tons per thousand board feet.

Sources: Production data are estimated from export data. Dissolving grade pulp export data are from Garrett and Dykstra (see sources for table 3); paper grade pulp exports for 1970-77 are estimated. Export data for 1978-88 are from unpublished compilations of U.S. Department of Commerce data on file with the Forest Investment, Marketing, and Trade Research Project, Forestry Sciences Lab, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, Oregon 97331. Pulp recovery data are from unpublished data on file with the U.S. Department of Agriculture, Forest Service, Alaska Region, Juneau, Alaska; data for other years are estimated.

Export logs

Production of logs for export has depended almost entirely on the level of timber harvest by private owners. Logs harvested from National Forests for which there is no domestic market have contributed a small volume to log exports in 1965-78 and a similar volume (but a much smaller proportion of the total) in 1979-88. Projected log exports (table 3) were calculated from projected private timber harvests[6] to which the small volume of log exports from Federal and other government harvests have been added.

[6] Knapp, Gunnar. 1989. Native timber harvests in Southeast Alaska. Anchorage, AK: Institute of Social and Economic Research. 64 p. On file with the Forest Investment, Marketing and Trade Research Project, Forestry Sciences Lab, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331.

Wood chips

Residues from sawn-wood production have been exported from Alaska since 1971; in some years, exports have been substantial (table 3). Wood chip exports have been extremely volatile, however; in the mid-1980s, no exports were reported. Because sawn-wood production is expected to increase and pulp production is expected to decline, we assumed that wood chip exports will continue. For our projections (table 3), we calculated exports as 30 percent of residue production; this proportion is the average for 1971-88. Production of residues from sawn wood is discussed below.

Derived Demand for Timber

To assess demands on Alaska forests, projections of product output must be converted to raw material requirements. In our calculations, we estimated the volume of timber necessary to support production of each product; the sum for all products is total (derived) demand for Alaska timber. We also took into account timber imports and the use of residues from sawn-wood production as pulp furnish.

Table 7 shows the conversion factors used to calculate timber harvest for sawn wood from sawn-wood production (table 3). The results are shown in table 8, and details of the computations are given in appendix 1. Overrun in sawn-wood production is the ratio of the volume of sawn wood produced (lumber tally) to the volume of logs used, measured in product units (log tally). Overrun varies with average log size, and milling technology. Data for 1976-86 are from unpublished appraisal data collected by USDA Forest Service, Alaska Region (the average for spruce and, hemlock sawn-wood production).[7] Lumber recovery is computed by using overrun and a constant ratio of board feet per cubic feet (see appendix 1).

[7] Martin, R. Michael. 1989. Correspondence dated June 15. On file with the Forest Investment, Marketing and Trade Research Project, Forestry Sciences Lab, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, OR 97331.

Table 7—Conversion factors for sawn wood and residues[a]

Year	Overrun (OVRR)	Recovery factor (LRF)	Volume factor (LVF)	Residue factor (RES)	Residue generation (RGF)	Use factor (UF)	Utilized residue generation (URGF)
	Mbf,LT / Mbf,LS	*bf,LT / cf,LS*	*bf,LT / cf,prd*	*cf,res / cf,LS*	*BDT per cf,LS*	*Propor-tion*	*BDT per Mbf*
1965	1.100	7.920	14.846	0.467	0.006	0	0
1966	1.100	7.920	14.846	.467	.006	0	0
1967	1.100	7.920	14.846	.467	.006	0	0
1968	1.100	7.920	14.846	.467	.006	0	0
1969	1.100	7.920	14.846	.467	.006	0	0
1970	1.100	7.920	14.846	.467	.006	0	0
1971	1.100	7.920	14.846	.467	.006	.10	.080
1972	1.100	7.920	14.846	.467	.006	.30	.241
1973	1.100	7.920	14.846	.467	.006	.15	.120
1974	1.100	7.920	14.846	.467	.006	.30	.241
1975	1.200	8.640	14.846	.418	.006	.50	.330
1976	1.221	8.793	14.846	.408	.006	.60	.379
1977	1.285	9.250	14.846	.377	.005	1.00	.556
1978	1.319	9.495	14.846	.360	.005	.30	.155
1979	1.355	9.757	14.846	.343	.005	1.00	.479
1980	1.276	9.184	14.846	.381	.005	1.00	.566
1981	1.184	8.526	14.846	.426	.006	1.00	.681
1982	1.196	8.614	14.846	.420	.006	1.00	.665
1983	1.216	8.756	14.846	.410	.006	.90	.575
1984	1.169	8.414	14.846	.433	.006	1.00	.702
1985	1.186	8.542	14.846	.425	.006	1.00	.678
1986	1.027	7.393	14.846	.502	.007	.90	.833
1987	0.975	7.020	14.846	.527	.007	1.00	1.024
1988	1.075	7.740	14.846	.479	.007	1.00	.843
1989	1.100	7.920	14.846	.467	.006	1.00	.803
1990	1.105	7.956	14.846	.464	.006	.90	.716
1991	1.110	7.992	14.846	.462	.006	.90	.709
1992	1.115	8.028	14.846	.459	.006	.90	.702
1993	1.120	8.064	14.846	.457	.006	.90	.695
1994	1.125	8.100	14.846	.454	.006	.90	.689
1995	1.130	8.136	14.846	.452	.006	.90	.682

Table 7—continued

Year	Overrun (OVRR)	Recovery factor (LRF)	Volume factor (LVF)	Residue factor (RES)	Residue generation (RGF)	Use factor (UF)	Utilized residue generation (URGF)
	Mbf,LT / Mbf,LS	*bf,LT / cf,LS*	*bf,LT / cf,prd*	*cf,res / cf,LS*	*BDT per cf,LS*	*Propor-tion*	*BDT per Mbf*
1996	1.135	8.172	14.846	.450	.006	.90	.675
1997	1.140	8.208	14.846	.447	.006	.90	.669
1998	1.145	8.244	14.846	.445	.006	.90	.662
1999	1.150	8.280	14.846	.442	.006	.90	.656
2000	1.155	8.316	14.846	.440	.006	.90	.649
2001	1.160	8.352	14.846	.437	.006	.90	.643
2002	1.165	8.388	14.846	.435	.006	.90	.636
2003	1.170	8.424	14.846	.433	.006	.90	.630
2004	1.175	8.460	14.846	.430	.006	.90	.624
2005	1.180	8.496	14.846	.428	.006	.90	.618
2006	1.185	8.532	14.846	.425	.006	.90	.612
2007	1.190	8.568	14.846	.423	.006	.90	.606
2008	1.195	8.604	14.846	.420	.006	.90	.600
2009	1.200	8.640	14.846	.418	.006	.90	.594
2010	1.205	8.676	14.846	.416	.006	.90	.588

[a] See appendix 1 for formulas and a description of calculations.

Sources: Overrun data for 1977-86 are from unpublished data on file with U.S. Department of Agriculture, Forest Service, Alaska Region, Juneau, Alaska; these are the unweighted average for spruce and hemlock. sawn-wood production. Other data are from Adams and others (1988). See appendix 1 for recovery and conversion factor calculations. In the formulas described in appendix 1, residue weight factor (RWF) is constant at 73.33 cubic feet per bone dry ton, and the board foot conversion factor (BFCF) is constant at 7.20 board feet log scale per cubic foot log scale.

Lumber recovery (table 7) reflects short-run production decisions, technology, and raw material characteristics. Producers may respond to short-run changes in relative prices by altering the production mix of sawn wood and residues. The combined volume of sawn wood and residue production cannot exceed the total 109 volume; appendix 1 shows the relation between sawn-wood recovery and residue production. We assumed that lumber recovery will increase between 1988 and 2010; therefore, residue generation (table 7) declines over this period. Table 7 and appendix 1 also show the

derivation of the estimate of utilized residues generated per thousand board feet of sawn wood production.

In table 9, we repeat the residue production factor from table 7 and, with sawn-wood production data (table 3), estimate total residue production. Data for 1965-88 are estimates. Residue exports (reported as wood chips) for 1965-88 are from published compilations of U.S. Department of Commerce data (Warren 1989). For 1989-2010, we assumed that a fixed proportion of production is exported (described above). Estimates of sawn-wood residues used in Alaska pulp production were calculated as total production minus exports, plus imports. Alaska imports of all timber products are shown in table 10. We assumed that wood chips are converted to pulp at the rate of 1 short ton of pulp per 1 short (bone-dry) ton of wood chips.

Pulp production (net of pulp produced from residues) was converted to roundwood requirements by using the recovery rate shown in table 6. An adjustment was also made for roundwood pulp wood imports. We assumed that all roundwood timber imports to Alaska (see table 10) are used for pulp and deducted this volume from pulp wood requirements. Table 8 shows the (net) derived demand for roundwood for pulp and the derived demand for roundwood exported as logs; these data are the same as those in table 3 because no conversion is required.

Table 8—Estimated Alaska timber harvest by product (derived demand) for 1965-88, and projections for 1989-2010

		Product		
Year	Total	Export logs	Lumber	Pulp
	Million board feet, roundwood equivalent			
1965	na	11.0	74.8	na
1966	na	15.8	129.5	na
1967	na	39.5	195.1	na
1968	na	47.1	235.1	na
1969	na	31.9	273.6	na
1970	621.2	51.5	302.0	267.7
1971	558.4	42.6	236.8	279.0
1972	595.0	65.8	325.5	203.6
1973	644.8	71.7	387.4	185.7
1974	628.4	34.9	346.8	246.6
1975	480.3	29.0	274.8	176.4
1976	540.0	26.2	250.0	263.8
1977	512.0	52.4	204.9	254.8
1978	413.7	68.0	189.8	155.9
1979	510.6	128.6	216.3	165.7
1980	610.3	160.5	210.8	239.0
1981	564.8	149.2	174.2	241.4
1982	575.8	241.1	151.3	183.3
1983	485.8	262.2	118.3	105.3
1984	482.4	231.5	108.5	142.4
1985	526.2	299.2	77.3	149.7
1986	578.5	345.8	123.0	109.7
1987	765.9	453.1	143.7	169.1
1988	887.4	519.5	164.0	203.9
1989	1,033.1	643.1	175.8	214.2
1990	753.2	366.0	174.3	212.9
1991	659.0	269.5	172.8	216.7
1992	611.0	221.0	164.6	225.3
1993	610.7	205.4	178.5	226.9
1994	604.6	194.5	186.3	223.7
1995	592.6	183.9	183.2	225.6

Table 8—continued

Year	Total	Product		
		Export logs	Lumber	Pulp
	Million board feet, roundwood equivalent			
1996	589.5	169.0	203.5	216.9
1997	580.1	154.5	211.9	213.7
1998	546.7	140.2	246.1	160.4
1999	543.6	126.2	232.1	185.2
2000	525.9	117.0	207.3	201.6
2001	539.0	117.0	229.5	192.5
2002	535.7	117.0	222.8	195.9
2003	527.7	117.0	248.2	162.5
2004	527.8	117.0	225.2	185.5
2005	524.3	117.0	218.2	189.1
2006	526.1	117.0	220.4	188.6
2007	529.9	117.0	226.1	186.8
2008	529.8	117.0	225.0	187.8
2009	530.8	117.0	225.8	188.0
2010	531.7	117.0	226.4	188.3

na = not available.

Sources: Historical data are estimated (see text for description of methods). Roundwood demand for pulp is adjusted for imports and use of residues. Timber imports (see table 10) are assumed to be entirely pulp wood.

Table 9—Production of residues from lumber production, wood chip exports, utilization of chips for pulp, and pulp produced in 1970-88, and projections for 1989-2010

Year	Residue generation factor[a]	Residues generated	Chip exports	Ratio of exports to production	Chips used for pulp	Pulp produced from residues
		Thousand short tons		*Proportion*	*Thousand short tons*	
1970	0	0	0	0	0	0
1971	.0803	20.9	19.6	.937	1.3	1.3
1972	.2410	86.3	20.2	.234	66.1	66.1
1973	.1205	51.3	0	0	51.3	51.3
1974	.2410	91.9	34.8	.379	57.1	57.1
1975	.3299	108.8	32.4	.298	76.4	76.4
1976	.3794	115.8	107.7	.929	8.2	8.2
1977	.5557	146.3	107.4	.734	38.8	38.8
1978	.1553	38.9	31.8	.819	54.9	54.9
1979	.4791	140.4	83.7	.596	136.5	136.5
1980	.5664	152.3	151.3	.994	32.9	32.9
1981	.6809	140.5	77.6	.553	62.8	62.8
1982	.6646	120.3	74.2	.616	46.2	46.2
1983	.5750	82.7	6.6	.080	118.1	118.1
1984	.7023	89.0	16.5	.186	72.5	72.5
1985	.6779	62.2	0	0	62.2	62.2
1986	.8334	105.3	0	0	105.3	105.3
1987	1.0240	143.5	0	0	143.5	143.5
1988	.8433	148.7	11.5	.077	137.2	137.2
1989	.8033	155.4	46.6	.300	108.8	108.8
1990	.7159	137.9	41.4	.300	96.5	96.5
1991	.7090	136.0	40.8	.300	95.2	95.2
1992	.7021	128.9	38.7	.300	90.2	90.2
1993	.6953	139.0	41.7	.300	97.3	97.3
1994	.6885	144.3	43.3	.300	101.0	101.0
1995	.6818	141.1	42.3	.300	98.8	98.8
1996	.6752	156.0	46.8	.300	109.2	109.2
1997	.6686	161.5	48.5	.300	113.1	113.1
1998	.6620	186.5	56.0	.300	130.6	130.6
1999	.6556	175.0	52.5	.300	122.5	122.5
2000	.6492	155.4	46.6	.300	108.8	108.8

Table 9—continued

Year	Residue generation factor[a]	Residues generated	Chip exports	Ratio of exports to production	Chips used for pulp	Pulp produced from residues
		Thousand short tons		*Proportion*	*Thousand short tons*	
2001	.6428	171.2	51.3	.300	119.8	119.8
2002	.6365	165.2	49.6	.300	115.6	115.6
2003	.6302	183.0	54.9	.300	128.1	128.1
2004	.6240	165.1	49.5	.300	115.6	115.6
2005	.6179	159.1	47.7	.300	111.4	111.4
2006	.6118	159.8	47.9	.300	111.9	111.9
2007	.6057	163.0	48.9	.300	114.1	114.1
2008	.5998	161.3	48.4	.300	112.9	112.9
2009	.5938	160.9	48.3	.300	112.6	112.6
2010	.5879	160.4	48.1	.300	112.3	112.3

[a] Bone-dry tons (BOT) produced per thousand board feet of sawn wood produced.

Sources: Chips used for pulp includes imports in 1978 and 1983 (see table 10). Because imports in 1978 were high (and zero in all other years except 1983), we assumed that inventory accumulation took place and allocated 1978 chip imports to 1978-80. Estimated consumption in 1978 equals 30 percent of imports in 1978; consumption in 1979 equals 50 percent of 1978 imports; consumption in 1980 equals 20 percent of 1978 imports.

Table 10—Alaska timber imports by product for 1970-88, and projections for 1989-2010

Year	Saw logs	Pulp logs		Wood chips	
	Thousand board feet	*Thousand cords*	*Thousand board feet*	*Thousand tons*	*Thousand board feet*
1970	na	na	na	na	na
1971	na	na	na	na	na
1972	na	na	na	na	na
1973	na	na	na	na	na
1974	na	na	na	na	na
1975	na	na	na	na	na
1976	na	na	na	na	na
1977	na	na	na	na	na
1978	2.5	3.8	1.9	159.6	59.1
1979	3.8	0	0	0	0
1980	37.1	0	0	0	0
1981	21.5	0	0	0	0
1982	1.4	0	0	0	0
1983	21.0	41.0	20.9	42.0	15.6
1984	5.3	60.6	30.8	0	0
1985	16.5	3.2	1.6	0	0
1986	21.4	72.2	36.7	0	0
1987	0	5.4	2.8	0	0
1988	2.1	13.0	6.6	0	0
1989	0		15.0		0
1990	0		15.0		0
1991	0		15.0		0
1992	0		15.0		0
1993	0		15.0		0
1994	0		15.0		0
1995	0		15.0		0
1996	0		15.0		0
1997	0		15.0		0
1998	0		15.0		0
1999	0		15.0		0
2000	0		15.0		0

Table 10—continued

Year	Saw logs	Pulp logs		Wood chips	
	Thousand board feet	*Thousand cords*	*Thousand board feet*	*Thousand tons*	*Thousand board feet*
2001	0		15.0		0
2002	0		15.0		0
2003	0		15.0		0
2004	0		15.0		0
2005	0		15.0		0
2006	0		15.0		0
2007	0		15.0		0
2008	0		15.0		0
2009	0		15.0		0
2010	0		15.0		0

na = not available

Sources: Data for 1978-88 are from unpublished compilations of U.S. Department of Commerce data on file with the Forest Investment, Marketing, and Trade Research Project, Forestry Sciences Lab, Pacific Northwest Research Station, 3200 SW Jefferson Way, Corvallis, Oregon 97331. Data for other years are estimated. Pulp log imports are converted from cords (the reported units) at 1.965 cords per thousand board feet. Wood chip imports are converted from short tons (the reported units) at 2.7 tons per thousand board feet.

Timber Harvest

Our estimate of the total demand for Alaska timber (table 8) is the sum of the three categories of derived demand. Because markets equilibrate through price adjustments (gaps between supply and demand do not persist), this can be taken as an estimate of timber supply, as well. As discussed above, a comparison of our estimates of demand with reported supply for 1970-88 provides one source of verification of our data and methods.[8] Table 11 shows timber harvest in Alaska for each major owner category: private (Alaska Native corporations), National Forest, and other public. Timber imports—roundwood and chips (converted to million board feet, roundwood equivalent)—are also shown in table 11.

[8] For 1988, harvest by private owners and harvest by other public owners are estimated.

Estimates of National Forest harvest depend on all previous assumptions (through derived demand) and on projections of harvest by other owners. Projected harvest by private owners (table 11) is based on data from Knapp (see footnote 6). We used his figures for most likely harvest levels. Harvest for other public owners was based historical data. For 1989-2010, projected National Forest harvest is the quantity of timber that equates total supply with projected derived demand, given harvest by other owners.

Knapp (see footnote 6) projects that harvest by Native corporations will drop sharply as soon as 1990 and will continue to fall through 2000. We interpreted these findings to produce estimates of annual harvest (table 11). The decline in private harvest affects total Alaska harvest (table 11) and log export projections (tables 3 and 8) but has little effect on projected National Forest harvest. This is a direct consequence of the assumption that the majority of private timber will continue to be exported as logs (see table 12).

National Forest harvests support production at Alaska sawmills and pulp mills (see table 13). Projected National Forest harvest for the next two decades is higher than average (annual) harvest in the current decade but well below harvests in the 1970s. Although we expect production of sawn wood to increase—approaching levels last reached in the 1970s—and production of pulp to remain high, total National Forest harvest remains relatively stable. This can be attributed partly to the use of residues for about one-third of pulp production. The product mix of National Forest harvests in Alaska therefore is expected to change over the next two decades (see tables 12 and 13). Haynes and Brooks (1990) discuss in detail the implications of these projections for the Alaska forest sector.

Table 11—Alaska timber harvest by. owner and timber imports, 1965-2010

Year	Total harvest	Owner: National Forest	Owner: Private	Owner: Other government	Timber imports
			Million board feet		
1965	440.0	404.5	0	35.5	0
1966	514.6	475.5	0	39.1	0
1967	534.9	476.8	0	58.0	0
1968	590.6	533.3	0	57.3	0
1969	581.4	523.3	0	58.1	0
1970	628.0	561.0	0	67.0	0
1971	574.9	529.4	0	45.5	0
1972	606.2	550.5	0	55.7	0
1973	655.9	591.6	0	64.3	0
1974	630.6	549.6	17.5	63.5	0
1975	468.4	413.1	20.8	34.6	0
1976	531.0	472.2	15.0	43.9	0
1977	487.5	420.7	0	66.8	0
1978	445.0	408.6	0	36.4	63.5
1979	495.3	459.5	0	35.8	3.8
1980	589.1	453.7	70.3	65.1	37.1
1981	564.3	387.5	122.0	54.8	21.5
1982	593.2	345.5	209.2	38.5	1.4
1983	525.7	251.9	232.0	41.8	57.4
1984	491.6	261.5	202.0	28.0	36.2
1985	543.0	265.7	263.3	14.0	18.1
1986	590.1	272.1	298.7	19.2	58.2
1987	713.2	352.2	335.0	26.0	2.8
1988	908.9	408.9	470.0	30.0	8.7
1989	1,033.1	368.1	635.0	30.0	15.0
1990	753.2	373.2	350.0	30.0	15.0
1991	659.0	379.0	250.0	30.0	15.0
1992	611.0	381.0	200.0	30.0	15.0
1993	610.7	395.7	185.0	30.0	15.0
1994	604.6	399.6	175.0	30.0	15.0
1995	592.6	397.6	165.0	30.0	15.0

Table 11—continued

Year	Total harvest	Owner: National Forest	Owner: Private	Owner: Other government	Timber imports
		Million board feet			
1996	589.5	409.5	150.0	30.0	15.0
1997	580.1	415.1	135.0	30.0	15.0
1998	546.7	396.7	120.0	30.0	15.0
1999	543.6	408.6	105.0	30.0	15.0
2000	525.9	395.9	100.0	30.0	15.0
2001	539.0	409.0	100.0	30.0	15.0
2002	535.7	405.7	100.0	30.0	15.0
2003	527.7	397.7	100.0	30.0	15.0
2004	527.8	397.8	100.0	30.0	15.0
2005	524.3	394.3	100.0	30.0	15.0
2006	526.1	396.1	100.0	30.0	15.0
2007	529.9	399.9	100.0	30.0	15.0
2008	529.8	399.8	100.0	30.0	15.0
2009	530.8	400.8	100.0	30.0	15.0
2010	531.7	401.7	100.0	30.0	15.0

Sources: Historical data are reported by Warren (1989). See table 10 for detail on imports, and refer to the text for the derivation of the projections.

Table 12—Shares of National Forest and private harvest exported and share of National Forest harvest used for pulp, 1965-2010

Year	Share of National Forest harvest that is: Exported	Used for pulp wood	Share of private harvest exported
	Proportion		
1965	0.050	0.70	na
1966	.050	.70	na
1967	.050	.60	na
1968	.050	.55	na
1969	.050	.50	na
1970	.050	.45	na
1971	.050	.55	na
1972	.050	.45	na
1973	.050	.35	na
1974	.050	.40	1.00
1975	.050	.35	1.00
1976	.050	.45	1.00
1977	.050	.55	na
1978	.050	.55	na
1979	.050	.55	na
1980	.053	.48	1.00
1981	.056	.51	1.00
1982	.053	.49	.98
1983	.076	.50	.96
1984	.065	.55	.97
1985	.061	.33	.97
1986	.062	.74	.98
1987	.074	.61	.98
1988	.114	.56	.95
1989	.068	.50	.95
1990	.067	.51	.94

Table 12—continued

Year	Share of National Forest harvest that is: Exported	Used for pulp wood	Share of private harvest exported
	Proportion		
1991	.066	.53	.93
1992	.066	.55	.92
1993	.063	.53	.91
1994	.063	.52	.90
1995	.063	.52	.89
1996	.061	.49	.88
1997	.060	.47	.87
1998	.063	.36	.86
1999	.061	.41	.85
2000	.063	.46	.80
2001	.061	.42	.80
2002	.062	.43	.80
2003	.063	.36	.80
2004	.063	.42	.80
2005	.063	.43	.80
2006	.063	.43	.80
2007	.063	.42	.80
2008	.063	.42	.80
2009	.062	.42	.80
2010	.062	.42	.80

na = not applicable (no harvest in these years).

Sources: Data showing the components of National Forest harvest for 1965-79 are estimated; data for 1980-88 are from U.S. Department of Agriculture, Forest Service (1989). Data for 1989-2010 are computed from table 13. Data showing the share of private harvest exported are estimated for all years.

Table 13—Estimated Alaska timber harvest by owner and product, 1965-2010

	National Forest				Private			
Year	Saw logs	Export logs	Pulp logs	Total	Saw logs	Export logs	Pulp logs	Total
	Million board feet, roundwood equivalent							
1965	101.1	20.2	283.1	404.5	0	0	0	0
1966	118.9	23.8	332.8	475.5	0	0	0	0
1967	166.9	23.8	286.1	476.8	0	0	0	0
1968	213.3	26.7	293.3	533.3	0	0	0	0
1969	235.5	26.2	261.7	523.3	0	0	0	0
1970	265.2	28.0	267.7	561.0	0	0	0	0
1971	223.9	26.5	279.0	529.4	0	0	0	0
1972	319.4	27.5	203.6	550.5	0	0	0	0
1973	376.3	29.6	185.7	591.6	0	0	0	0
1974	275.6	27.5	246.6	549.6	0	17.5	0	17.5
1975	216.0	20.7	176.4	413.1	0	20.8	0	20.8
1976	184.7	23.6	263.8	472.2	0	15.0	0	15.0
1977	144.9	21.0	254.8	420.7	0	0	0	0
1978	232.3	20.4	155.9	408.6	0	0	0	0
1979	270.8	23.0	165.7	459.5	0	0	0	0
1980	212.0	23.9	217.8	453.7	0	70.3	0	70.3
1981	168.3	21.6	197.6	387.5	0	122.0	0	122.0
1982	157.8	18.4	169.3	345.5	0	204.9	4.3	209.2
1983	106.8	19.1	126.0	251.9	0	222.9	9.1	232.0
1984	100.8	16.9	143.8	261.5	0	196.8	5.2	202.0
1985	161.9	16.1	87.7	265.7	0	254.3	9.0	263.3
1986	53.9	16.8	201.4	272.1	0	293.9	4.8	298.7
1987	111.2	26.1	214.9	352.2	0	328.3	6.7	335.0
1988	133.4	46.5	229.0	408.9	0	446.5	23.5	470.0
1989	160.8	25.0	182.4	368.1	0	603.3	31.8	635.0
1990	156.3	25.0	191.9	373.2	0	329.0	21.0	350.0
1991	154.8	25.0	199.2	379.0	0	232.5	17.5	250.0
1992	146.6	25.0	209.3	381.0	0	184.0	16.0	200.0
1993	160.5	25.0	210.2	395.7	0	168.4	16.7	185.0
1994	168.3	25.0	206.2	399.6	0	157.5	17.5	175.0
1995	165.2	25.0	207.4	397.6	0	146.9	18.2	165.0

Table 13—continued

Year	National Forest				Private			
	Saw logs	Export logs	Pulp logs	Total	Saw logs	Export logs	Pulp logs	Total
	Million board feet, roundwood equivalent							
1996	185.5	25.0	198.9	409.5	0	132.0	18.0	150.0
1997	193.9	25.0	196.1	415.1	0	117.4	17.6	135.0
1998	228.1	25.0	143.6	396.7	0	103.2	16.8	120.0
1999	214.1	25.0	169.5	408.6	0	89.2	15.8	105.0
2000	189.3	25.0	181.6	395.9	0	80.0	20.0	100.0
2001	211.5	25.0	172.5	409.0	0	80.0	20.0	100.0
2002	204.8	25.0	175.9	405.7	0	80.0	20.0	100.0
2003	230.2	25.0	142.5	397.7	0	80.0	20.0	100.0
2004	207.2	25.0	165.5	397.8	0	80.0	20.0	100.0
2005	200.2	25.0	169.1	394.3	0	80.0	20.0	100.0
2006	202.4	25.0	168.6	396.1	0	80.0	20.0	100.0
2007	208.1	25.0	166.8	399.9	0	80.0	20.0	100.0
2008	207.0	25.0	167.8	399.8	0	80.0	20.0	100.0
2009	207.8	25.0	168.0	400.8	0	80.0	20.0	100.0
2010	208.4	25.0	168.3	401.7	0	80.0	20.0	100.0

Table 13—continued

Year	Other government				All owners			
	Saw logs	Export logs	Pulp logs	Total	Saw logs	Export logs	Pulp logs	Total
	Million board feet, roundwood equivalent							
1965	17.7	17.7	0	35.5	118.9	38.0	283.1	440.0
1966	19.5	19.5	0	39.1	138.4	43.3	332.8	514.6
1967	29.0	29.0	0	58.0	195.9	52.9	286.1	534.9
1968	28.6	28.6	0	57.3	242.0	55.3	293.3	590.6
1969	29.0	29.0	0	58.1	264.5	55.2	261.7	581.4
1970	33.5	33.5	0	67.0	298.7	61.5	267.7	628.0
1971	22.8	22.8	0	45.5	246.7	49.2	279.0	574.9
1972	27.9	27.9	0	55.7	347.2	55.4	203.6	606.2
1973	32.2	32.2	0	64.3	408.5	61.7	185.7	655.9
1974	31.7	31.7	0	63.5	307.3	76.7	246.6	630.6
1975	17.3	17.3	0	34.6	233.3	58.7	176.4	468.4
1976	21.9	21.9	0	43.9	206.7	60.5	263.8	531.0
1977	33.4	33.4	0	66.8	178.3	54.4	254.8	487.5
1978	18.2	18.2	0	36.4	250.5	38.6	155.9	445.0
1979	17.9	17.9	0	35.8	288.7	40.9	165.7	495.3
1980	32.5	32.5	0	65.1	244.5	126.7	217.8	589.1
1981	27.4	27.4	0	54.8	195.7	171.0	197.6	564.3
1982	19.3	19.3	0	38.5	177.1	242.6	173.6	593.2
1983	20.9	20.9	0	41.8	127.7	262.9	135.1	525.7
1984	14.0	14.0	0	28.0	114.8	227.7	149.0	491.6
1985	7.0	7.0	0	14.0	168.9	277.4	96.7	543.0
1986	9.6	9.6	0	19.2	63.6	320.4	206.2	590.1
1987	13.0	13.0	0	26.0	124.2	367.4	221.6	713.2
1988	15.0	15.0	0	30.0	148.4	508.0	252.5	908.9
1989	15.0	15.0	0	30.0	175.8	643.3	214.2	1,033.1
1990	18.0	12.0	0	30.0	174.3	366.0	212.9	753.2
1991	18.0	12.0	0	30.0	172.8	269.5	216.7	659.0
1992	18.0	12.0	0	30.0	164.6	221.0	225.3	611.0
1993	18.0	12.0	0	30.0	178.5	205.4	226.9	610.7
1994	18.0	12.0	0	30.0	186.3	194.5	223.7	604.6
1995	18.0	12.0	0	30.0	183.2	183.9	225.6	592.6

Table 13—continued

Year	Other government: Saw logs	Other government: Export logs	Other government: Pulp logs	Other government: Total	All owners: Saw logs	All owners: Export logs	All owners: Pulp logs	All owners: Total
	Million board feet, roundwood equivalent							
1996	18.0	12.0	0	30.0	203.5	169.0	216.9	589.5
1997	18.0	12.0	0	30.0	211.9	154.5	213.7	580.1
1998	18.0	12.0	0	30.0	246.1	140.2	160.4	546.7
1999	18.0	12.0	0	30.0	232.1	126.2	185.2	543.6
2000	18.0	12.0	0	30.0	207.3	117.0	201.6	525.9
2001	18.0	12.0	0	30.0	229.5	117.0	192.5	539.0
2002	18.0	12.0	0	30.0	222.8	117.0	195.9	535.7
2003	18.0	12.0	0	30.0	248.2	117.0	162.5	527.7
2004	18.0	12.0	0	30.0	225.2	117.0	185.5	527.8
2005	18.0	12.0	0	30.0	218.2	117.0	189.1	524.3
2006	18.0	12.0	0	30.0	220.4	117.0	188.6	526.1
2007	18.0	12.0	0	30.0	226.1	117.0	186.8	529.9
2008	18.0	12.0	0	30.0	225.0	117.0	187.8	529.8
2009	18.0	12.0	0	30.0	225.8	117.0	188.0	530.8
2010	18.0	12.0	0	30.0	226.4	117.0	188.3	531.7

Sources: Data for all years are estimated. Summary columns (harvest for all owners, by product) should be compared to data in table 8. Table 13 illustrates detailed assumptions about the origin, by owner, of saw-log, export-log, and pulp-log harvests. The total for all products is equal to data in table 8; totals for each category are only roughly equal to data in table 8.

Sensitivity Analysis

All projections depend on assumptions; our methodology was one of making explicit many of the assumptions crucial in the future of the Alaska forest sector. Table 14 reflects the sensitivity of projections of the derived demand for National Forest timber to changes in selected assumptions. There were two objectives in this analysis. The first was an examination of the variability in model output when exogenous data were changed. If the derived demand for National Forest timber is extremely variable as assumptions change, our projections may not be reliable. If projections change relatively little when key assumptions vary within reasonable bounds, we can assert that the model and its results are robust.

The second objective of the sensitivity analysis was to display projections resulting from sets of assumptions that may be more plausible to some readers than to others. Some readers may accept our methods but question particular assumptions underlying the projections summarized in table 1. We therefore compared the projections resulting from these revised assumptions to the projection that was the product of the assumptions we considered most reasonable (the base).

In the first alternative projection, we reduced the estimate of total pulp production by reducing the share of pulp production shipped to domestic markets. Exports were assumed to account for 90 percent of total production; that is, the quantity of pulp assumed to be shipped to domestic markets was reduced by 50 percent. The derived demand for National Forest timber was reduced by less than 10 percent (roughly 8 percent by 2010) when this. alternative assumption was made.

Table 14—Alternative projections of the derived demand for Alaska National Forest timber

		Alternative number				
Year[b]	Base[c]	1	2	3	4	5
		Million board feet				
1970	539.5	539.5	539.5	539.5	539.5	539.5
1975	489.4	489.4	489.4	489.5	489.4	489.4
1980	411.0	411.0	411.0	411.0	411.0	411.0
1985	280.7	280.7	280.7	280.7	280.7	280.7
1990	382.0	353.6	378.4	382.0	379.4	377.3
1995	403.5	367.6	389.5	403.6	385.8	398.1
2000	403.2	371.6	361.2	404.1	372.9	386.1
2005	397.1	366.3	335.3	399.1	366.9	377.1
2010	400.8	367.8	323.0	403.2	370.6	380.8

[a] See text for a description of the alternative projections.
[b] Data are annual averages centered on the year given, except 2010 reports the average for 2003-2010.
[c] Data: reported in table 1.

In the second alternative projection, Alaska's share of North American softwood lumber exports to Japan was reduced to 2 percent by 2010 (in a steady downward trend) from the 5- to 6-percent share assumed in the base projection. The result was a decrease in projected lumber production because Alaska was assumed to remain almost completely dependent on the Japanese market. Compared to the base projection, average annual lumber production was lower by nearly 60 percent in 2010. The derived demand for National Forest timber was lower, but only by about 20 percent (by 2010). Although lumber production in Alaska depends almost entirely on National Forest timber, decreased residue production increases the demand for roundwood pulp wood.

In the third alternative projection we changed two assumptions. First, Japanese sawn-wood consumption was reduced compared to the base. Annual growth in Japanese sawn-wood consumption was assumed to be 0.5 percent instead of 0.7 percent. The second change was a reduction in Alaska's dependence on the Japanese market. The share of exports of softwood lumber going to Japan was reduced to 90 percent by 2010 (in a steady downward trend) from 95.4 percent (constant over the projection), as was assumed in the base; that is, shipments from Alaska to markets other than Japan were assumed to increase. These changes had roughly offsetting impacts. In this third alternative projection, Alaska lumber production and the derived demand for National Forest timber were almost exactly equal to those in the base projection.

In the fourth alternative projection, we incorporated the revised assumptions from the third alternative and illustrated the impact of assuming that access to Japanese markets is more restricted than in the base. The share of the Japanese sawn softwood market held by imports was reduced in the fourth alternative; the maximum import market share was assumed to be 25 percent (reached in 1990). This share was held constant at 25 percent for 1990-2010. In the base projection, the import share of the Japanese market for sawn softwood increased to a maximum of 33 percent (reached in 1998). The result of this change was a 30-percent reduction in projected lumber production (compared to the base) and an 8-percent reduction in the derived demand for National Forest timber.

In the fifth and final alternative projection, we examined the impact of changes in harvest by private owners in Alaska. Knapp (see footnote 6) expresses the widely held view that harvest by private owners (Native Alaska corporations) will decline from current levels (we estimate 1989 harvest at 635 million board feet); however, the timing and the extent of the drop in harvest is uncertain. In this alternative we therefore assumed that private timber harvests in Alaska will be higher than the base for all years of the projection. The sustainable harvest for private owners was assumed to be 200 million board feet of timber harvest per year, compared to 100 million in the base projection. All other assumptions were as in the base projection. This change has only a modest

impact on the derived demand for National Forest timber because the majority of the private harvest is assumed to be exported. In all projections, we assumed that the share of private harvests exported decreases over time, but only to 80 percent by 2010 (table 12); therefore, the most significant change as a result of changing projected harvest by private owners was an increase in log exports from Alaska. The derived demand for National Forest timber dropped by about 5 percent, thereby reflecting a modest increase in pulp wood supplied by private owners.

The general conclusion we drew from these alternative projections was that our projections of the derived demand for Alaska National Forest timber are not extremely sensitive to significant changes in the major assumptions. Even when projected lumber production (almost entirely dependent on National Forest timber) was reduced by 50 percent, the derived demand for National Forest timber declined by only 20 percent. It is important for the reader to remember that these are projections of the derived demand for National Forest timber, conditioned on assumptions specific to each projection and on the general assumption that no structural changes in markets occur.

Literature Cited

Adams, Darius M.; Jackson, Kristine C.; Haynes, Richard W. 1988. Production, consumption, and prices of softwood products in North America: regional time series data, 1950 to 1985. Resour. Bull. PNW-RB-151. Portland, OR: U.S. Department ,of Agriculture, Forest Service, Pacific Northwest Research Station. 49 p.

Food and Agriculture Organization. 1977. Yearbook of forest products, 1975. FAO For. Series 2. Rome: United Nations, Food and Agriculture Organization. . 397 p.

Food and Agriculture Organization. 1986. Forest products: world outlook projections. For. Pap. 73. Rome: United Nations, Food and Agriculture Organization. 101 p.

Food and Agriculture Organization. 1989. Yearbook of forest products, 1987. FAO For. Series 22. Rome: United Nations, Food and Agriculture Organization. .348 p.

Haynes, Richard W.; Brooks, David J. 1990. An analysis of the timber. situation in Alaska: 1970-2010. Gen. Tech. Rep. PNW-254. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 33 p.

Matsushita, Koji. 1988. Statistics of forestry. In: Handa, R., ed. Forest policy in Japan. Tokyo: Nippon Ringyo Chosakai [Association for Research and Publishing on Japanese Forestry]: appendix 1-48.

Ulrich, Alice H. 1988. U.S. timber production, trade, consumption, and price statistics: 1950-86. Misc. Publ. 1460. Washington, DC: U.S. Department of Agriculture, Forest Service. 81 p.

U.S. Department of Agriculture, Forest Service. 1989. Timber supply and demand. R10-MB-78. Juneau, Alaska: U.S. Department of Agriculture, Forest Service, Alaska Region. 36 p.

U.S. Department of Commerce. 1987. Lumber production and mill stocks. Current Industrial Rep. MA24T. Washington, DC: U.S. Department of Commerce, Bureau of Census, Industry Division. 7 p.

Warren, Debra D. 1989. Production, prices, employment, and trade In Northwest forest industries, fourth quarter 1988. Resour. Bull. PNW-RB-167. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 90 p.

Wharton Econometric Forecasting Associates. 1988. U.S. long-term forecast: 25-year extension and alternative scenarios. Boston, MA: Wharton Econometric Forecasting Associates. 180 p.

Wood-products Stockpile Corporation. 1989a. International trade in wood products. Tokyo: Nippon Mokuzai Bichiku Kiko. March. 14 p.

Wood-products Stockpile Corporation. 1989b. Short-term forecast on the supply-demand situation of timber in Japan. Tokyo: Nippon Mokuzal Blchiku Kika. March. 8 p.

Wood-products Stockpile Corporation. 1989c. Wood supply and demand information service. Tokyo: Nippon Mokuzai Bichiku Kiko. February. 33 p.

Appendix 1

Conversion Factors and Calculations for Sawn-Wood and Residue Production

Equations (1-4) show the relation between recovery of sawn wood and production of residues in sawn-wood manufacturing. With these explicit calculations, projections of sawn-wood output (log requirements) and residue production (and wood chip exports) satisfy materials accounting balances. These four equations define (1) sawn-wood recovery (units of output per unit of input); (2) residue recovery (proportion of the log recovered as residues); (3) total residue production (residue production per unit of log input); and (4) utilized residues (used residues produced per unit of sawn-wood produced).

$$LRF = OVRR * BFCF . \quad (1)$$

$$RES = 1 - LRF/LVF . \quad (2)$$

$$RGF = RES/RWF . \quad (3)$$

$$URGF = [(LRGF/LRF) * 1000] * UF . \quad (4)$$

The elements of equations (1-4) are defined as follows:

LRF = lumber recovery factor (board feet lumber tally per cubic feet log scale),
OVRR = overrun (board feet lumber tally per board feet log scale),
BFCF = board-foot cubic-foot ratio (board feet log scale per cubic feet log scale),
RES = residue factor (cubic feet residues per cubic feet log scale),
LVF = lumber volume factor (board feet lumber tally per cubic feet lumber tally),
RGF = residue generation factor (bone dry tons per cubic feet log scale),
RWF = residue weight factor (cubic feet per bone dry ton),
URGF = utilized residue generation factor (bone dry tons per thousand board feet lumber tally), and
UF = use factor (total used as a proportion of total generated).

APPENDIX 2

Expanded Projections of Conditions in Japanese Sawn-Wood Markets

Conditions in Japanese markets are important determinants of Alaska timber harvest and timber products output. In the following discussion and in tables 15-18, we expand our projections to focus on implications for Japanese domestic timber and sawn-wood production and for log imports (for sawn wood), by source.

In table 15, Japanese sawn-wood consumption (from table 4) is shown along with sawn-wood imports (with detail for softwood and hardwood imports) and domestic sawn-wood production. Although consumption is expected to increase more than 15 percent between 1988 and 2010, total imports are expected to nearly double. As a result, Japanese domestic sawn-wood

production and logs used in Japanese sawn-wood production are projected to decline through 2000. A modest increase in domestic sawn-wood production is projected after 2000. This is a consequence of the 33-percent market share bound on sawn softwood imports (table 10) and increases in domestic timber production (table 16).

Imported logs have supplied more than half of the raw material for Japanese sawn-wood production since 1970, but both domestic timber production and log imports peaked in the early 1970s. The rise and decline in Japanese log imports (for sawn wood) is almost entirely attributable to tropical hardwood log imports (table 16). We project a continued decline in tropical log imports but have not anticipated any abrupt supply curtailments (such as additional embargoes by exporting countries). Softwood log imports are projected to decline slightly (roughly 3 percent) by 2000 as a result of sawn-wood imports increasing faster than consumption. We expect that the market share for sawn-wood imports will not increase above 33 percent, which will lead to a gradual increase in log Imports after 2000. Japanese production of sawn wood also draws on increased production from domestic (plantation) forests after 2000.

Table 17 displays detailed historical and projected data for Japanese sawn softwood consumption, production, imports, and sources of raw material. Consumption and import data are consistent with table 4; timber import data are as shown in table 16. Table 18 expands the column of softwood timber imports to show sources of Imports by major supplier. Softwood log exports from the United States to Japan are projected to decline to 2000; these data are consistent with other projections of U.S. timber markets.[9] Canada and the Soviet Union are expected to continue to export logs to Japan, at levels roughly comparable to those observed in the early to mid 1980s. Other sources of softwood logs, primarily New Zealand and Chile, are projected to account for an increasing share of Japanese log imports over the next two decades.

[9] U.S. Department of Agriculture, Forest Service. 1988. An analysis of the timber situation in the United States: 1989-2040. Part 2: The future resource situation. Review draft. On file with the U.S. Department of Agriculture, Forest Service, Resources Program and Assessment Staff, Washington, DC.

Table 15—Japanese sawn-wood consumption, imports, and domestic production for 1965-88, and projections for 1989-2010

Year	Consumption	Imports			Domestic production	Logs for sawn wood	Cubic recovery[a]
		Total	Soft	Hard			
	Thousand cubic meters, sawn wood					*Thous. m³*	
1965	33,585	963	822	141	32,622	45,969	0.710
1966	36,192	1,191	1,142	49	35,001	48,768	.718
1967	39,754	1,969	1,837	132	37,785	52,791	.716
1968	42,682	2,537	2,353	184	40,145	55,691	.721
1969	43,433	2,066	1,873	193	41,367	56,829	.728
1970	45,428	3,010	2,704	306	42,418	58,052	.731
1971	44,035	2,129	1,806	323	41,906	57,828	.725
1972	45,495	2,422	2,036	386	43,073	61,156	.704
1973	48,101	3,680	3,247	433	44,421	63,703	.697
1974	44,092	3,637	3,185	452	40,455	56,447	.717
1975	39,319	2,612	2,426	186	36,707	52,377	.701
1976	42,496	3,237	3,013	224	39,259	55,047	.713
1977	41,695	3,511	3,208	303	38,184	53,871	.709
1978	42,657	3,857	3,436	421	38,800	54,976	.706
1979	44,642	5,017	4,549	468	39,625	56,012	.707
1980	42,436	5,447	4,892	555	36,989	52,074	.710
1981	36,228	3,898	3,410	488	32,330	45,945	.704
1982	37,381	4,892	4,245	647	32,489	44,070	.737
1983	34,232	4,668	3,918	750	29,564	42,526	.695
1984	33,062	4,786	3,984	802	28,276	41,218	.686
1985	33,557	5,392	4,320	1,072	28,165	40,792	.690
1986	34,198	5,813	4,803	1,010	28,385	41,238	.688
1987	37,646	8,133	6,591	1,542	29,513	43,367	.681
1988	38,092	9,432	7,511	1,922	28,660	42,252	.678
1989	38,400	9,608	7,649	1,958	28,792	41,132	.700
1990	38,881	10,183	8,068	2,115	28,698	40,997	.700
1991	39,153	10,712	8,449	2,263	28,441	40,630	.700
1992	39,427	11,249	8,836	2,413	28,179	40,255	.700
1993	39,703	11,792	9,227	2,565	27,911	39,873	.700
1994	39,981	12,342	9,623	2,719	27,639	39,484	.700
1995	40,245	12,846	10,142	2,704	27,399	39,141	.700

Table 15—continued

Year	Consumption	Imports			Domestic production	Logs for sawn wood	Cubic recovery[a]
		Total	Soft	Hard			
	Thousand cubic meters, sawn wood					*Thous. m³*	
1996	40,527	13,406	10,553	2,853	27,120	38,744	.700
1997	40,810	13,973	10,970	3,004	26,837	38,338	.700
1998	40,810	14,447	11,313	3,134	26,364	37,662	.700
1999	41,096	14,680	11,392	3,288	26,417	37,738	.700
2000	41,657	14,809	11,685	3,124	26,848	38,354	.700
2001	41,949	14,913	11,767	3,146	27,036	38,623	.700
2002	42,242	15,017	11,849	3,168	27,225	38,893	.700
2003	42,242	15,017	11,849	3,168	27,225	38,893	.700
2004	42,538	15,122	11,932	3,190	27,416	39,165	.700
2005	42,836	15,155	12,157	2,998	27,680	39,543	.700
2006	43,136	15,261	12,242	3,019	27,874	39,820	.700
2007	43,437	15,368	12,328	3,041	28,069	40,099	.700
2008	43,742	15,476	12,414	3,062	28,266	40,380	.700
2009	44,048	15,584	12,501	3,083	28,464	40,662	.700
2010	44,356	15,693	12,588	3,105	28,663	40,947	.700

[a] Cubic meters of sawn wood per cubic meter of logs used.

Sources: All data are reported by Matsushita (1988) for 1965-85; consistent data through 1988 are reported by Wood-products Stockpile Corp. (1989a, 1989b). Consumption data are production plus imports minus exports (export data are not shown); data are equal to those shown in table 4.

Table 16—Logs used for sawn-wood production in Japan for 1965-88, and projections for 1989-2010

Year	Total	Domestic production	Log imports[a]		
			Total	Softwood	Hardwood
	Thousand cubic meters, roundwood				
1965	45,969	34,124	11,845	5,947	5,898
1966	48,768	34,450	14,318	7,559	6,759
1967	52,791	33,572	19,219	11,478	7,741
1968	55,691	31,301	24,390	15,661	8,729
1969	56,829	28,890	27,939	15,544	12,395
1970	58,052	27,362	30,690	18,395	12,295
1971	57,828	26,325	31,503	15,991	15,512
1972	61,156	26,433	34,723	19,795	14,928
1973	63,703	26,102	37,601	20,886	16,715
1974	56,447	22,388	34,059	17,591	16,468
1975	52,377	20,961	31,416	17,238	14,178
1976	55,047	21,378	33,669	18,771	14,898
1977	53,871	20,526	33,345	19,409	13,936
1978	54,976	20,482	34,494	19,669	14,825
1979	56,012	21,461	34,551	20,967	13,584
1980	52,074	20,953	31,121	17,172	13,949
1981	45,945	19,527	26,418	13,871	12,547
1982	44,070	19,953	24,117	14,816	9,301
1983	42,526	19,392	23,134	14,401	8,733
1984	41,218	18,946	22,272	13,800	8,472
1985	40,792	18,814	21,978	14,500	7,478
1986	41,238	18,397	22,841	16,000	6,841
1987	43,367	18,097	25,270	17,374	7,896
1988	41,544	17,044	24,500	16,564	7,936
1989	41,132	16,500	24,632	15,580	9,052
1990	40,997	16,250	24,747	15,386	9,361
1991	40,630	16,000	24,630	15,430	9,200
1992	40,255	15,750	24,505	15,468	9,037
1993	39,873	15,500	24,373	15,503	8,871
1994	39,484	15,250	24,234	15,532	8,702
1995	39,141	15,000	24,141	15,909	8,232

Continued

Table 16—continued

Year	Total	Domestic production	Log imports[a]		
			Total	Softwood	Hardwood
		Thousand cubic meters, roundwood			
1996	38,744	15,000	23,744	15,684	8,060
1997	38,338	15,000	23,338	15,454	7,885
1998	37,662	15,000	22,662	15,011	7,651
1999	37,738	15,000	22,738	15,219	7,519
2000	38,354	15,000	23,354	15,986	7,368
2001	38,623	15,250	23,373	15,957	7,416
2002	38,893	15,300	23,593	16,124	7,469
2003	38,893	15,400	23,493	16,026	7,467
2004	39,165	15,500	23,665	16,146	7,519
2005	39,543	15,600	23,943	16,638	7,306
2006	39,820	15,700	24,120	16,763	7,357
2007	40,099	15,800	24,299	16,890	7,409
2008	40,380	15,900	24,480	17,019	7,461
2009	40,662	16,000	24,662	17,149	7,514
2010	40,947	16,100	24,847	17,281	7,566

[a] Logs used for sawn wood production.

Sources: Total logs used for sawn-wood production is from 1able 15; historical data are from Matsushita (1988) and Wood-products Stockpile Corp. (1989a, 1989b, 1989c). Projections of domestic log production are our estimates.

Table 17—Japanese sawn softwood consumption, production, and imports, sawn wood recovery, and softwood log consumption for 1965-88, and projections for 1989-2010

Year	Sawn wood			Sawn wood cubic recovery[a]	Logs used for domestic production		
	Consumption	Imports	Production		Total	Domestic	Imported
	Thousand cubic meters sawn-wood basis				*Thousand cubic meters roundwood basis*		
1965	26,996	822	26,174	0.768	34,202	28,255	5,947
1966	29,010	1,142	27,868	.776	36,084	28,525	7,559
1967	31,892	1,837	30,055	.776	38,855	27,377	11,478
1968	33,749	2,353	31,396	.772	40,770	25,109	15,661
1969	34,254	1,873	32,381	.838	38,717	23,173	15,544
1970	35,395	2,704	32,691	.806	40,625	22,230	18,395
1971	33,118	1,806	31,312	.841	37,311	21,320	15,991
1972	34,353	2,036	32,317	.778	41,584	21,789	19,795
1973	35,759	3,247	32,512	.769	42,305	21,419	20,886
1974	32,699	3,185	29,514	.819	36,024	18,433	17,591
1975	29,789	2,426	27,363	.785	34,848	17,610	17,238
1976	32,693	3,013	29,680	.809	36,701	17,930	18,771
1977	35,205	3,208	31,997	.873	36,665	17,256	19,409
1978	34,134	3,436	30,698	.833	36,869	17,200	19,669
1979	35,223	4,549	30,674	.784	39,114	18,147	20,967
1980	34,913	4,892	30,021	.856	35,081	17,909	17,172
1981	29,244	3,410	25,834	.847	30,515	16,644	13,871
1982	30,745	4,245	26,500	.823	32,209	17,393	14,816
1983	28,025	3,918	24,107	.810	30,867	17,319	14,401
1984	27,475	3,984	23,491	.789	29,787	15,987	13,800
1985	27,970	4,320	23,650	.773	30,616	16,116	14,500
1986	28,625	4,803	23,822	.749	31,793	15,793	16,000
1987	31,274	6,591	24,683	.750	32,897	15,523	17,374
1988	31,436	7,511	23,925	.750	31,903	15,339	16,564
1989	31,872	7,649	24,223	.775	31,255	15,675	15,580
1990	32,271	8,068	24,203	.775	31,230	15,844	15,386
1991	32,497	8,449	24,048	.775	31,030	15,600	15,430
1992	32,725	8,836	23,889	.775	30,824	15,356	15,468
1993	32,954	9,227	23,727	.775	30,615	15,113	15,503
1994	33,184	9,623	23,561	.775	30,401	14,869	15,532
1995	33,806	10,142	23,664	.775	30,534	14,625	15,909

Table 17—continued

Year	Sawn wood			Sawn wood cubic recovery[a]	Logs used for domestic production		
	Consumption	Imports	Production		Total	Domestic	Imported
	Thousand cubic meters sawn-wood basis				*Thousand cubic meters roundwood basis*		
1996	34,042	10,553	23,489	.775	30,309	14,625	15,684
1997	34,281	10,970	23,311	.775	30,079	14,625	15,454
1998	34,281	11,313	22,968	.775	29,636	14,625	15,011
1999	34,521	11,392	23,129	.775	29,844	14,625	15,219
2000	35,408	11,685	23,724	.775	30,611	14,625	15,986
2001	35,656	11,767	23,890	.775	30,825	14,869	15,957
2002	35,906	11,849	24,057	.775	31,041	14,918	16,124
2003	35,906	11,849	24,057	.775	31,041	15,015	16,026
2004	36,157	11,932	24,225	.775	31,259	15,113	16,146
2005	36,839	12,157	24,682	.775	31,848	15,210	16,638
2006	37,097	12,242	24,855	.775	32,071	15,308	16,763
2007	37,356	12,328	25,029	.775	32,295	15,405	16,890
2008	37,618	12,414	25,204	.775	32,521	15,503	17,019
2009	37,881	12,501	25,380	.775	32,749	15,600	17,149
2010	38,146	12,588	25,558	.775	32,978	15,698	17,281

[a] Cubic meters of sawn wood per cubic meter of logs used.

Sources: Consumption data are from table 4; imports and- production data are from Matsushita (1988) and Wood-products Stockpile Corp. (1989a, 19890). Historical data for softwood sawn wood recovery are computed; data for 1989-2010 are our estimates.

Table 18—Japanese softwood log imports by source for 1965-88, and projections for 1989-2010

Year	Total imports	North America			USSR	Other
		Total	USA	Canada		
		Thousand cubic meters				
1965	5,947	3,470	3,278	193	2,139	338
1966	7,559	4,693	4,407	286	2,798	68
1967	11,478	7,104	6,461	644	4,007	367
1968	15,661	9,140	8,636	504	4,673	1,848
1969	15,544	8,445	8,180	266	5,927	1,172
1970	18,395	10,314	9,642	672	6,570	1,511
1971	15,991	7,955	7,527	428	6,603	1,433
1972	19,795	10,510	10,302	209	7,133	2,152
1973	20,886	11,459	11,326	132	7,701	1,726
1974	17,591	8,959	8,615	344	7,216	1,416
1975	17,238	9,468	9,195	273	6,870	900
1976	18,771	11,198	10,901	297	7,562	11
1977	19,409	10,520	10,025	495	7,241	1,648
1978	19,669	11,190	10,783	407	7,836	643
1979	20,967	13,368	12,833	536	7,072	527
1980	17,172	11,009	10,368	642	5,937	226
1981	13,871	7,825	7,230	595	5,408	638
1982	14,816	8,651	8,063	588	5,366	799
1983	14,401	8,765	7,674	1,091	5,130	506
1984	13,800	8,378	7,186	1,192	4,906	516
1985	14,500	9,177	7,798	1,379	4,461	862
1986	16,000	9,746	8,319	1,427	5,611	643
1987	17,374	11,549	9,669	1,880	5,517	309
1988	16,564	10,576	9,390	1,186	5,027	961
1989	15,580	9,287	8,056	1,231	5,095	1,198
1990	15,386	9,195	7,919	1,276	5,162	1,029
1991	15,430	8,982	7,661	1,321	5,230	1,218
1992	15,468	8,860	7,495	1,365	5,297	1,311
1993	15,503	8,845	7,435	1,410	5,365	1,293
1994	15,532	8,841	7,386	1,455	5,432	1,259
1995	15,909	8,831	7,331	1,500	5,500	1,578

Table 18—continued

Year	Total imports	North America			USSR	Other
		Total	USA	Canada		
		Thousand cubic meters				
1996	15,684	8,652	7,152	1,500	5,600	1,432
1997	15,454	8,473	6,973	1,500	5,700	1,281
1998	15,011	8,293	6,793	1,500	5,800	918
1999	15,219	8,115	6,615	1,500	5,900	1,204
2000	15,986	7,973	6,473	1,500	6,000	2,013
2001	15,957	7,973	6,473	1,500	6,000	1,984
2002	16,124	7,973	6,473	1,500	6,000	2,151
2003	16,026	7,973	6,473	1,500	6,000	2,053
2004	16,146	7,973	6,473	1,500	6,000	2,173
2005	16,638	7,973	6,473	1,500	6,000	2,665
2006	16,763	7,973	6,473	1,500	6,000	2,790
2007	16,890	7,973	6,473	1,500	6,000	2,917
2008	17,019	7,973	6,473	1,500	6,000	3,046
2009	17,149	7,973	6,473	1,500	6,000	3,176
2010	17,281	7,973	6,473	1,500	6,000	3,308

Sources: Data for the United States include exports from all regions (Ulrich 1988; Warren 1989); U.S. export data were converted at 4.1 cubic meters per thousand board feet. Data for Canada are exports from British Columbia. 'Other' includes New Zealand and Chile. Total imports are from Food and Agriculture Organization (1977, 1986); data for 1987-88 are from Wood-products Stockpile Corp. (1989a). Data for USSR are from Matsushita (1988) and Wood-products Stockpile Corp. (1989a); data for Canada are from Warren (1989).

*U.S GOVERNMENT PRINTING OFFICE: 1991-591-001/40013

Brooks. David J.; Haynes, Richard W. 1990. Timber products output and timber harvests In Alaska: projections for 1989-2010. Gen. Tech. Rep. PNW-GTR-261. Portland, OR: U.S. Department of Agriculture. Forest Service, Pacific Northwest Research Station. 48 p.

Projections of Alaska timber products output and timber harvest by owner were developed by using a detailed, trend-based analysis. Historical data for 1965-88 were the basis for projections for 1989-2010. Projections of timber products output for each major product (export logs, sawn wood. and market pulp) were used to compute the derived demand for timber. The assumptions these projections depend on Include the level of harvest by Alaska Native corporations, sawn-wood consumption In Japan, and exports of market pulp. Potential harvest from Alaska National Forests (primarily the Tongass National Forest) is calculated as the volume of timber that balances the derived demand, given harvest by other owners. Total harvest In Alaska Is expected to average 660 million board feet per year during the early 1990s and 545 million board feet per year between 1995 and 2005. Projected demand Is such that harvest from Alaska National Forests can remain roughly constant at 400 million board feet per year from 1990 to 2010. The sensitivity of these projections to changes in major assumptions Is examined.

Keywords: Supply and demand, production, trade. Pacific Rim. National Forests

The **Forest Service** of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.

The U.S. Department of Agriculture is an Equal Opportunity Employer. Applicants for all Department programs will be given equal consideration without regard to age, race, color, sex, religion, or national origin.

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

Official Business
Penalty for Private Use, $300

BULK RATE
POSTAGE +
FEES PAID
USDA-FS
PERMIT No. G-40

Do NOT detach Label