Effects of Restrictions on Softwood Lumber and Plywood Trade in the Pacific Basin:

Application of the Spatial Temporal Forest Products (STFP) Model

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I. Introduction

Identification of patterns in availability and consumption of forest products throughout the world is necessary in order to make decisions regarding the management of timber supplies in various global regions. The major U.S. trading partners for forest products are Japan and Canada. Japan is the leading importer of U.S. forest products while Canada is the major exporter of these commodities to the United States.

Canada and the United States, from the standpoint of forest resources, could be considered as a single economic region, with only a political boundary and certain trade barriers separating them (Zivnuska). The United States is the only developed nation which has a surplus of growth over cut, yet still is a net importer of forest products. This is explained in part by the close relationship of the U.S. and the Canadian forest products industries for which the U.S. is the major market. In its wood trade balance

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U.S. ports to be shipped in vessels of U.S. registry. In the early 1970's, west coast mills were at a ten to fifteen dollar per thousand board feet (MBF) disadvantage relative to coastal British Columbia mills due to this act. However, imports have also increased in mid-western and eastern U.S. markets to which the lumber is shipped by rail. In the interior regions of Canada, provincial governments favor the subsidizing of forest industries in order to promote employment and economic activity.[1] One of the main impacts of the Jones Act, then, is the elimination of Alaskan lumber from markets in the 48 contiguous states. Most lumber produced in Alaska is destined for export to Japan.

The United States and Canada are the only important producers and consumers of softwood plywood in the world. Neither imports nor exports have been significant because of mutual tariff restrictions on softwood plywood. Woodbased panel markets exist in Japan, but at present, hardwood plywood made from Philippine mahogany (luan) are used, and softwood plywood is not likely to make much of an inroad there, due to the low price of the tropical hardwood, and to the tariff which Japan has on softwood plywood. However, Japan is the largest supplier of hardwood plywood imports for the United States, and future imports will continue to originate in Asia.

The Canadian Position

Canada is the world's most important exporter of forest products, both in value and volume. Even though domestic consumption of wood products is increasing, the majority of timber harvested goes into wood products for export trade. Although Canada exports forest products to more than fifty countries, the U.S. is the largest single market, taking approximately three-quarters of the value of Canada's forest products exports. Further development of Canadian forest potential will be heavily conditioned on expanding markets, especially export markets.[2] This has historically been the case for expanded sales of Canadian forest products, with the exception of plywood.

[1] See Holland, in *Report of the President's Advisory Panel on Timber and the Environment.* p. 301.
[2] See Holland, p. 305.

to Japan. During this same period, plywood production has increased nearly ten times, although exports of plywood are generally declining.

III. Previous Modeling Research

For the United States, an important portion of the lumber supply comes from imports, primarily from Canada. Imports of softwood lumber accounted for 28 percent of the total lumber consumed in 1978: Total imports increased 15 percent from the previous year. This shows that attention should be given to imports, not only from the view of the total share, but also from relative growth rates, and its effects on decision making regarding international trade as well as domestic forest products policies. Several studies have recognized the importance of the relationship between U.S. and Canada into their models (McKillop, 1967; Robinson, 1974; Adams, 1977). Buongiorno, *et al.* (1976) modeled monthly U.S. lumber imports. They stated that imports depend on importers' expectations of construction activity, domestic and foreign prices, and domestic prices of other goods.

In 1977, Haynes, Holley, and King developed the Equilibrium Timber Model (ETM). This model was a modification of the original Interregional Timber Model (ITM) (Holly, Haynes, and Kaiser, 1975). A linear programming formulation is used which allocates timber resources to products through the marketing system from various supply regions to demand regions.

The development of forest products research suggests that price and flows of these commodities are affected by the existence of excess demand in certain areas and excess supply in other areas, which represent consuming and producing areas, respectively. Forest products are transferred between these areas according to price differentials where trade barriers do not exist, and are transferred subject to trade barriers where they do exist. This leads to the inclusion of imports and exports when the models describe movements of forest products across borders. This research implies that a study which constructs a model meeting the objectives as described earlier could be of use in evaluating policy changes which affect the movements of forest products, or in forecasting future forest products needs in various regions of

The demand equations for softwood lumber and plywood are necessary in order to develop the relationships which govern trade between countries. First, the structural form of the equations are specified consistent with economic theory and lumber and plywood idustries in each country. Then, demand equations are estimated using ordinary least squares (OLS).

Softwood lumber is an input used in producing housing, furniture, and other wooden products, therefore, the demand for softwood lumber is derived from these final products. In each of the three trading countries, the primary use of lumber is in building construction, specifically, the construction of housing.

The three structural softwood lumber demand equations are:

(1.2) $Q_L^{US} = f\,(P_L^{US}, P_P^{US}, HS^{US}, D)$

(1.3) $Q_L^{C} = f\,(PRL, PPAD^C, VBP^C, CWI^C, D)$

(1.4) $Q_L^{J} = f\,(PLAD^J, PPAD^J, WC^J, D)$

where Q_L^i = per capita softwood lumber consumption in board feet (i = U.S., Canada, and Japan),

P_L^{US} = real producer price index of softwood lumber (1967 = 100),

P_P^{US} = real producer price index for plywood (1967 = 100),

HS^{US} = thousands of housing starts (annual), D = 0/1 dummy variable (1951-1972 = 0, 1973-1978 = 1) to represent the effects of the oil embargo,

PRL = real producer price index of softwood lumber in Canada divided by the real producer price index of softwood lumber in the U.S., (1967 = 100) adjusted by the U.S./Canadian exchange rate,

$PPAD^C$ = real producer price index of plywood in Canada (1967 = 100) adjusted by the U.S./Canadian exchange rate,

VBP^C = value of building permits in Canada in U.S. dollars, All other variables were defined previously.

The above specification for softwood lumber and plywood demand fit the Marshallian form, where quantity is a function of own price, income and other appropriate shifters. Although income is not entered directly into the equation, it is included implicitly in housing starts which are a function of disposable income.

The other necessary components of the STFP model are supply, transportation costs, and storage costs. Since forest products are derived from a perennial, it is assumed that each country's supply of softwood lumber and plywood is fixed in the short run.

The transportation costs for softwood lumber and plywood are shown in Table 1.1. These costs reflect the quoted rates for the various years, and may be substantially above the actual rates paid by exporting firms. The ocean transportation costs for lumber are open competitive rates as quoted by shipping lines. The ocean transportation costs for plywood are the agreed upon rates for all carriers as provided by the Pacific Westbound Con-

Table 1.1

TRANSPORTATION COSTS

From	U.S.		Canada		Japan	
To	Lumber[a]					
	1980	1981	1980	1981	1980	1981
U.S.	0	0	10	10	89	78
Canada	62	73	0	0	94	82
Japan	89	78	94	82	0	0
To	Plywood[b]					
	1980	1981	1980	1981	1980	1981
U.S.	0	0	33	38	79	87
Canada	33	38	0	0	79	87
Japan	79	87	79	87	0	0

[a] In $U.S. per million board feet (MBF).
[b] In $U.S. per thousand square feet 3/8 inch basis.

Table 1.3

SOFTWOOD LUMBER DEMAND EQUATIONS

Independet[a)] Variables	Intercept	Independent Variables	$F^{b)}$	$\bar{R}^{2\,c)}$	D.W.[d)]
Q_L^{US}	82.266	$-.319 \cdot P_L^{US}$ + .658) $\cdot P_P^{US}$ + .0289 $\cdot HS^{US}$ −5.283 $\cdot$ D (−1.80)[e] (10.46) (3.69) (−0.87) (−0.21)[f]	41.46	0.86	1.66
Q_L^{C}	165.391	−113.097 $\cdot$ PRL + 1.447 $\cdot PPAD^D$ + 31.140 $\cdot VBP^C$ (−1.51) (3.71) (1.03) (−0.41) −.523 $\cdot CWI^C$ + 43.765 + D (−2.06) (3.08)	11.80	0.71	1.73
Q_L^{J}	81.971	−70.756 $\cdot PLAD^J$ + 109.065 $\cdot PPAD^J$ + .613 $\cdot$ WC (−1.20) (2.26) (2.93) (−0.21) −21.374 $\cdot$ D (−4.39)	6.90	0.63	1.55

a Units of measurement are board feet per person.
b The highest critical F-value at the 90% level of significance is 3.83.
c Coefficient of determination adjusted for degrees of freedom.
d Durbin-Watson statistic.
e Figures in parentheses are t-statistics.
f Figures in parentheses are price elasticities.

Table 1.4

PLYWOOD DEMAND EQUATIONS

Dependent[a)] Variable	Intercept	Independent Variables	$F^{b)}$	$\bar{R}^{2\,c)}$	D.W.[d)]
Q_P^{US}	81.971	$-.852 \cdot P_P^{US}$ + .299 $\cdot P_L^{US}$ + .0249 $\cdot HS^{US}$ + .0336 $\cdot NRC^{US}$ (−6.92)[e] (4.08) (5.22) (4.92) (−1.40)[f]	166.96	0.96	2.10
Q_P^{C}	2.497	−.531 $\cdot PPAD^C$ + .419 $\cdot PLAD^C$ + 54.288 $\cdot VH^C$ + 45.667 $\cdot VBP^C$ (−2.27) (7.34) (3.24) (−0.28)	53.62	0.90	1.62
Q_P^{J}	−10.640	−119.161 $\cdot PPAD^J$ + 146.119 $\cdot PLAD^J$ + .683 $\cdot NRC^J$ (−3.20) (5.01) (7.70) (−0.28)	64.37	0.93	2.24

a Units of measurement are in square feet of 3/8 inch basis plywood per person.
b The highest critical F-value at the 90% levels of significance is 3.83.
c Coefficient of determination adjusted for degrees of freedom.
d Durbin-Watson statistic.
e Figures in parentheses are t-statistics.
f Figures in parentheses are price elasticities.

magnitude than the others, and is larger than what is expected for plywood, McKillop, *et al.* (1980) conducted a study which found regional price elasticities for plywood in the U.S. to be between -0.23 and -1.69. All three price elasticities derived in this study are within this range.

The STFP model results for 1980 and 1981 are shown in Table 1.5. The model seems to perform fairly accurately. The lumber and plywood prices generated are within 14% and 6% of their respective actual prices. Demand quantities for lumber are within 8% but for plywood, estimated errors are as much as 19%. A reason for these large errors is the low plywood consumption levels during the early 1980's.

Table 1.6

7.5 BILLION BOARD FEET QUOTA RESULTS

		U.S.		Canada[a]		Japan	
		1980	1981	1980	1981	1980	1981
Price of lumber:	quota	336	283	155	174	405	412
($U.S./MBF)	base	236	257	174	184	424	422
	% change	42.4	10.1	-10.9	-5.4	-4.5	-2.4
Quantity demanded:	quota	30.9	29.3	5.8	5.2	15.4	15.1
(Million MBF)	base	31.9	29.6	5.5	5.2	14.7	14.7
	% change	-3.1	-1.0	5.5	0.0	4.8	2.7
Net trade:	quota	7.5	7.5	9.4	9.3	1.9	1.8
(Million MBF)	base	8.6	7.8	9.8	9.2	1.3	1.5
	% change	-12.8	-3.8	-4.1	1.1	46.2	20.0
Price of plywood:	quota	226	200	192	181	261	268
($U.S./1000 ft.^{2})	base	192	191	188	191	261	269
	% change	17.7	4.7	2.1	-5.2	0.0	-0.4
Quantity demanded:	quota	21.2	21.9	2.0	2.4	14.5	12.5
(Million ft.^{2})	base	21.0	21.9	2.1	2.4	14.5	12.5
	% change	1.0	0.0	-4.8	0.0	0.0	0.0
Net trade:	quota	0.1	0.0	0.0	0.0	0.0	0.0
(Million ft.^{2})	base	0.0	0.0	0.0	0.0	0.0	0.0

a Under this scenario, Canada adds approximately 100 million BF of lumber to its inventory from 1980 to 1981.

The effects on plywood were not as strong as those on lumber. In the U.S., the price increased, through the substitution effect for lumber. Increased lumber price is an incentive for the construction industry to substitute more plywood for lumber, thus driving the plywood price upwards. In Canada, where the reverse is expected because of a decrease in the lumber price, an interesting phenomenon took place. In the first year, plywood prices actually increased, instead of decreasing. The reason for this is that the increased use of plywood in the U.S. drove prices high enough for the U.S. to begin importing plywood from Canada. This reduced the Canadian plywood supply, and the Canadian price increased. In the second period, however, the increase in plywood price in the U.S. was not large enough to make imports economically feasible. Therefore, the lower lumber price in Canada induced increased lumber consumption, which, in turn, decreased plywood consumption. Consequently, the plywood price fell in Canada in the second period.

The effects in Japan, the third trading partner, are almost entirely felt on lumber. There are relatively no effects on plywood in Japan. The magnitude of the price and quantity changes in Japan are dependent on the response of Canadian consumption to price changes. In this case, the price decrease is not enough to induce complete consumption of the excess supply, and it is made available to Japan at a lower price. It should also be noted that the quota affected the price differential between time periods. Depending on how restrictive the quota is in one year relative to the next, prices can fluctuate widely. This occurred in the U.S. and Canada. The point is that the 1980 price of lumber in Canada is 19 dollars less than in 1981. The maximum carry-over cost is $18.50. Under the quota scenario, Canada carried over, or increased its stocks of lumber by approximately 100 million board feet.

VII. Summary

The STFP model has shown to be an effective policy evaluation tool. The model performed well in describing the softwood lumber and plywood markets in the U.S., Canada, and Japan. When it was adjusted to include barriers to trade, the results were

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