LIBERALISATION OF FOREST PRODUCT TRADE AND THE NEW ZEALAND FOREST SECTOR, 2000–2015: A GLOBAL MODELLING APPROACH

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ABSTRACT

The aim of this study was to model the effects on the New Zealand forest sector of tariff elimination under the ASEAN Free Trade Area - Closer Economic Relations (AFTA-CER) and P5 regional trade agreements, and of tariff reductions under the World Trade Organization (WTO) administered General Agreement on Tariffs and Trade (GATT 1994). These scenarios were compared to a base scenario of no trade liberalisation except for the Closer Economic Relations (CER) agreement between Australia and New Zealand. All trade agreements were compared under three scenarios regarding growth in New Zealand's roundwood supply. The projections were made with the Global Forest Products Model from 1998 to 2015. The Global Forest Products Model is a spatial equilibrium model, which gives projections of production, consumption, and trade for each of 180 countries and 14 forest commodity categories.

Results suggested the regional trade agreements (P5 and AFTA-CER) would have a limited effect on New Zealand production of forest products under all supply scenarios. The P5 and AFTA-CER would result in greater paper and paperboard production and exports, with an associated increase in fibre consumption. Tariff reduction under GATT 1994 had the most significant overall impact, increasing the production of all major processed commodities. In particular, the production and exports of paper and paperboard, and wood-based panels, were projected to be higher, and those of roundwood and pulp lower as their domestic consumption increased. From a policy perspective, this study suggests that if New Zealand wishes to increase domestic utilisation of its future roundwood harvest, supporting the tariff reduction initiative of GATT 1994 would be of greater benefit than tariff removal under the P5 or AFTA-CER regional trade agreements. According to the Global Forest Products Model, New Zealand has a competitive advantage in pulp, paper, and fibre production, rather than sawlog and sawntimber

production as suggested by previous New Zealand studies. A possible explanation for this disparity is that the Global Forest Products Model does not disaggregate industrial roundwood into pruned, saw, and pulp logs. The Global Forest Products Model, therefore, ignores New Zealand's relative abundance of material for producing sawnwood and possible differences in the trend of pruned log, sawlog, and pulp log prices.

Keywords: international trade; forest products; tariffs; trade liberalisation; spatial equilibrium model; comparative advantage.

INTRODUCTION

The purpose of this study was to predict the potential effects of trade liberalisation on the New Zealand forest sector. The Global Forest Products Model, a spatial equilibrium model, was used to predict these effects, and this study represents the first time a global model of forest products trade has been used to carry out such an analysis. The Global Forest Products Model provides the ability to analyse the New Zealand forest sector in an international context by considering the numerous and complex links between countries and between industries. The study was part of a larger project estimating the potential impact of trade liberalisation initiatives on the New Zealand forest sector and regional economic development (New Zealand Forest Research Institute Limited 2001).

This study considers the effects of two regional trade agreements: AFTA-CER, between the ASEAN* Free Trade Area and Closer Economic Relations countries†, and P5 between the United States, Chile, Australia, New Zealand, and Singapore. Global trade liberalisation under the World Trade Organisation (WTO)-administered General Agreement on Tariffs and Trade (GATT 1994) is also considered. Of New Zealand's major (by value) forest product export markets, Australia accounted for over NZ$879 million (28% of the total) in 2000, ASEAN countries accounted for nearly NZ$283 million (9%), and the P5 countries (excluding Australia) nearly NZ$390 million (13%) (New Zealand Forest Owners' Association 2001). These countries are important and growing markets for New Zealand forest product exports, particularly of sawn timber, paper and paperboard, and wood-based panels.

The AFTA-CER regional trade agreement requires member countries to grant duty-free access to each other's markets by 2015. The year 2005 is an optimistic target date for some of the initial liberalisation, with further liberalisation set to occur by 2010. The most recent AFTA members — Vietnam, Myanmar, Cambodia, and Laos — would have until 2015 to grant duty-free access (Lisa McGowan, New Zealand Ministry of Foreign Affairs and Trade, pers. comm.).

The P5 regional trade agreement is likely to seek total tariff elimination for all products by a set date. As tariffs for forest products are not a sensitive issue for these five countries, they are likely to be eliminated at the beginning of the agreement, regardless of the rest of its content (Lisa McGowan, New Zealand Ministry of Foreign Affairs and Trade, pers. comm.).

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* The ASEAN (Association of South East Asian Nations) countries are Brunei, Darussalam, Indonesia, Malaysia, Philippines, Singapore, and Thailand. Vietnam, Laos, Cambodia, and Myanmar are due to become members.

† The CER countries are Australia and New Zealand.

The Asia-Pacific Economic Cooperation (APEC) Bogor Goals of free-trade among APEC member economies‡ require that developed members of APEC (Australia, Canada, Japan, New Zealand, and the USA) achieve free trade by 2010. So, for the P5 agreement to be of any value, the date of tariff elimination would have to be before 2010. For this study it was assumed that forest products tariff elimination under the P5 agreement would be achieved by 2005.

The Uruguay Round of GATT ended with an agreement to reduce tariffs on most forest products by 33% on a trade-weighted basis. The major developed countries were committed to tariff elimination on pulp and paper by 2004, and reducing tariffs by 50% on solid wood products over 5 years from 1995. The Uruguay Round agreement also committed major developed countries and most developing countries to set bound rates (a maximum tariff rate) on forest products (Barbier 1996). The WTO, established in January 1995, provides an institutional foundation for the GATT and other trade agreements. Here the post-WTO GATT is referred to as GATT 1994 (Bowen *et al.* 1998).

The objective of this study was to predict the effect of each of these agreements on the New Zealand forest sector over the next 15 years. The next part of the paper describes the methods used to make the projections. The third part discusses the results in terms of the predicted effects of each of the agreements on New Zealand production, consumption, and trade and discusses some of the limitations of the study. The last part summarises the main findings of the study.

METHODS

The effect of global tariff reductions and regional trade agreements on New Zealand forest sector production, consumption, and trade was predicted with the Global Forest Products Model.

The model used in this study was a modification of that developed by Zhang *et al*. (1993) for the Food and Agriculture Organisation (FAO) global outlook study of forest products consumption, production, and trade in 180 countries. A second version of the Global Forest Products Model was developed by Zhu *et al*. (1998), also for the FAO. The model was applied recently to analyse the effects of accelerated tariff liberalisation (ATL) on the global forest products sector (Zhu *et al*. 2001) in terms of changes in production, consumption, and trade. Turner *et al*. (2000) produced a user guide of the model. This paper presents a brief description of the Global Forest Products Model; for a more detailed description of the model, including its mathematical formulation, the reader is referred to Zhu *et al.* (2001).

The Global Forest Products Model is a spatial partial-equilibrium model of global production, consumption, and trade of forest products. Another example of this type of model in forestry is the Global Trade Model (Kallio *et al.* 1987). Demand, supply, trade, and prices in the forest sector are determined simultaneously, in accord with economic equilibrium theory. The current version of Global Forest Products Model produces forecasts for 180 countries and 14 forest commodity categories, from 1998 to 2015 (Zhu *et al*. 2001).

‡ The APEC member economies are Australia, Brunei Darussalam, Canada, Chile, People's Republic of China, Hong Kong, China, Indonesia, Japan, Republic of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, Philippines, Russian Federation, Singapore, Chinese Taipei, Thailand, United States, and Vietnam.

The Global Forest Products Model solves for market equilibrium by mathematical programming. The theory is that of spatial equilibrium in competitive markets (Samuelson 1952; Takayama & Judge 1971). The model solves the equilibrium by maximising the value of the products, minus the cost of production, subject to material balance and capacity constraints in each country and each year. Because material flows throughout the system must balance, the model ensures data consistency within countries, and coherence of projections between countries.

In each projection year, for each country and commodity, supply (domestic production plus imports) is equal to demand (final consumption, plus input into other processes, plus exports). Final demand is represented by demand equations, while demand for wood or intermediate products derives from the demand for final products through input-output coefficients that describe technologies in each country. The supply of raw wood and non-wood fibres in each country is represented by supply equations. The supply of final products represented with input-output coefficients is constrained by capacity. The supply of recycled paper is constrained by the waste paper supply, which itself depends on paper consumption and the recycling rate. Each country exports to the world market and imports from the world market. Projected prices are such that they clear markets: at those prices commodity demand is equal to supply in each country.

From one year to the next, demand changes in each country due to changes in income. The wood supply changes according to the chosen wood supply scenario. The amount of recycled fibre used in making paper and paperboard changes with technology and recycling policy. Capacity increases or decreases according to new investments that depend on past production and the profitability of production in different countries, as revealed by the shadow price of capacity.

Tariff changes affect the cost of imports, *ad valorem*. A new equilibrium is then computed subject to the new demand and supply conditions, new technology, new capacity, and new tariffs. Trade changes with inertia tied to past trade and the gross domestic product (GDP) of importing countries.

The general principle of the Global Forest Products Model is, then, that global markets optimise the allocation of resources in the short run (within 1 year). Long-run resource allocation is governed partly by market forces, as in capacity expansion and trade, and also by political forces such as the wood supply shifts determined by forest policy, the waste paper recovery rates by environmental policy, the trade tariffs that change the cost of imports, and the techniques of production determined by exogenous progress.

Modifications to the Global Forest Products Model

To model regional trade agreements in this study, a number of modifications were made to the version of the Global Forest Products Model described by Zhu *et al*. (2001).

Trade flows

The key adaptation made to the Global Forest Products Model as part of this study was to describe in detail the trade flows among AFTA-CER and P5 countries. Thus, total imports and exports for each of these countries were disaggregated by country of origin and destination. Bilateral trade data for 1997 among the AFTA-CER and P5 member countries

were taken from FAOStat (Food and Agriculture Organisation of the United Nations 2000). Recovered paper bilateral trade data came from "Recovered Paper Data 1997–1998" (Food and Agriculture Organisation of the United Nations 1999). Bilateral trade data were adjusted to reconcile differences between trade reported by partner countries, and to ensure that total bilateral trade flows did not exceed each country's reported total imports and exports.

Tariff rates

The tariff data in the Global Forest Products Model were modified for AFTA-CER and P5 countries to reflect these trade agreements. Tariff schedules for 1997 under the P5 and AFTA-CER trade agreements are given in Tables 1 and 2, respectively, and represent tariffs applied to other P5 or AFTA-CER countries. Tariffs for all other countries were kept at their 1997 levels. The tariff rates under the GATT 1994 have been detailed by Zhu *et al*. (2001) as the Base Scenario in that study. Changes in tariff schedules were set to result in a uniform decline in tariffs to their target levels by the required tariff liberalisation date. Target tariff levels, and years in which they are to become effective, are given in Tables 1 and 2.

Final demand

In the Global Forest Products Model the demand for a final product in a country is a function of the price of the product and of the country GDP. The assumptions on the GDP growth rates by country used in the study by Zhu *et al*. (2001) were updated by the Food and Agriculture Organisation (Adrian Whiteman, FAO, pers. comm.). They reflected in particular the effects of the Asian economic crisis (Table 3).

TABLE 1–1997 applied tariff rates (%), target tariff levels, and date for achieving target tariff level in the P5 member countries*, for selected commodities.

Country	Commodity	1997	Target tariff level	Year to achieve target
USA	Plywood/veneer	5.0	0.0	2005
	Particleboard	0.8	0.0	2005
	Fibreboard	0.6	0.0	2005
	Printing & writing paper	1.5	0.0	2005
	Other paper & paperboard	2.4	0.0	2005
Chile	Industrial roundwood	11.0	0.0	2005
	Sawnwood	11.0	0.0	2005
	Plywood/veneer	11.0	0.0	2005
	Chemical pulp	11.0	0.0	2005
	Newsprint	11.0	0.0	2005
Australia	Sawnwood	5.0	0.0	2005
	Plywood/veneer	5.0	0.0	2005
	Printing & writing paper	5.0	0.0	2005
New Zealand	Sawnwood	8.0	0.0	2005
	Particleboard	7.5	0.0	2005
	Fibreboard	6.5	0.0	2005
	Newsprint	7.5	0.0	2005

* Singapore tariffs on forest products were all zero in 1997.

Source: APEC, World Trade Organisation, and country Harmonised Tariff System (HTS) schedules.

TABLE 2–1997 applied tariff rates (%), target tariff levels, and date for achieving target tariff level in the AFTA-CER member countries, for selected commodities.

Country	Commodity	1997	Target tariff level	Year to achieve target
Indonesia	Sawnwood	10.0	0.0	2010
	Plywood/veneer	20.0	0.0	2010
	Recovered paper	25.0	0.0	2010
	Printing & writing paper	15.0	0.0	2010
Laos	Industrial roundwood	2.0	0.0	2015
	Sawnwood	5.0	0.0	2015
	Plywood/veneer	20.0	0.0	2015
	Chemical pulp	3.0	0.0	2015
	Newsprint	10.0	0.0	2015
Malaysia	Plywood/veneer	40.0	0.0	2010
	Newsprint	5.0	0.0	2010
	Other paper & paperboard	20.0	0.0	2010
Thailand	Sawnwood	5.0	0.0	2010
	Plywood/veneer	20.0	0.0	2010
	Chemical pulp	7.0	0.0	2010
	Newsprint	35.0	0.0	2010
Australia	Sawnwood	5.0	0.0	2005
	Plywood/veneer	5.0	0.0	2005
	Printing & writing paper	5.0	0.0	2005
New Zealand	Sawnwood	8.0	0.0	2005
	Particleboard	7.5	0.0	2005
	Newsprint	7.5	0.0	2005

Source: APEC, World Trade Organisation, and country Harmonised Tariff System (HTS) schedules.

TABLE 3–Assumed growth rates of real gross domestic product, GDP, and shift rate of roundwood supply, S, from 2000 to 2015 (% per year) for AFTA-CER and P5 member countries.

Country	GDP growth rate		Supply shifter	
	2000*	2006	2000	2011
Brunei Darussalam	2.00	2.00	0.32	–0.05
Indonesia	4.65	4.90	0.89	–0.16
Malaysia	5.96	6.25	–0.98	–1.78
Philippines	4.82	5.28	–2.71	–1.51
Singapore	6.44	6.44	0.00	0.00
Thailand	5.35	5.00	1.20	2.88
Viet Nam	6.50	6.50	1.86	0.47
Laos	5.99	6.00	–0.86	–1.33
Cambodia	6.00	6.00	–1.44	–2.81
Myanmar	4.58	4.84	–1.13	–1.51
United States	2.63	2.72	0.69	0.79
Chile	5.75	5.75	2.43	1.83
Australia	3.43	3.49	0.34	0.11
New Zealand	**2.50**	**3.00**	**2.64**	**2.11**

* Year represents date at which GDP growth/supply shift rate is effective.

Raw material supply

In the Global Forest Products Model the supply of industrial roundwood is a function of price. Roundwood supply also shifts over time, independently of price. These rates of shift vary by country, and are based on information regarding past production, forest area and stock, growth rates, extent of plantations, and policies of each country (Zhu *et al*. 2001). Supply shifts are based on the annual percentage changes in the "commercially available wood supply" projected by the Global Fiber Supply Model (Bull *et al*. 1998; Zhu *et al*. 2001) and modified by the FAO (Adrian Whiteman, FAO, pers. comm.). (Table 3).

Trade inertia bounds

In the Global Forest Products Model the yearly changes in imports and exports of each country are determined by international competitive forces and the resulting equilibrium prices. In addition, to avoid large changes, trade is bounded by trade inertia constraints. These constraints are meant to simulate the slow adjustment of trade due to institutional and other constraints (Adams & Haynes 1987; Zhu *et al*. 2001). This study recognised that in addition to being caused by competitive advantage, trade (especially intra-industry trade) tends to grow in accordance with general economic activity. To simulate this, inertia constraints allow imports to vary (due to competition) around a trend defined by the elasticity of domestic demand with respect to GDP, as follows:

$$\begin{aligned} T^{U}_{ijk} &= T_{ijk,-1}\,(1 + \alpha_{ik}\, g_i + \varepsilon_{ik}) \\ T^{L}_{ijk} &= T_{ijk,-1}\,(1 + \alpha_{ik}\, g_i - \varepsilon_{ik}) \end{aligned} \qquad (1)$$

where: T^{U}_{ijk}, T^{L}_{ijk} are the upper and lower bounds on imports of commodity k, to country i from country j;

α_{ik} is the elasticity of domestic demand with respect to the GDP for commodity k, in country i;

g_i is the GDP growth rate in country i (Table 3); and,

$0 < \varepsilon_{ik} < 1$ is a fraction of the previous year's quantity imported of commodity k, in country i.

For this study, ε_{ik} was assumed to be 0.07. Imports, therefore, were constrained to not vary more than 7% from the previous year's imports, adjusted for changes in demand due to GDP changes. The elasticities of domestic demand with respect to GDP are included in Table 4.

Transportation and manufacturing costs

In the version of the Global Forest Products Model used by Zhu *et al.* (2001), demand and supply prices, and transport and manufacturing costs were calculated the same way — using export prices exclusive of freight rates. In this study, demand and supply prices, transport costs, and manufacturing costs were calibrated to reflect freight rates (Table 5); thus, commodity prices included the cost of transportation if the commodity was imported by a country. Commodity freight rates do not differ among countries as countries import to, and export from, the world. This assumption was maintained for AFTA-CER and P5 countries for which bilateral trade flows were incorporated into the Global Forest Products Model for this study.

TABLE 4–Income elasticities of domestic demand used in trade inertia constraints.

Commodity	Country income	
	High*	Low†
Fuelwood & charcoal	–2.26	0.40
Industrial roundwood	1.00	1.00
Other industrial roundwood	–0.58	0.19
Sawnwood	0.32	0.46
Plywood/veneer	0.73	0.74
Particleboard	1.15	0.65
Fibreboard	0.82	0.82
Mechanical pulp	1.00	1.00
Chemical pulp	1.00	1.00
Other pulp	1.00	1.00
Waste paper	1.00	1.00
Newsprint	1.14	1.05
Printing and writing paper	1.66	1.11
Other paper and paperboard	0.94	0.92

* Australia, Austria, Belgium-Luxembourg, Canada, Denmark, Finland, France, Germany, Ireland, Israel, Italy, Japan, Kuwait, Netherlands, Norway, New Zealand, South Africa, Spain, Sweden, Switzerland, United Kingdom, and the USA.

† All other countries.

TABLE 5–1997 world commodity prices and freight factors used to calculate transport costs.

Commodity	World price* (US$)	Freight factor† (%)
Fuelwood & charcoal	44.5	0.18
Industrial roundwood	83.6	0.18
Other industrial roundwood	83.6	0.18
Sawnwood	227.7	0.12
Plywood/veneer	453.7	0.04
Particleboard	201.1	0.04
Fibreboard	293.8	0.04
Mechanical pulp	317.1	0.09
Chemical pulp	448.6	0.09
Other fibre pulp	860.0	0.09
Waste paper	98.7	0.20
Newsprint	543.1	0.06
Printing and writing paper	886.3	0.08
Other paper and paperboard	739.6	0.08

* Prices are 1997 average world export unit values (US$) from FAOStat (Food and Agriculture Organisation of the United Nations 2000).

† Freight factors are expressed as a percentage of export (f.o.b. value). Refer to Turner & Buongiorno (2001) for derivation of these freight factors.

Two sets of demand and supply prices were used — export and import prices — instead of a unique price as used by Zhu *et al.* (2001). The commodity price in a country in 1997 depended on whether the country was a net importer or exporter of that commodity. The prices of net exported commodities were equal to the average world unit value of exports

(Table 5). The prices for net imported commodities were calculated from these export prices, the freight factors* (Table 5) (from Turner & Buongiorno 2001), and tariff rates (Tables 1 and 2) by:

$$P^{I}_{ik} = P^{X}_{k}(1 + t_{ik} + FF_k) \quad (2)$$

where: P^{X}_{k} is the export price for commodity k;

P^{I}_{ik} is the import price for commodity k, in country i;

FF_k is the freight factor of commodity k;

t_{ik} is the *ad valorem* import tariff;

Transport costs, for each country and commodity, were calculated as:

$$T_k = P^{X}_{k} FF_k \quad (3)$$

In the Global Forest Products Model, products for which supply is represented by input-output coefficients have an associated manufacturing cost. These manufacturing costs depend on the input-output coefficients and the prices of input and output commodities (Zhu *et al*. 2001). Input and output prices were set equal to the import price if the country was a net importer of that input or output, or to the export price otherwise, and manufacturing cost was calculated as:

$$C_k = P_k - \sum_i P_i \alpha_i \quad (4)$$

where: C_k is the manufacturing cost per unit;

P_k is the import or export price of the manufactured good, k;

P_i is the import or export price of the i^{th} input good; and,

α_i is the i^{th} input-output coefficient (the amount of input-good i to produce one unit of output k).

New Zealand assumptions

Specific assumptions were made regarding New Zealand chemical and mechanical pulp capacity (Table 6), and waste paper recovery and utilisation rates. Growth in New Zealand's chemical and mechanical pulp capacity was constrained, to reflect the limited potential for development of new pulp mills. The areas of plantation forest in New Zealand are dispersed across regions, and no single region has a sufficient area of plantation forest to support a new pulp mill. In addition, newly built wood-based panel plants further reduce the fibre resource available for pulp production (Brown 1997). It is anticipated that growth in pulp capacity will be due to capacity expansion in existing mills, but not to the construction of new mills.

TABLE 6–Assumed New Zealand capacity for production of pulp.

	Capacity (000 tonne per year)			
	1997–2003	2004–2008	2009–2014	2015
Mechanical pulp	852	852	852	852
Chemical pulp	748	786	825	866

* Freight factor is the freight rate expressed as a proportion of the free on board (f.o.b.) value of exports.

Growth in New Zealand's waste paper recovery rate was constrained to reflect the poor economics of waste paper recovery in New Zealand because of the country's small and dispersed population (Brown 1997). It was assumed there would be a 0.7% per annum increase in the amount of paper and paperboard recovered as waste paper. Under this assumption New Zealand waste paper recovery would grow from 22% of paper and paperboard consumption in 1997 to 34% in 2015. Of the countries represented in the Global Forest Products Model, 84% have higher waste paper recovery rates than New Zealand. It was also assumed there would be no change in the proportion of recovered paper utilised in New Zealand production of paper and paperboard.

Projections with Trade Policy Scenarios to 2015

Using the Global Forest Products Model, four trade policy scenarios were modelled, each under three New Zealand roundwood supply scenarios, for a total of twelve scenarios. The trade policy scenarios represent the regional trade agreements of interest, P5, or AFTA-CER, and tariff liberalisation under GATT 1994. The effects of these agreements on New Zealand forest product production, consumption, and trade were computed by comparison with a base scenario that kept tariffs at 1997 levels. This base scenario included zero tariffs on products traded between New Zealand and Australia under CER.

Three separate assumptions were made regarding the rate of shift of New Zealand roundwood supply (Table 7). Analysing the effect of the trade agreements under different roundwood supply scenarios provided an indication of the robustness of the study's results to underlying assumptions. The base-supply scenario is that described in Table 3. The low-supply scenario represented assumed shifts in New Zealand roundwood supply such as might occur if Article 3.4 of the Kyoto Protocol is ratified allowing the use of plantation forests as carbon sinks, thus providing a financial incentive to not harvest. The high-supply scenario estimates were based on the predicted average annual change in New Zealand roundwood availability from the National Exotic Forest Description base-cut scenario* (Ministry of Agriculture and Forestry 2001). Industrial roundwood supply shift rates for all other countries were kept the same in all scenarios.

TABLE 7–New Zealand roundwood supply shift rate, 1997–2015 (% per year).

Scenario	1997–2010	2011–2015
Base supply	2.64	2.11
Low supply	1.00	1.00
High supply	5.44	0.47

RESULTS AND DISCUSSION

The demand projected by the Global Forest Products Model for New Zealand industrial roundwood to 2015, under all three roundwood supply scenarios, was less than the potential supply suggested by the National Exotic Forest Description (Ministry of Agriculture and

* This scenario assumes a continuation of historical planting rates and average age of harvested material.

Forestry 2001) (Table 8). The National Exotic Forest Description projections are based on age-class structure and assumptions regarding average age of harvest and planting rate. The Global Forest Products Model supply projections add economic considerations. Harvest is determined not only by potential supply, but also by market demand and the resulting equilibrium price.

TABLE 8–Potential supply (NEFD)*, and projected demand from the Global Forest Products Model, for New Zealand industrial roundwood harvest, 2000–2015 (000 m^3).

Year	Potential supply	Projected demand†		
		Low supply	Base supply	High supply
2000	18 383	16 608	16 963	17 402
2001	19 870	16 890	17 669	18 165
2002	25 223	17 461	18 136	19 051
2003	28 615	18 180	18 901	19 917
2004	28 817	18 923	19 694	20 855
2005	28 767	19 113	20 214	21 946
2006	30 096	19 304	20 748	23 171
2007	30 662	20 109	21 521	24 265
2008	30 937	20 807	22 374	25 501
2009	31 193	21 015	23 252	26 832
2010	31 241	21 225	23 745	28 349
2011	31 131	21 612	24 898	29 707
2012	30 905	21 830	26 021	31 335
2013	30 759	22 048	27 289	33 072
2014	30 672	22 375	28 091	34 840
2015	31 420	22 599	28 687	36 973

* NEFD = National Exotic Forest Description base cut (Ministry of Agriculture & Forestry 2001).

† Base trade scenario

The effects by the year 2015 of the trade agreements on New Zealand forest product production, consumption, and trade for the base-supply scenario are shown in Table 9. All three trade agreements, compared with no trade liberalisation, led to an increase in the production of paper products. The AFTA-CER and GATT 1994 trade agreements also resulted in increased wood-based panel production. Production of industrial roundwood and waste paper was lower under the P5 and AFTA-CER agreements, while production of these commodities under GATT 1994 was unchanged or increased. The percentage change in production of most forest products was greatest under GATT 1994.

The change in the product mix under trade liberalisation was reflected in the composition of New Zealand exports (Table 9). New Zealand exports of more-processed commodities (particleboard, mechanical pulp, newsprint, and printing and writing paper) increased, while exports of primary commodities (industrial roundwood and waste paper) were lower under all three trade agreements. GATT 1994 resulted in an increase in exports of all wood-based panels and sawnwood, and also resulted in the largest change in New Zealand forest product exports compared with the other trade agreements. The impact of the trade agreements on exports was larger than on production.

TABLE 9–Percentage difference, relative to base trade scenario of no tariff removals, in New Zealand forest product production, consumption, and exports in 2015, as projected by the Global Forest Products Model for the base roundwood-supply scenario.

Commodity	Production			Consumption			Exports		
	P5	AFTA-CER	GATT 1994	P5	AFTA-CER	GATT 1994	P5	AFTA-CER	GATT 1994
Industrial roundwood	–2.2	–4.2	0.5	–1.5	–0.1	4.5	–2.9	–8.4	–3.6
Sawnwood	–2.4	–1.1	1.3	0.0	0.0	0.0	–4.2	–2.0	2.3
Plywood/veneer	–1.8	–2.1	14.4	0.0	0.0	–0.1	–4.2	–5.0	34.2
Particleboard	0.0	4.2	26.7	–5.6	–5.6	–5.9	8.8	19.7	77.7
Fibreboard	–1.7	5.1	29.9	1.0	–4.1	–4.0	–2.9	9.4	45.8
Mechanical pulp	0.0	0.0	0.0	–6.1	–3.1	0.2	8.2	4.3	–0.3
Chemical pulp	0.0	0.0	–2.1	–2.2	0.4	4.6	2.2	–1.2	–12.1
Waste paper	–13.6	–11.4	5.6	159.6	167.8	176.8	–52.3	–52.4	–60.1
Newsprint	15.9	22.1	30.8	5.0	5.0	0.0	47.8	55.3	66.8
Printing & writing paper	30.0	8.8	61.9	4.5	–0.7	–8.6	16.7	16.7	3.3
Other paper and paperboard	2.5	6.1	9.0	–0.4	7.7	0.6	13.2	–17.6	32.2

The lesser effect of the AFTA-CER and P5 regional trade agreements on New Zealand forest sector production, relative to those of the GATT 1994, may arise for several reasons. Firstly, the AFTA-CER and P5 agreements do not include important New Zealand forest product markets such as Japan and the Republic of Korea, and important emerging markets such as India and the People's Republic of China. Additionally, forest product exports from a number of ASEAN member countries and Chile directly compete with New Zealand exports to these markets. Finally, the small effect of the P5 regional trade agreements is a reflection of the already low tariffs on forest products in the P5 countries (Table 1).

All three trade agreements resulted in an increase in waste paper consumption and a decrease in particleboard consumption. The higher newsprint and printing and paper production (Table 9) caused the higher fibre consumption that was predominantly waste paper due to the constraint on expansion of New Zealand wood pulp capacity. Generally, however, the three trade agreements had very different impacts on the pattern of New Zealand's forest product consumption.

Of particular interest, given New Zealand's wish to increase the value added to the country's roundwood harvest, is the impact of trade liberalisation on industrial roundwood consumption and product mix. According to the projections, the P5 and AFTA-CER trade agreements had a minor negative effect on New Zealand's roundwood consumption. The GATT 1994 agreement, however, resulted in a moderate increase in New Zealand roundwood consumption, reflecting increased domestic demand for roundwood to produce and export wood-based panels.

Comparisons of estimates of trade liberalisation impacts for the different roundwood supply scenarios (Tables 9, 10, and 11) show that consumption impacts are sensitive to changes in roundwood supply assumptions. The only clear results for all three roundwood supply scenarios were that waste paper consumption increases. Under the high-supply scenario the GATT 1994 agreement had little impact on New Zealand roundwood consumption, reflecting the more moderate change in wood-based panel production under this supply scenario.

Production and export impacts are generally robust to changes in roundwood supply assumptions. The percentage changes in production and exports due to GATT 1994 under the high roundwood-supply scenario were smaller than those under the base-supply scenario. Under the low-supply scenario, though, there was also an increase in sawnwood and plywood/ veneer production and exports for all trade agreements. As the low roundwood-supply scenario is only likely under severe curtailing of the New Zealand roundwood supply, the general results regarding the impacts of trade liberalisation on production and exports can be considered reliable.

According to the results, New Zealand would have a comparative advantage in newsprint under AFTA-CER and P5, and in wood-based panels and paper and paperboard under the GATT 1994. The manufacturing cost data for each country used in the Global Forest Products Model show New Zealand to have relatively low manufacturing costs for wood-based panels and paper and paperboard compared with other countries in the AFTA-CER and P5 agreements (Table 12). The manufacturing cost of sawnwood in New Zealand, on the other hand, was high compared with Chile, Indonesia, Malaysia, and Thailand (Table 12). Manufacturing costs in the Global Forest Products Model were calculated assuming a

TABLE 10–Percentage difference, relative to base trade scenario of no tariff removals, in New Zealand forest product production, consumption, and exports in 2015, as projected by the Global Forest Products Model for the high roundwood-supply scenario.

Commodity	Production			Consumption			Exports		
	P5	AFTA-CER	GATT 1994	P5	AFTA-CER	GATT 1994	P5	AFTA-CER	GATT 1994
Industrial roundwood	0.6	–0.5	0.5	1.3	–0.9	1.4	0.0	–0.2	–0.2
Sawnwood	1.9	–1.9	0.1	5.1	–5.3	–0.9	0.0	0.2	0.7
Plywood/veneer	0.9	–6.7	0.3	0.0	0.0	–0.9	1.7	–12.7	1.4
Particleboard	2.2	1.1	5.7	3.2	–0.9	–5.1	1.5	2.6	13.6
Fibreboard	1.1	4.8	9.1	–1.9	8.4	1.0	1.8	4.0	10.9
Mechanical pulp	0.0	0.0	0.0	–10.2	–7.9	–5.1	15.3	11.8	7.6
Chemical pulp	0.0	–0.8	0.0	–4.9	–1.0	1.2	7.0	–0.6	–2.3
Waste paper	–11.9	–8.6	4.1	147.4	154.9	162.1	–52.2	–55.9	–60.5
Newsprint	6.9	6.7	15.0	–1.2	–5.9	–8.9	24.6	29.9	38.3
Printing & writing paper	53.9	50.6	49.4	–1.5	–9.9	–8.2	0.0	–9.4	3.1
Other paper and paperboard	1.8	10.0	10.9	–2.3	–1.7	2.5	8.0	3.3	23.1

TABLE 11–Percentage difference, relative to base trade scenario of no tariff removals, in New Zealand forest product production, consumption and exports in 2015, as projected by the Global Forest Products Model for the low roundwood-supply scenario.

Commodity	Production			Consumption			Exports		
	P5	AFTA-CER	GATT 1994	P5	AFTA-CER	GATT 1994	P5	AFTA-CER	GATT 1994
Industrial roundwood	4.1	–2.4	–6.9	1.0	2.1	8.4	9.5	–10.0	–32.8
Sawnwood	3.4	3.9	10.0	0.0	0.0	0.0	6.3	7.2	18.5
Plywood/veneer	5.5	0.2	16.6	–0.5	0.2	–0.5	14.0	0.2	41.1
Particleboard	1.2	6.7	27.2	3.0	7.5	–1.6	–0.7	5.8	64.6
Fibreboard	–11.1	–2.0	15.1	–5.3	0.0	0.0	–13.5	–2.7	21.2
Mechanical pulp	0.0	0.0	0.0	–12.6	–11.2	–9.0	19.9	17.6	14.2
Chemical pulp	0.0	0.0	0.0	–8.2	–8.7	–4.3	13.2	13.3	7.1
Waste paper	9.1	10.0	8.1	141.6	145.1	151.6	–49.7	–50.0	–55.5
Newsprint	12.7	19.7	17.0	4.9	3.7	3.9	20.2	34.9	29.5
Printing & writing paper	88.7	4.8	111.3	–4.5	–1.0	–9.0	3.4	20.7	20.7
Other paper and paperboard	–4.1	–5.1	–0.2	0.9	–2.4	1.0	–18.5	–17.8	1.7

TABLE 12–Manufacturing costs* ($/m^3 or $/t) in the Global Forest Products Model for selected commodities and countries.

Country	Manufactured commodity					
	Sawnwood	Plywood/ veneer	Particleboard	Newsprint	Printing & writing paper	Other paper & paperboard
New Zealand	105	336	92	186	634	372
Australia	128	290	52	335	694	413
United States	115	377	102	237	630	431
Chile	78	308	63	195	682	558
Indonesia	78	277	63	216	516	476
Malaysia	71	308	63	371	825	732
Thailand	90	391	37	324	565	455

* Excluding wood or wood pulp input.

competitive equilibrium, i.e., the cost of all inputs, excluding raw materials, was equal to the unit value of the output minus the cost of raw materials (Equation 4) (Zhu *et al*. 2001).

This result differs from a number of New Zealand Ministry of Agriculture and Forestry† regional and investment studies (e.g., Ministry of Forestry 1995), which suggest that New Zealand could increase its sawmill capacity, based on New Zealand's large inventory of pruned logs and sawlogs. This disparity between New Zealand's actual production and that predicted by the Global Forest Products Model was visible in the differences between early projections and actual outcomes.

The Global Forest Products Model used 1997 as the base year from which to start the projections. By the year 2000, the Global Forest Products Model projections (with the base supply and GATT 1994 scenario) under-estimated New Zealand's 2000 actual production of industrial roundwood, sawnwood, plywood/veneer, fibreboard, and pulp, and over-estimated production of paper and paperboard (Table 13). A possible explanation for this disparity is that the Global Forest Products Model does not distinguish between pruned logs, sawlogs, or pulp logs; thus the model does not incorporate New Zealand's relative abundance of material for producing sawnwood. Constraints to New Zealand increasing its paper and paperboard production, such as those implied by the resource consent requirements of the Resource Management Act 1991, were also not incorporated into the model.

Where the New Zealand forest sector's competitive advantage actually lies (in paper and paperboard as implied by manufacturing costs in the Global Forest Products Model, or sawnwood as implied by Ministry of Agriculture and Forestry roundwood supply projections) has several implications for the predicted long-term effects of trade liberalisation. If the description of the New Zealand forest sector in the Global Forest Products Model is erroneous, then the predicted increase in newsprint production under trade liberalisation is unlikely to occur, and more sawnwood may be produced instead. Alternatively, if the Global

† The Ministry of Agriculture and Forestry was established in 1998. Prior to that, forestry was the responsibility of the Ministry of Forestry.

TABLE 13–New Zealand forest product production in year 2000, forecast with the Global Forest Products Model*, and actual production (MAF)†.

Commodity	Units	MAF	GFPM	Difference (%)
Industrial roundwood	000 m^3	18 482	17 234	–6.8
Sawnwood	000 m^3	3 862	3 397	–12.0
Plywood/veneer	000 m^3	648	342	–48.8
Particleboard	000 m^3	212	245	15.6
Fibreboard	000 m^3	819	684	–16.5
Mechanical pulp	t	824	800	–2.9
Chemical pulp	t	781	748	–4.2
Newsprint	t	378	440	18.9
Other paper and paperboard‡	t	497	549	10.5

* Base supply and GATT Uruguay Round trade scenario.

† MAF = New Zealand Ministry of Agriculture & Forestry. Source: Ministry of Agriculture & Forestry Statistical Releases (various).

‡ Includes printing and writing paper.

Forest Products Model is correct, then the profitability of growing pruned logs and sawlogs compared to pulp logs may decrease. If this happens, plantation owners are likely to export pruned logs and sawlogs. This would have the effect of delaying some impacts of the trade agreements by 20 to 25 years as forest management practices might shift to regimes producing a higher proportion of pulp logs.

Limitations of the Study

Carrying out this study identified several limitations of the methods used to predict the effects of trade liberalisation. Firstly, the Global Forest Products Model does not incorporate the impacts of trade liberalisation on country income. If estimates of the macro-economic effects of tariff liberalisation were available, it would be possible to predict the consequences with the Global Forest Products Model. The extent to which New Zealand's GDP would change under the trade agreements studied is unclear.

The Global Forest Products Model does not distinguish between pruned logs, sawlogs, and pulp logs. These commodities are aggregated as industrial roundwood. Indeed, there is no finer disaggregation in international trade statistics, including those in FAOStat. Yet, Trømborg *et al*. (2000) demonstrated the importance of making this distinction in the Global Forest Products Model in terms of price projections. Therefore, the representation of New Zealand's comparative advantage in sawlog supply and sawnwood production could be made more realistic if finer data on the sawlog and pulpwood trade could be found.

In this application of the Global Forest Products Model, the possibility of the formation of new trading partners was not considered. Trade could change only among the countries that were already trading with New Zealand in 1997. The direction of the error thus introduced is unknown, but it is unlikely to be large given that the main trading partners were considered explicitly.

CONCLUSIONS

An important policy implication of this study is that if New Zealand wished to increase domestic use of its future roundwood harvest, supporting the tariff reduction initiative of the GATT 1994 would be of greater benefit than pursuing tariff elimination under the P5 or AFTA-CER regional trade agreements.

Due to several limitations of the methods, these findings should be viewed as provisional and subject to further research. Nevertheless, the ability to view the New Zealand forest sector in its full international context, with numerous and complex links between countries and between industries, gives the modelling approach used here undeniable value for this type of analysis.

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