Assessing the Impact of Trade Policy and Technology Changes in the U.S. Forestry Sectors

by

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Abstract

Increased trade liberalization and globalization of financial markets are influencing both the demand for and supply of forest products in the U.S. Meanwhile, more innovations are introduced into the U.S. forestry sectors to meet the growing demands for forest products. Since the U.S. is the largest producer and consumer of forest products in the world, these changes are expected to have significant implications for forestry sectors across the world. This study aims at (1) estimating the impacts of forest products trade liberalization on the U.S. forestry sectors; (2) examining the effect of technological progress in the U.S. forestry production relative to the rest of the world. A multi-regional multi-sectoral applied global general equilibrium model is employed to achieve the goal. Results of the study have implications for better production and marketing decisions as well as policy prescriptions related to sustainable forest management in the U.S.

Introduction

Influenced by various factors, the U.S. forestry sectors are experiencing great changes. In the paper, the attention is focused on the economic impacts of multi-lateral trade policies and technological progress on the U.S. forestry sectors.

According to Sizer, Downes and Kaimowitz (1999), early in 1997, members of the Asia-Pacific-Economic Cooperation (APEC) forum included forest products among eight product categories nominated for early trade liberalization. At the APEC meeting in 1998, leaders agreed to move the forest product tariff reduction proposals into the forum of the World Trade Organization (WTO). Meanwhile, at the WTO, the United States leads the effort to persuade other members to accelerate tariff reduction for forest products. For example, the U.S. has urged other members to move up the deadline for tariff elimination on pulp and paper products from the beginning of 2004 to that of year 2000. And for other forest products, the U.S. wants other members to agree to phase out tariffs by the beginning of 2002. Roger Sedjo and David Simpson (1999) also agreed that future tariff liberalization on forest products is possible and they examined the economic impacts on forestry. However, when countries like the U.S. are vigorously promoting the elimination of import tariff among members of WTO, their proposals have faced significant oppositions from some major trade partners, including Japan and the European Union, which makes elimination of the import tariff infeasible in the near future. So, in the paper, a worldwide 33% tariff reduction on forest products is introduced following the Uruguay Round's tariff reduction scheme.

Another interesting issue in trade policy is the expiration of the five-year-old U.S.-Canada Softwood Lumber Agreement. The pact, which expires on March 31 2001, restricts US lumber imports from British Columbia, Alberta, Ontario, and Quebec to 14.7 million board feet a year without penalty. Additional amounts are subject to tariffs. An unusual coalition of U.S. timber companies and environmental groups is pressuring the Bush administration to negotiate a new agreement to offset the price of cheap lumber imports. While the U.S. and Canada seek to remove barrier to forest products in other markets, they have maintained a side deal keeping trade restrictions in place between themselves. So, at this point, by introducing a hypothetical 1% increase in the U.S. import tax on Canadian wood products, we explored the implications for the U.S. in the face of an increase in import tariff on Canada's softwood lumber when the agreement expires.

As for the technology side, historically, the United States' comparative advantage in industrial timber production was based on the vast coverage of lands with old growth forests. However, much of the old growth forest is now either harvested or preserved in the form of protected areas. Therefore, the U.S can no longer rely on its natural forests to exploit its comparative advantages in industrial wood production. According to Sedjo (1997), in response, the United States is moving through a transition from reliance on

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naturally generated forests to increased reliance on plantation forests. In addition, in the recent decades, wood fiber from natural forests has become even more inaccessible, since the remaining unlogged forests are increasingly being set-aside due to the desire to increase the area of protected forests in the form of national parks and wildland reserves. This change should simultaneously increase the attractiveness of several yield-increasing activities, including forest management, industrial forest plantations, and genetic improvements that increase tree growth, yields, and desirable tree and fiber characteristics. Currently, there are even more innovations in forestry involving biotechnology, including the development of clonal propagation and the use of modern molecular biology techniques. As these technologies find their applications in all forestry sectors and will increase the outputs substantially, it is quite intriguing to address their potential impact on future markets for timber and wood products. According to the growth of yield per acre in the U.S. forestry sectors (Census Bureau, 2000), a 2% technological progress is introduced to all the forestry sectors in our experiment.

The paper is organized as follows. A brief description of the Global Trade Analysis Project (GTAP) model is given in the next section. Data specification and simulations are presented in the third section. Simulation results are provided and discussed in the fourth section. A brief summary concludes the paper.

Method

The standard GTAP model, a multi-regional and multi-sectoral Computable General Equilibrium (CGE) model, is chosen for this study. Many researchers have used CGE models to analyze regional or international forestry issues: (1) environmental concerns (Pohjola, 1999), (2) wood-using industry (Lin (1996), Bruce (1988)), (3) regional policy (Wiebelt, 1994), (4) economic development (Marcouiller and Stier, 2000), (5) taxation (Boyd and Newman, 1991). However, it appears that the impacts of changes in the U.S. forestry sectors have not drawn much attention, though the U.S. is both the world's largest producer and consumer of forest products.

The GTAP model is a highly non-linear model with detailed sectoral and regional linkages through international trade, primary and intermediate input markets. It focuses on the real side of the economy, with particular emphasis on the response of the economy to trade policy and technological changes.

The behavioral assumptions of the model involve cost minimization by producers and utility maximization by households, and the assumption that there is sufficient competition for unit profits to be driven to zero. One crucial assumption is that economic agents respond to marginal market prices for input and outputs, rather than to official prices (Martin, 1993).

Although agents are assumed to respond in a manner consistent with neoclassical theory to the market prices that they experience, these market prices are affected by distortion, such as overvaluation of the official exchange rate, the foreign exchange retention system, and import tariffs and licensing, all of which can be included in the model.

To facilitate solution by Johansen's method, the model was linearized in percentage changes. Following Armington (1969), domestic and imported products are treated as imperfect substitutes. A standard simplifying feature of CGE models adopted in our model is a two-level representation of technology in which intermediate inputs and a composite primary factor input are demanded in fixed proportion to output. Changes in output levels thus require changes in the composite primary factor input levels that, in the presence of any fixed factor, require substitution between factors. Following standard practice in this type of model, this substitution is represented using constant elasticity of substitution (CES).

For many goods, there are marked differences between the product produced for the export market and that produced for the domestic market: both in the product's physical characteristics and in its less tangible marketing requirements. To capture these differences, it is assumed that products sold on the domestic market are differentiated from those sold on the export market. These differences are represented using a constant elasticity of transformation (CET) functional form.

Our model is short-run, with capital assumed to be fixed in each sector. As is common in short-run models, investment does not add to the effective capital stock. The underlying time period is assumed to be sufficiently long for new equipment and machinery to be produced but not brought into line for production.

Data Specification and Simulations

The database used for this study is an aggregated version of the database released by GTAP (1995). The original 45 regions and 50 commodities were aggregated into 5 regions and 7 sectors. The 5 regions are the U.S. (USA), Canada (CAN), Japan (JPN), the European Union (EU) and the Rest of the World (ROW). Each region consists of 7 sectors: Agriculture, Logging, Wood product (Wood), Pulp and Paper (P&P), Other Resources (OthRes), Manufacturing (Mnfcs) and Services (Svces).

We conducted three experiments in our model. These are: Simulation (1) A decrease in the import tariff on forest products in all regions by 33%; Simulation (2) An increase in the U.S. import tariff on

Canadian wood products by 1%; and Simulation (3) A 2% technological progress in the U.S. logging, wood product and pulp and paper sectors. Simulation results are documented in the following section.

Simulation Results

To understand the simulation results better, some selective characteristics of the U.S. forestry sectors are presented first based on the base period data in 1995.

With a large home market, the U.S. only exports a small portion of its production (6.98%, 5.94% and 6.64%, respectively, see second row of table1). Nevertheless, the region accounts for a relatively larger percentage of world trade (23.01%, 8.51% and 13.38% respectively, see third row of table1), thus the production in the U.S. has a large impact on world market prices for forest products. In addition, except for the wood product sector, the U.S. is comparatively independent of the production outside the U.S (see fourth row in table1). And the general equilibrium demands for forestry products are inelastic (last row of table1).

Table1 Economic Characteristics of the U.S. Forestry Sectors

	Logging	Wood	P&P
Export/Production (%)	6.98	5.94	6.64
World Trade Share (%)	23.01	8.51	13.38
Import/Domestic Use (%)	0.46	13.97	6.43
Price Demand Elasticity	-0.50	-0.85	-0.59

Source: Calculated from GTAP Database (1995).

Simulation1: impact of a 33% decrease in import tariff on forest products in all regions

Table2 Changes in Price and Output of a 33% Decrease in Import Tariff on Forest Products in All Regions

	Price (% change)					Output (% change)				
	USA	CAN	JPN	EU	ROW	USA	CAN	JPN	EU	ROW
Logging	0.001	-0.029	-0.025	0.033	-0.031	0.019	-0.027	-0.022	0.089	-0.099
Wood	-0.018	-0.033	-0.021	-0.03	-0.207	-0.027	-0.223	-0.039	0.152	-0.145
P&P	-0.018	-0.02	-0.025	-0.03	-0.269	0.025	0.039	0.073	0.033	-0.131

As presented in Table2, in the U.S. logging sector, the price and the output increase by 0.001% and 0.019%, respectively. The U.S. exports $2,432 million timber products to the world, accounting for 23.1% of the world's timber trade, while its import is only $142 million (from GTAP database 1995). Thus, this tariff reduction puts the U.S. in a favorable position in export competition with an increasing demand for the U.S. timber products, which pushes up the price and the output. In the wood product sector, the price decreases as a result of the overall tariff reduction, leading to a decreasing output. As for the pulp and paper sector, a falling price and a growing output have been found. Though both the prices in wood product and pulp and paper sector decrease, the output of wood product sector decreases while that of the pulp and paper sector increases. The logic behind is as follows: The falling prices in both cases are leading to increasing domestic demands. On the one hand, the U.S. mainly depends on domestic production to meet the growing demands for pulp and paper products. While on the other hand, the U. S. imports foreign productions to meet the growing demand for wood products (see fourth row in Table1).

Table3 indicates exports in all forestry sectors in all regions grow as a result of increasing demand incurred by lower international prices, except for the wood product sector in Canada. The total volume of global exports in logging, wood product and pulp and paper sectors increase by $91.86 million, $2387.7 million and $2077.5 million, respectively. However, performance of Canada's wood product sector can be explained as follows. According to GTAP database 1995, no import tax is levied on Canadian wood products by the U.S. Thus, the worldwide import tax reduction has little impact on the trade volume of wood products between the U.S. and Canada, though a large portion of Canada's wood product export aims at the U.S. (74.34% of its total export). On the other hand, the tariff reduction lowers prices for wood products in other regions, whereas increasing Canada's relative price for wood products. Thus, the relative price moves in favor of other regions against Canada, causing fall in Canadian export to the U.S. as well as other markets.

Some selected results for important macro variables are reported in Table4. Trade balance of the U.S., Canada, Japan and the European Union increases by $220.837 million, $11.609 million, $247.748 million and $231.207 million, respectively, while that of Rest of the World decreases by $711.403 million. Compared with Rest of the World, the other four countries are more efficient in producing forest products, having lower prices for similar products. With the tariff reduction, they face a substantial increase in demand for forest products in the world market, squeezing out exports from Rest of the World.

Table3 Changes in Export of a 33% Decrease in Import Tariff on Forest Products in All Regions (% change)

	USA	CAN	JPN	EU	ROW
Agriculture	0.031	0.037	0.053	0.011	-0.024
Logging	0.299	4.979	1.587	0.708	0.994
Wood	1.231	-0.233	10.841	1.275	4.462
P & P	0.515	0.101	4.766	0.347	5.491
OthRes	0.026	0.012	0.043	0.009	-0.006
Mnfcs	0.013	0.019	0.022	-0.013	0.005
Svces	0.029	0.048	0.042	0.01	0.011

As far as real GDP and welfare are concerned, Canada and Japan lose from the tariff reduction due to worsened terms of trade. Because of lower international prices, there are increasing demands for forest products imports in both countries, while their exports of forest products do not change so much, adding the pressure to export more other products (rather than forest products) to pay for the increasing demands for forest products. With supply prices falling relative to other regions in the world, terms of trade of Canada and Japan deteriorate.

Table4 Selective Macroeconomic Impacts of Simulation1

	DTBAL	QGDP	WELFARE
USA	220.837	3	4.978
CAN	11.609	-0.313	-7.166
JPN	247.748	-3	-9.751
EU	231.207	15.5	79.447
ROW	-711.403	435	383.326

Note: (1) DTBAL: Trade Balance (2) QGDP: Real GDP
(3) Figures are in $US million

Table5 Changes in Price and Output of a 1% Increase in U.S. Import Tariff on Canadian Wood Products

	Price (% change)					Output (% change)				
	USA	CAN	JPN	EU	ROW	USA	CAN	JPN	EU	ROW
Logging	0.02	-0.373	0.001	0.003	0.007	0.031	-0.664	0.003	0.005	0.014
Wood	0.017	-0.124	0	0	0.002	0.13	-1.303	-0.002	0.015	0.066
P & P	0.002	-0.065	-0.001	0	0.001	-0.008	0.098	-0.001	-0.003	-0.004

Simulation2: impact of a 1% increase in U.S. import tariff on Canadian wood products

According to the 1997 GTAP model database, the U.S. imports $10,384 million wood products from Canada, accounting for 52% of US's total wood product import and 7.26% of U.S's domestic use that year. So, not surprisingly, with this 1% increase in U.S. import tariff on Canadian wood products, domestic price for wood products in the U.S. increases by 0.017% (see column2, Table5). The domestic prices for timber and pulp and paper products also increase by 0.02% and 0.002%, respectively, for all of the three sectors are linked to each other through primary and intermediate markets. Higher prices in both the logging and wood product sectors lead to increasing outputs in the two sectors, while the output in pulp and paper sector declines by 0.008% though the domestic price for pulp and paper products increases by 0.002% (see column 2, Table5). This result can be explained by change of relative prices. When the U.S. price for pulp and paper products increases, the price in Canada decreases dramatically. Thus, the U.S. has a higher relative price for pulp and paper products than before. So, it imports more products from Canada to meet its domestic demand, leading to a decreasing output in the pulp and paper sector.

Table6 Changes in Export of a 1% Increase in U.S. Import Tariff on Canadian Wood Products (% change)

	USA	CAN	JPN	EU	ROW
Agriculture	-0.006	0.101	0	-0.001	-0.003
Logging	-0.349	1.559	0.021	0.008	0.003
Wood	-0.238	-2.359	0.436	0.07	0.251
P & P	-0.031	0.166	-0.017	-0.011	-0.018
OthRes	0.016	-0.011	0.001	0	0
Mnfcs	-0.013	0.18	0	-0.001	-0.006

Svces	-0.016	0.163	-0.001	-0.001	-0.004

Due to higher relative prices, exports in all of the three forestry sectors in the U.S. are falling (see column2, Table6). As reported in GTAP database, 74.346% of Canada's wood product export goes to the U.S., which explains why Canada's export of wood product decreases by 2.539% with the import tax increase.

Table7 Selective Macroeconomic Impacts of Simulation2

	DTBAL	QGDP	WELFARE
USA	18.394	0	75.259
CAN	-13.821	-10.75	-87.553
JPN	0.527	0.5	-2.048
EU	2.126	0	-2.439
ROW	-7.226	-1	5.798

Note: Figures are in $US million

Table7 summarizes the macroeconomic impacts of increasing U.S. import tax on Canada's wood products by 1%. Both the trade balance and welfare improve in the U.S, as a result of its improved terms of trade. On the contrary, Canada's deterioration in trade balance, real GDP and welfare can be explained by its worsened terms of trade. As mentioned earlier, due to higher domestic prices, except the other resources sector, export volume in other sectors in the U.S. decreases by 0.006%, 0.349%, 0.238%, 0.031%, 0.013% and 0.016% respectively. Therefore, the U.S. supply price rises relative to other regions, resulting in a better terms of trade (increasing by 0.009%). As for Canada, with falling domestic prices for all products, export in all sectors grows except that in the wood product and other resources sector (see column3, Table6). Thus, its supply prices decrease relative to other regions, leading to the deterioration of its terms of trade.

Simulation3: impact of a 2% technological progress in the U.S. forestry sectors.

Table8 Changes in Price and Output of a 2% Technological Progress in the U.S. Forestry Sectors

	Price (% change)					Output (% change)				
	USA	CAN	JPN	EU	ROW	USA	CAN	JPN	EU	ROW
Logging	-3.64	-1.022	-0.536	-0.17	-0.236	0.445	-1.758	-0.774	-0.256	-0.416
Wood	-2.538	-0.498	-0.188	-0.08	-0.102	1.948	-1.943	-0.108	-0.28	-0.61
P & P	-2.443	-0.325	-0.094	-0.09	-0.107	1.013	-1.411	-0.069	-0.242	-0.298

As shown in Table8, in the U.S., domestic prices for forest products decrease by 3.64%, 2.538% and 2.443%, respectively, while the outputs increase by 0.445%, 1.948% and 1.013%, respectively. And if the output changes are converted into dollar terms, the outputs increase by $158 million, $2,790 million and $ 3,021 million, respectively. In addition, it can be found that changes of the prices are much bigger than those of the outputs caused by the above-mentioned inelastic demands.

Table 9 reports the changes in export. Exports of all of the three forestry sectors in the U.S. grow by 12.682%, 11.07% and 6.586%, i.e., $313 million, $952 million and $1,316 million, respectively, which can be attributed to lower domestic prices brought by the technological innovations. However, the production expansion in forestry pushes up the prices for production factors, such as labor and capital, leading to higher prices for other products in the U.S., with higher relative prices, exports of other sectors rather than forestry sectors fall by 0.342%, 0.068%, 0.612% and 0.508%, respectively (see column2, table9).

Table9 Changes in Export of a 2% Technological Progress in the U.S. Forestry Sectors (% change)

	USA	CAN	JPN	EU	ROW
Agriculture	-0.342	0.333	0.07	0.054	0.061
Logging	12.682	-4.356	0.315	-1.025	-2.468
Wood Products	11.07	-2.599	-2.259	-0.962	-1.893
P&P	6.586	-2.335	-1.547	-0.799	-1.181
OthRes	-0.068	-0.058	0.128	0.043	0.027
Mnfcs	-0.612	0.713	0.135	0.077	0.116
Svces	-0.508	0.625	0.084	0.089	0.081

As we've discussed in the previous paragraph, except for the forestry sectors, exports of all the other sectors in the U.S. decrease, resulting in a decreasing trade balance of $2,471 million (see Table10). However, the U.S. also benefits from the technological progress substantially, with improvement in real GDP and welfare. The growing welfare in the U.S. originates from three aspects,

technology, allocative efficiency of existing resources and improvement in terms of trade, among which technology contributes the largest portion to the positive welfare change ($9,366.041 million, accounting for 92.586% of the total). Besides the U.S, Japan also experiences growth in welfare. Being the third largest importer of forest products in the world, Japan doesn't have to pay so much for forest product imports from the U.S. as it used to, resulting in an improved terms of trade. And this better terms of trade leads to the improvement of Japan's welfare.

Table10 Selective Macroeconomic Impacts of Simulation3

	DTBAL	QGDP	WELFARE
USA	-2471	9737	10116
CAN	27.36	-21.7	-197
JPN	530.8	-17	24.8
EU	986.7	-34	-229
ROW	925.7	-8	-58.2

Note: Figures are in $US million.

Conclusions

The U.S. benefits from the worldwide import tariff reduction on forest products to a small extent, with a $3 million increase in real GDP and a $4.978 million increase in welfare. In addition, this tax reduction has a small impact on global trade volume, with almost unchanged trade volume for agriculture, other resources, manufacturing and services. Even for forest products, the trade volume only increases by 0.86%, 2.36% and 1.39%, respectively.

Increasing import tariffs on Canadian wood products benefits the U.S. forestry sectors. Though having higher domestic prices for forest products, the U.S. improves its terms of trade (increases by 0.009%), which explains the improvement in its trade balance and welfare.

Technological progress is beneficial to the U.S. forestry sectors. Due to technological progress, outputs of the forestry sectors grow substantially, leading to lower prices for both domestic and international consumers Meanwhile, both increases in the real GDP and welfare in the U.S. can also be attributed to the technological innovations.

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