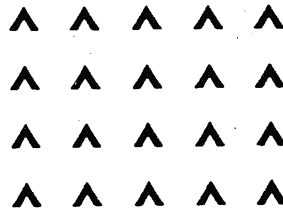# C I N T R A F O R

Working Paper

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An Assessment of the Impacts of Recent Environmental and Trade Restrictions on Timber Harvest and Exports

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WORKING PAPER 33

AN ASSESSMENT OF THE IMPACTS OF RECENT ENVIRONMENTAL AND TRADE RESTRICTIONS ON TIMBER HARVEST AND EXPORTS

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SUMMARY

The Pacific Northwest has traditionally been a strong participant in international forest products markets in the Pacific Rim. The combination of a substantial resource base, processing capabilities to manufacture high quality timber products and export facilities have contributed to a comparative advantage in the export of wood and wood products. The region has been able to maintain its comparative advantage, and hence its market share in the Pacific Rim at a time when other US regions, notably the South, have successfully increased domestic market share.

Recent environmental legislation has reduced the timber resource base substantially and will impact the management of additional areas. A 44 percent decline in timber sales volume in 1989 will result in an annual 9.7 million cubic meters (2.0 billion board feet) reduction by 1995 in public timber harvest. As a consequence, public timber revenues will decline and there will be higher relative sawlog cost to both domestic and foreign purchasers of timber produced in the region. The 75 percent log export restriction by the state of Washington will lower these costs for domestic mills but increase them further for foreign purchasers. The reduced timber harvest and trade restriction will also diminish the export value of logs and finished products originating from the region. Hence, the region's comparative advantage and market share will decline as other regions will become more competitive with the Pacific Northwest in forest products trade.

Specific measures of these impacts associated with a 2 billion board feet reduction in public timber harvests are:
1) The decline in timber sales volume from public lands reduces public timber receipts by $176 million (in 1988 dollars) in 1995 and reaches $188 million in 2000. The total revenue decline for the public sector amounts to $1.9 billion dollars for the 11 year period (1989-2000).
2) The reduction in timber sales volume from public lands in the PNW region leads to increased log production from overseas producers. Other producers offset nearly 90 percent

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of the timber reduction in the public sector. Over half of the harvest reduction is made up overseas in only two years. The private sector in the PNW region is unable to effectively increase the share of the log market. Harvests from the private sector in the region begin to decline in 1993. By 2000 timber harvest from the private sector in the PNW is only ten percent of the contribution by other regions.

3) The impact on sawlog costs for the sawnwood and plywood sectors is substantial. A 9.7 million cubic meter reduction in public timber harvest will increase annual log costs by $1 billion in 1995 and 2000 on a global basis. Log costs in 1995 in the PNW region will increase $211 million compared to $63 million for the South and $34 million for Canada. A similar pattern is observed in 2000. In Japan, the impact of reduced timber supply increases log cost by $131 million in 1995 and $90 million in 2000. Log cost impacts in 2000 are lower as Japan adjusts to the decrease in public timber harvests. The price increase for sawlog will allow marginal softwood log producers to harvest more logs. The substitution of hardwood logs for softwoods can also be expected in regions where technological and economic constraints are not binding.

4) The impacts on profits for sawmills and plywood mills are also substantial and regionally distributed. Profits in the US West decline in 1995 by $79 million. There are only modest gains in profits in the South; $7.4 million. In 1995, Canada increases its profit in the sawmill industry by $84 million. The decline in profits in 2000 for the US West is $60 million, while the South's profit increase by $1.3 million. Canada, by 2000 increases its profits in the sawmill industry by $90 million. Japan's sawmill industry sees a decline in profits of $77 million in 1995 and $32 million in 2000.

5) In the export markets, the value of US log exports declines by $152 million in 1995 and $166 million in 2000. Globally, the value of log exports decreases by $75 and $83 million in 1995 and 2000 respectively. Nearly one quarter of the decline in US log export value is recovered by Chile and New Zealand during this period. In the sawnwood markets, the

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decline in value of coniferous sawnwood is matched by an increase in export value from Canada. The value of sawnwood exports by US West is reduced $135 million and $246 million in 1995 and 2000, respectively. Canada increases its export value of sawnwood by $152 and $205 million in 1995 and 2000 respectively. In the plywood sector, the US West experiences a decline in export value of $45 million in 1995 and 2000, while the US South increases its export value by $57 and $58 million in 1995 and 2000 respectively.

6) The diminished supply of timber in the region will reduce lumber and plywood production globally and increase the prices of finished product. Globally the cost to consumers in increased lumber and plywood prices is $849 million in 1995 and $904 million in 2000. For the US, the consumer costs are $161 million in 1995 and $198 million in 2000. The price increase for lumber and plywood will promote greater non-wood substitution as end users will prefer new technologies that incorporate less wood inputs on the basis of factor cost.

While policies that promote the conservation of forest resources for non-timber outputs are likely to be successful within the regions in which they are implemented, allowing the region to achieve a higher environmental standard, the impacts of reduced timber harvests will increase timber output pressure on forest resources in other regions and other forests within the region and allow non-wood resources potentially more damaging to the environment to substitute for the wood-based items. If the overseas regions that increase their timber outputs do not maintain their forest resources under a sustainable management regime, forest productivity and forest area will decline bringing into question the overall environmental gains achieved with conservation efforts in the Pacific Northwest. In effect, imposing a single regional environmental policy only shifts the environmental benefits from one region to another -- old growth forest area will stabilize in the Pacific Northwest, but forest area and productivity in other regions will fall. When evaluated globally, the environmental benefits of such a trade-off may be negative: restricting the use of renewable forest resources in one region may produce a negative environmental impact globally.

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The study demonstrates the globalization of specific Pacific Northwest harvest constraints and illustrates the need for a better understanding of the environmental benefits which the forest products industry can provide on a global level. Allowing timber production to take place in regions where sustainable management is more likely to be successful will increase the comparative advantage of forest products versus non-wood substitutes as well as maximizing environmental benefits within a global context. The present study is a first step in demonstrating these benefits. An extension of the present analysis will quantify the environmental effects with the appropriate linkages between forest products production and trade and the production of environmental byproducts.

INTRODUCTION

While several studies study have investigated the regional impacts of preserving northern spotted owl habitat (Lippke et al., 1990; Greber et al., 1990; Sommers et al., 1990; Gilless et al., 1990, Hamilton et al., 1990), the international consequences of reducing the timber supply caused by implementing such a plan have not been adequately addressed. This seems particularly important since the share of international trade of forest products from the Pacific Northwest is large. In addition, as a partial response to the reduction in domestic timber supply, recent legislation has imposed a log export ban on state timber sales while making the ban on log exports from federal timber sales permanent. Although the policy has been implemented as a partial response to the reduced federal harvest available to processors, little information has been produced with respect to the international impacts resulting from this ban. More recently Flora and McGinnis (1990) have analyzed international impacts, but only in a limited way. A fuller understanding of the impacts of these regional policies on the international competitiveness of the forest sector in the Pacific Northwest is warranted given the global environment in which this sector participates.

The present study demonstrates the impacts of two regional policies -- the reduction

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of timber sales volume from public lands and a 75 percent log export ban for Washington State lands -- on international forest products markets. The purpose of this demonstration is to show how the impacts of the regional policies translate themselves into international ones. The study provides the basis for a discussion of the likely changes in regional competitiveness and market shares for the Pacific Northwest and the need to examine the environmental impacts beyond the regional boundaries that result from changing international harvest and trade flows.

RECENT ENVIRONMENTAL LEGISLATION REDUCES THE REGION'S TIMBER RESOURCE-BASED COMPETITIVENESS

The principal effect of recent environmental legislation is to reduce the volume of timber sold on public and possibly private lands. Data from the USFS (Warren 1990) suggests a 44 percent reduction in the timber volume sold during 1989. Additional reductions on federal lands are expected as owl conservation plans such as the ISC recommendation are implemented.

A reduction in timber supply will increase sawlog prices as mills raise their bid for logs from public sources. Such high bid prices reduces competitive processing of the logs unless product prices increase to the full extent of the bid price increase (Perez-Garcia and Lippke, 1991). Owners of private timber supplies, within the sawlog market served by public timber, react by (1) increasing production if they are not limited by any biological, economic and political constraints, and (2) shifting a portion of their exports to supply domestic purchasers with their increased bid prices. As a result, exports from the region will decline as they replace a part of the reduction in domestic harvest from public land.

It is through the trade of both log and finished products that the international effects of the conservation policy is felt. The net effect of reducing log exports will be to increase log prices in markets overseas. Japanese and Korean mills consuming log imports from the Pacific Northwest region experience an increase in their log costs as a consequence of higher

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log prices in the trade market. A short supply of logs will require them to replace their reduced inventory with higher domestic timber harvest or imports from other sources. Log exporters, other than the US Westside Private and Inland Private regions of Western US, will be encouraged to expand log exports.

If log consumption is constrained by a loss in trade volume and the reduction is not met by either increased log production at home or supplemented by greater imports from other sources, coniferous sawnwood and plywood production will be affected. A reduction in log consumption translates directly into a reduction in lumber and plywood production. In instances where increased log production results in increased domestic consumption of logs rather than exportation, then domestic production of sawnwood and plywood will expand (An example is given by the Canadian markets since log exports are generally restricted). Marginal producers of logs, such as the Soviet East, if allowed to increase their production and exports of coniferous logs by releasing political, economic and institutional constraints, will reduce the impact on final markets as additional log-for-log rather than lumber-for-log substitution takes place in international markets.

LOG EXPORT RESTRICTIONS DECREASE THE DOMESTIC TIMBER RESOURCE VALUE

A ban on log exports, all other things being equal, will increase the domestic supply of logs. Since the increase in domestic supply decreases sawlog prices, log production from private and other public sources within the stumpage market will decline. As a result, log supply to domestic mills will not increase to the full extent of the log export restriction. The overall net effect however will be to stimulate processing of logs into lumber and plywood at home. In international markets, the ban will increase sawlog prices similar to the analysis presented above.

An export ban on state land logs will also induce private timber owners to enlarge their share of log exports. To the extent that they have adequate supply of near comparable

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quality to capture the reduction in export market share by the public sector, the effects of the ban on exports of state-owned timber on international stumpage markets will be reduced. In effect, a ban on log exports from state lands will amount to a transfer of market share to the private sector or to international suppliers.

Finally, increased sawnwood and plywood production will be directed towards export markets. Sawnwood and plywood production in log importing countries will decline as a result of increased log import costs. The scarcity of domestic products increases the prices for these items attracting greater foreign participation in their markets. Therefore, the decline in domestic production allows sawnwood and plywood produced in other areas to capture a larger share of these domestic market.

THE COMBINED POLICIES REDUCES SAWLOG PRICE GROWTH AT HOME AND AUGMENTS IT ABROAD.

The degree to which the offsetting effects will be felt at home depends on the amount of substitution between the lost volume of timber harvest and the amount of export volume which is affected by the ban. All other things being equal, the trade restriction will amplify the response already expected by private timber producers in the region -- to shift a portion of their exports to domestic consumption. This further reduces the log supply in foreign markets causing sawlog prices to increase even greater in these markets.

DEMONSTRATING THE EFFECTS WITH THE GLOBAL TRADE MODEL

The study utilizes the global trade model of forest products to demonstrate the policy impacts.[1] The model has been modified to allow lumber trade from the Pacific Northwest

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[1]The global trade model is described in several publications. Cardellichio et al. (1989) present a brief overview of the model and preliminary results of an analysis of Pacific Rim markets. Cardellichio et al. (1988) provide a complete description of timber supply equations. Finally Cardellichio and Adams (1988) describe the limitations of the IIASA version of the global trade model and some of the changes that are present in the current CINTRAFOR version.

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and British Columbia to be determined endogenously. Previously, the trade of lumber from these regions were fixed in a preliminary analysis of the Pacific Rim forest products markets (Cardellichio et. al., 1989).[2]

The effect of the environmental restriction is implemented in the global trade model by shifting the supply curve for public timber in the US Westside Public and US Inland Public regions.[3] Public timber supply in the Westside Public region is reduced by specifying lower volumes of sold timber starting in 1989. For the Westside Public region, the total sales volume are reduced 44 percent, from 26.0 to 14.6 million cubic meters (mcm). The quantity of sold volume for the Inland Public region is reduced by 2.8 mcm from 17 mcm. These levels of sold volume are maintained constant throughout the rest of the forecast period.

The 75 percent log export ban on Washington State lands is implemented indirectly by reducing the amount of log exports from the US Westside Private region.[4] A 75 percent export restriction implies that 25 percent of the sales volume from Washington state lands is exportable. With 66 percent of state timber meeting export standards, nearly 16 percent of the state sales volume will continue to be exported. This implies that exports from US Westside Private will decline about 10 percent.[5] The policy is implemented in 1991 by

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[2]The constraints on lumber flows were deleted by allowing transportation costs to vary. Otherwise, assuming the constant transportation costs for trade flows, price differences in the forecast period are sufficient to prevent any lumber flow originating in Westside US and British Columbia to go to Japan. That is, since softwood lumber price in Japan decreases relative to the prices in Westside and British Columbia, profits in the forecast period at the 1987 constant transportation cost are negative.

[3]Inland Public region contains the portion of California's public timber resource where conservation measures would reduce timber harvests.

[4]All public timber production is "exported" to the private sector.

[5]This is not totally true since restricting the trade of logs from the public sector should produce a response from the private sector. They will increase their exports of logs to the degree that they have competitive quality logs available, as will other exporters in the globe. Hence the policy scenario assumes that there is no response from the private sector, although the model does capture the response from other exporters in the globe. It is frequently argued that if the private sector is already exporting almost all of the quality logs acceptable in the export markets since the premium prices for these logs are substantial. Therefore the error from the assumption may

reducing equilibrium trade flows observed in the environmental restriction scenario from the US Westside Private region. The scenario maintains the reduction constant in percentage terms throughout the rest of the forecast period.

PUBLIC TIMBER SALES VOLUME REDUCTION INCREASES SAWLOG PRICES AROUND THE GLOBE

Table 1 presents the changes observed from the base reference for the coniferous sawlog, sawnwood and plywood sectors, and for the countries in the Pacific Rim for 1990. By 1990, there is an increase in sawlog prices around the globe. Sawlog prices on the US Westside (both public and private sectors) increase $1.24 per cubic meter (in $1980) from $46.50 per cubic meter ($224.22 per mbf). A smaller increase is observed in the Inland region reaching $40.20 per cubic meter ($193.84 per mbf). These price increases result from constraining the production in the public sectors for the two regions.

By 1990, the total reduction in sawlog production is 4.1 million cubic meters (mcm) for the Pacific Northwest region. US Westside Public reduces its sawlog production by 3.3 mcm from 18 mcm. US Inland Public's sawlog production declines 0.8 mcm to 13.5 mcm. As a response to the gain in sawlog prices, the Westside and Inland Private sectors increase their production 1.5 and 0.7 mcm respectively. US Eastside Private (within the US West region) also increases production by 0.1 mcm. In total, private production for the region increases 2.3 mcm. Others regions including the US South, US North, the Canadian regions (BC Canada, Interior Canada, and Eastern Canada) and Japan increase production by a total of 1.1 mcm. Sweden, Finland and Western Europe (not shown in the table) also increase log production. Global sawlog production decreases about 0.4 mcm.

The net effect of a decline in sawlog production on log consumption by sawmills is to decrease consumption in both the Westside and Inland Private regions as well as importing

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be quite small.

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countries. Log consumption drops 1 and 0.2 mcm, respectively in Westside and Inland Private regions. Log consumption also falls in Japan and Korea. Log consumption in Chile declines since more logs are exported and log production is constrained by available inventory. More logs are consumed in the US South and the Canadian regions. For Canada, log export restrictions prevent the increases in log production to be exported. Since the response from the Soviet East region is exogenous in the model, and assumed to be an actual planning rather than an economic decision, this region does not increase its log production and exports. It could of course choose to respond with increased exports either more than or less than their fare share with respect to other exporters.

In the sawnwood and plywood markets, prices also increase as a result of reduced supplies. Sawnwood prices increase $0.70 per cubic meters ($3.38 per mbf) whereas plywood prices increase $0.60 ($2.89 per mbf) per cubic meter. Sawmills reduce production with lower sawlog availability. In the US West region[6], a production decline results in reduced exports. The net decline in exports is approximately 0.3 mcm from 9 mcm in 1990. Higher log consumption results in greater sawnwood and plywood production for the US South and higher sawnwood production for Canada. The US South reduces imports of sawnwood, and expands its export share of plywood whereas Canada increases exports of sawnwood. Chile, as a result of decreased log consumption by its domestic mills also lowers sawnwood export quantities by a small amount (0.1 mcm). Lower log consumption in Japan reduces sawnwood production and increases imports by 0.2 mcm.

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[6]Includes Westside Private and Public, Eastside Private and Public, Inland Private and Public, Alaska and California.

Table 1: Impact summary for the environmental restriction scenario for the year 1990.

REGION (1)	SAWLOGS prod (2)	cons (3)	exp (4)	imp (5)	price (6)	SAWNWOOD prod (7)	cons (8)	exp (9)	imp (10)	price (11)	PLYWOOD prod (12)	cons (13)	exp (14)	imp (15)	price (16)
Westside Private	1.5	-1.0	-0.9		1.2	-0.4		-0.3		0.7	-0.1		-0.1		0.6
Westside Public	-3.3														
Eastside Private	0.1	0.1			0.2	0.1				0.7					0.6
Eastside Public															
Inland Private	0.7	-0.2			0.7					0.7					0.6
Inland Public	-0.8														
Alaska					1.2					0.7					
California															
US South	0.3	0.3			0.1	0.1	0.1	-0.1	-0.1	0.7	0.1		0.1		0.6
US North	0.1				0.1		-0.1			0.7				-0.1	0.6
BC Canada	0.1	0.1			0.1				0.2	0.7					0.6
Interior Canada	0.2	0.2								0.7					
Eastern Canada	0.2	0.1			0.1	0.1				0.7					
Chile		-0.2	0.1		1.2	-0.1		-0.1		2.0					
Japan	0.2	-0.2		-0.3	1.2	-0.2			0.2	0.7					0.6
Korea		-0.1		-0.1	1.2					0.8					
China					1.2					0.7					
Taiwan					1.2					0.7					
Soviet West					0.1					0.7					0.6
Soviet East					1.2					0.7					
New Zealand					1.2					2.0					

Notes: All numbers are the changes associated with the implementation of the scenario. An explanation of the base case is given in the text. (1) region; (2) sawlog production in million cubic meters (mcm); (3) sawlog consumption in mcm; (4) sawlog exports in mcm; (5) sawlog imports in mcm; (6) sawlog price in $US1980 dollars per cubic meter; (7) sawnwood production in mcm; (8) sawnwood consumption in mcm; (9) sawnwood exports in mcm; (10) sawnwood imports in mcm; (11) sawnwood price in $US 1980 dollars per cubic meter; (12) plywood production in mcm; (13) plywood consumption in mcm; (14) plywood exports in mcm; (15) plywood imports in mcm; (16) plywood price in $US 1980 dollars per cubic meter. Blanks indicate zero or not applicable.

By 1995, the full impact of the decline in harvest from the public sector is evident (see Table 2). Sawlog prices on the US Westside increase $2.74 per cubic meters to $49.30 per cubic meter (about $237.72 per mbf). In the Inland region, sawlog prices reach $41.40 per cubic meter, an increase of $1.94 per cubic meter. In 1995, US Westside Public's log production falls by 7.0 mcm to 10.1 mcm. Log production from Inland Public decreases 2.5 mcm to 14.7 mcm. The total reduction in sawlog production is 9.6 mcm as Chile also decreases its output of logs. The reduction in public sawlog production is made up in part by the private sectors of US Westside and Inland (3.2 mcm). Other regions in the US, Canada and Japan also increase production (3.3 mcm). World log production decreases by 1 mcm as Sweden, Finland and Western Europe also augment production.

By 1995, log consumption declines in the US Westside and US Inland regions, Chile, Japan and Korea. Chile, devoting more of its resources to export markets, also sees a decline in log consumption, again constrained by timber availability. Log consumption increases in the US South, US North, the Canadian regions, as well as the Eastside of the US West region.

Table 2: Impact summary for the environmental restriction scenario for the year 1995.

REGION (1)	SAWLOGS prod (2)	cons (3)	exp (4)	imp (5)	price (6)	SAWNWOOD prod (7)	cons (8)	exp (9)	imp (10)	price (11)	PLYWOOD prod (12)	cons (13)	exp (14)	imp (15)	price (16)
Westside Private	1.7	-3.1	-2.3		2.7	-1.1	-0.1	-1.4		1.9	-0.4	-0.1	-0.4		1.7
Westside Public	-7.0														
Eastside Private	0.2	0.2			0.6						1.9	0.1			1.7
Eastside Public															
Inland Private	1.5	-1.1			1.9	-0.4				1.9					1.7
Inland Public	-2.5														
Alaska					2.7					1.9					
California															
US South	1.2	1.2			0.6	0.3	-0.1		-0.3	1.9	0.3		0.4		1.7
US North	0.3	0.3			0.5	0.1	-0.2		-0.2	1.9				-0.1	1.7
BC Canada	0.4	0.3			0.1	0.2	-0.1	0.4		1.9					1.7
Interior Canada	0.6	0.6			0.2	0.2	0.2	0.2		1.9					
Eastern Canada	0.6	0.6			0.3	0.2				1.9					
Chile	-0.1	-0.3	0.2		2.7	-0.1		-0.1		3.9					
Japan	0.3	-1.5		-1.8	2.7	-1.0	-0.1		1.0	1.9					1.7
Korea		-0.1		-0.1	2.7	-0.1	-0.1	-0.1		3.2					
China					2.7					1.9					
Taiwan					2.7					1.9					
Soviet West					0.5					1.9					1.7
Soviet East					2.7					1.9					
New Zealand		-0.1	0.1		2.7					4.7					

(see notes at end of Table 1)

The trends observed in the sawnwood and plywood sector continue into 1995. Sawnwood production increases as more log are consumed in the US South, North and the Canadian regions, reducing imports for the US regions and increasing exports for the Canadian regions. Sawnwood production reaches 25.9 mcm in US South, 4.1 mcm in the US

North, and 9.0, 23.0 and 15.5 mcm in the Canadian regions of BC, Interior and Eastern Canada, respectively. Plywood production also increases in the US South, directing most of this production to export markets. In the US Westside and Inland regions, reduced log supplies decrease lumber and plywood production and exports. Sawnwood production declines to 13.9 and 14.4 mcm in these regions, respectively, while exports decline to 7.2 mcm for Westside Private. Plywood production drops 4 mcm to 7.7 mcm decreasing export levels to 3.6 mcm. Chile, increasing log exports and reducing domestic consumption of logs, also decreases lumber production and exports to 2.1 and 0.3 mcm respectively. The decrease in log imports for Korea results in a decrease in lumber production and exports. Japan's decrease in lumber production translates into more imports, up 1 mcm from 6.4 mcm in 1995.

By 2000, sawlog prices remained near 1995 levels (see Table 3). US Westside prices gained $2.40 per cubic meter to maintain its level around $49.10 per cubic meter ($236.76 per mbf). US Inland prices increased $2.10 per cubic meters to $43.70 per cubic meter ($210.72 per mbf). Total sawlog production decline 9.7 mcm in both public regions to 10.0 (Westside Public) and 15.3 mcm (Inland Public). US Westside private timber contributes little to the overall production increase, reaching only one-sixth of the increase observed in 1995 to produce 34.9 mcm. Similarly, the private sector in US Inland region increases production by only 0.9 mcm to 21.0 mcm. The US South and Interior Canada regions also continue to increase market share lost by the public sector on the West Coast. The US South region increases production 1.1 mcm to 92.8 mcm. The sawlog production of the Interior Canada region reaches 60.3 mcm. Both the BC and Eastern Canadian regions also increase production contributing 22.6 and 40.6 mcm respectively. The overall reduction in timber production is 1.2 mcm as Sweden, Finland, and Western Europe maintain their increased production levels from previous years.

Table 3: Impact summary for the environmental restriction scenario for the year 2000.

REGION	SAWLOGS					SAWNWOOD					PLYWOOD				
	prod	cons	exp	imp	price	prod	cons	exp	imp	price	prod	cons	exp	imp	price
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Westside Private	0.3	-3.8	-2.8		2.4	-1.5	-0.1	-2.1		2.1	-0.5	-0.1	-0.4		1.7
Westside Public	-6.8														
Eastside Private	0.2	0.2			0.9	0.1				2.1	0.1				1.7
Eastside Public															
Inland Private	0.9	-2.0			2.1	-0.8				2.1	-0.1				1.7
Inland Public	-2.9														
Alaska					2.4					2.1					
California															
US South	1.1	1.1			0.7	0.2	-0.1	0.1	-0.2	1.9	0.4	-0.1	0.4		1.7
US North	0.3	0.3			0.7	0.1	-0.1		-0.3	2.1		-0.1		-0.1	1.7
BC Canada	0.6	0.6			0.3	0.2	-0.1	0.2		2.1		-0.1		-0.1	1.7
Interior Canada	1.0	1.0			0.3	0.4		0.4		2.1					
Eastern Canada	0.8	0.8			0.4	0.4		0.4		2.0					
Chile		-0.5	0.5		2.4	-0.3		-0.2		3.4					
Japan	0.3	-1.7		-2.0	2.4	-1.1	-0.2		1.1	2.1					1.7
Korea		-0.1		-0.2	2.4	-0.1	-0.1			2.1					
China					2.4					2.1					
Taiwan					2.4					2.1					
Soviet West					0.7					2.1					1.7
Soviet East					2.4					2.1					
New Zealand			0.1		2.4	-0.1				4.7					

(see notes at the end of Table 1)

Sawlog consumption continues to decline in 2000 for US Westside, US Inland, Chile, Japan and Korea, while the levels of sawlog consumption for other regions are maintained at 1995 levels. Similarly, log exports also declines for the US Westside region while Japanese and Korean log imports grow slightly as Chile continues to increase its exports of softwood

logs. US Westside exports 5.8 mcm compared to 8.1 mcm for Chile and 4.9 mcm for New Zealand. Japanese and Korean imports reach 14.2 and 3.5 mcm, respectively.

Sawnwood and plywood prices in 2000 continue to increase due to the decline in sawlog availability. Production of sawnwood and plywood drops in both US Westside and US Inland regions resulting in a decline in lumber exports by 2.1 mcm and plywood exports by 0.4 mcm. The Canadian regions increase lumber exports in response to higher prices by 1.0 mcm. The US South increases plywood exports by 0.4 mcm. Japan augments imports of sawnwood lumber by 1.1 mcm to replace a similar decline in domestic production.

TRADE RESTRICTION RAISE INTERNATIONAL SAWLOG PRICES WHILE DEPRESSING THE DOMESTIC TIMBER RESOURCE VALUE

Table 4 presents the 1995 changes from the base case reference for the coniferous sawlog, sawnwood and plywood sectors when the trade restriction is imposed in the US Westside region. The table illustrates the basic result of a trade restriction; sawlog price within the market affected by the restriction declines while it increases in other markets. By 1995, sawlog prices decreased $0.50 per cubic meter in the US Westside region to $46.10 per cubic meter ($222.29 per mbf). As a result sawlog production declines 0.3 mcm to 37.4 mcm. Higher sawlog prices increase timber harvests slightly in the US South and North regions, as well as the Canadian regions. Sawlog prices gain from $0.10 to $0.60 per cubic meter ($0.48 to $2.90 per mbf) in these regions. Harvest increase around 0.1 mcm in each of the regions.

The reduction of 1.2 mcm of log exports results in an increase in 0.9 mcm in log processing for the US Westside region. The increase in processing enables the US Westside region to expand exports of sawnwood by 0.4 mcm and plywood by 0.1 mcm. This is the proposed effect of a log embargo. The increase in sawnwood production is used to substitute the decrease in domestic sawnwood production occasioned by a shortfall of log exports in Japan and Korea.

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Table 4: Impact summary for the trade restriction scenario for the year 1995.

REGION (1)	SAWLOGS					SAWNWOOD					PLYWOOD				
	prod (2)	cons (3)	exp (4)	imp (5)	price (6)	prod (7)	cons (8)	exp (9)	imp (10)	price (11)	prod (12)	cons (13)	exp (14)	imp (15)	price (16)
Westside Private	-0.4	0.9	-1.2		-0.5	0.4		0.4		0.1	0.1		0.1		-0.1
Westside Public	0.1														
Eastside Private						0.1				0.1					-0.1
Eastside Public															
Inland Private	0.1	0.1				0.1				0.1					-0.1
Inland Public															
Alaska						0.6				0.1					
California															
US South	0.1	0.1				0.1	0.1			0.1	-0.1	0.1			-0.1
US North	0.1									0.1					-0.1
BC Canada	0.1									0.1					-0.1
Interior Canada	0.1	0.1								0.1					
Eastern Canada	0.1									0.1					
Chile	-0.1	-0.2	0.2		0.6	-0.1		-0.1		0.8					
Japan	0.1	-0.8		-0.8	0.6	-0.1			0.6	0.1					-0.1
Korea		-0.1		-0.1	0.6	-0.1	-0.1	-0.1		0.7					
China					0.6					0.1					
Taiwan					0.3					0.1					
Soviet West					0.1					0.1					-0.1
Soviet East					0.6					0.1					
New Zealand					0.6					1.1					

(see notes at the end of Table 1)

By 2000, the impact of the trade restriction is less severe as the constant ten percent decrease in log exports from the US Westside region translates into a smaller nominal amount of export volume banned by the trade policy (see Table 5). The slight decrease in sawlog price has a negligible effect on timber production. Decreases in timber consumption

caused by a decline in log imports are large enough such that sawlog prices drop slightly in Japan and other importing countries. Sawnwood and plywood production in the US Westside increases. Again, the increase in sawnwood production is exported to Japan.

Table 5: Impact summary for the trade restriction scenario for the year 2000.

REGION (1)	SAWLOGS prod (2)	cons (3)	exp (4)	imp (5)	price (6)	SAWNWOOD prod (7)	cons (8)	exp (9)	imp (10)	price (11)	PLYWOOD prod (12)	cons (13)	exp (14)	imp (15)	price (16)
Westside Private		1.1	-1.0		-0.2	0.5		0.5			0.2		0.1		-0.1
Westside Public	0.2														
Eastside Private		-0.1													-0.1
Eastside Public															
Inland Private					0.1						-0.1				-0.1
Inland Public															
Alaska					-0.1										
California															
US South						0.1					-0.1		-0.1		-0.1
US North						0.1									-0.1
BC Canada															
Interior Canada	0.1	0.1				0.1		0.1							
Eastern Canada										-0.1					
Chile		-0.1	0.2		-0.1	-0.1		-0.1							
Japan		-0.7		-0.7	-0.1	-0.4			0.5						-0.1
Korea				-0.1	-0.1					0.2					
China					-0.1										
Taiwan					-0.4										
Soviet West															-0.1
Soviet East					-0.1										
New Zealand					-0.1			0.4							

(see notes at the end of Table 1)

THE COMBINED POLICIES ACCENTUATE INTERNATIONAL EFFECTS

Tables 6 presents the results for 1995 when both the timber harvesting restrictions and trade ban are imposed. In general, the table illustrates that the two policy impacts offset each other in the US Westside region and have cumulating effects in all other markets. With both restrictions in effect, sawlog prices increase $2.30 per cubic meter to $48.90 ($235.79 per mbf) in the US Westside region. Sawlog prices in Japan increase $3.40 to $173.80 per cubic meter ($838.07 per mbf). Figure 1 illustrates the changes in sawlog prices in several regions under the environmental plus trade restrictions scenario. Increases in sawlog prices stimulates greater harvests. As Figure 2 and Table 6 demonstrate, US Westside private timber owners increase production by 1.4 mcm to 39.2 mcm in 1995. This is less than the production increase observed in the environmental restriction scenario by 0.3 mcm. Sawlog prices and production in other US and Canadian regions remain fairly similar as in the environmental restriction scenario, each region gaining a slightly higher market share (see Figure 3). A large shortfall in logs in Japan causes a sharp increase in their sawlog prices. Only Chile and New Zealand are able to increase their exports as both the Soviet East and British Columbia in Canada have log export constraints in effect. Chile, however, is also constrained by the available inventory of their plantations so that any increase in log exports is limited. Figure 4 illustrates the decline in Japanese and Korean log imports and exports from the US Westside regions. Chilean log exports increase only slightly as total volume of log trade in the Pacific region declines.

As a result of the acute decline in sawlog production in the US Westside and Inland Public regions, sawlog consumption drops 2.3 and 1.0 mcm respectively. Both the increase in production from the private sectors and a decline in exports account for the difference in the consumption figures. Increases in sawlog production in other US and Canadian regions are processed into sawnwood and plywood. Chile and New Zealand both decrease domestic consumption as a portion of these logs are directed towards the export markets. The

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increase in production from these areas are not sufficient to restore global sawnwood production to the base level. As a result, lumber prices increase slightly as is demonstrated in Figure 5.

Table 6: Impact summary for the environmental and trade restrictions scenario for the year 1995.

REGION	\-\-\-\-\-\-\-\-\-\-\-SAWLOGS\-\-\-\-\-\-\-\-\-\-\-					\-\-\-\-\-\-\-\-\-\-SAWNWOOD\-\-\-\-\-\-\-					\-\-\-\-\-\-\-\-\-\-\-PLYWOOD\-\-\-\-\-\-\-\-\-				
	prod	cons	exp	imp	price	prod	cons	exp	imp	price	prod	cons	exp	imp	price
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Westside Private	1.4	-2.3	-3.2		2.3	-0.8	-0.1	-1.1		2.0	-0.4	-0.1	-0.3		1.7
Westside Public	-6.9														
Eastside Private	0.2	0.2			0.6					2.0					1.7
Eastside Public															
Inland Private	1.6	-1.0			1.9	-0.4				2.0	-0.1				1.7
Inland Public	-2.5														
Alaska					3.4					2.0					
California															
US South	1.2	1.2			0.6	0.3	-0.1		-0.3	1.8	0.3	-0.1	0.3		1.7
US North	0.3	0.3			0.6	0.1	-0.2		-0.2	2.0		-0.1		-0.1	1.7
BC Canada	0.4	0.4			0.1	0.2	-0.1	0.5		2.0					1.7
Interior Canada	0.7	0.7			0.2	0.2		0.2		2.0					
Eastern Canada	0.6	0.7			0.3	0.2				2.0					
Chile	-0.1	-0.3	0.2		3.4	-0.1	-0.1	-0.1		4.2					
Japan	0.4	-2.3		-2.7	3.3	-1.6	-0.2		1.5	2.0					1.7
Korea		-0.2		-0.1	3.4	-0.1	-0.1	-0.1		4.2					
China					3.4					2.0					
Taiwan					3.0					2.0					
Soviet West					0.5					2.0					1.7
Soviet East					3.3					2.0					
New Zealand		-0.1	0.1		3.3					5.8					

(see notes at the end of Table 1)
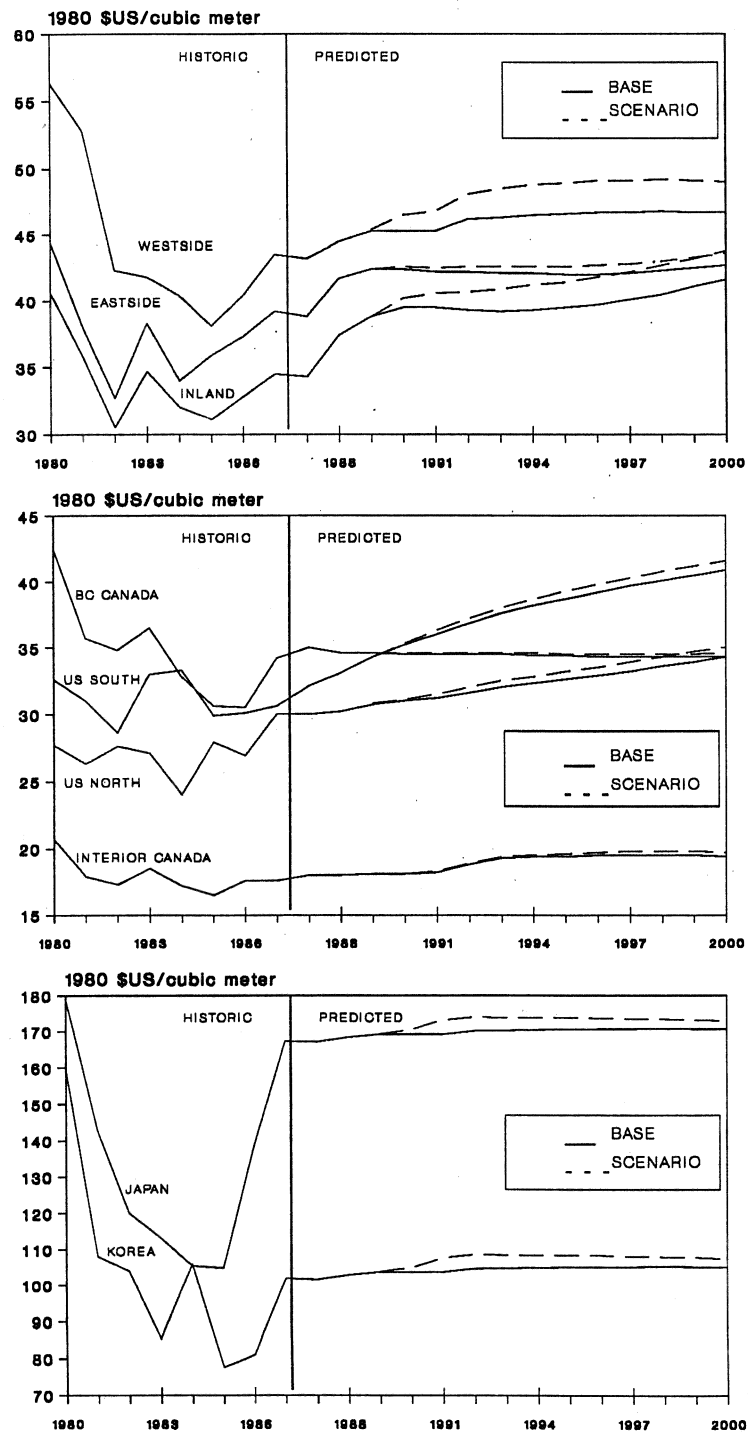
Figure 1: Sawlog prices increase globally

million cubic meters

HISTORIC — PREDICTED

WESTSIDE PRIVATE

WESTSIDE PUBLIC

BASE
SCENARIO

million cubic meters

HISTORIC — PREDICTED

INLALND PUBLIC

INLAND PRIVATE

BASE
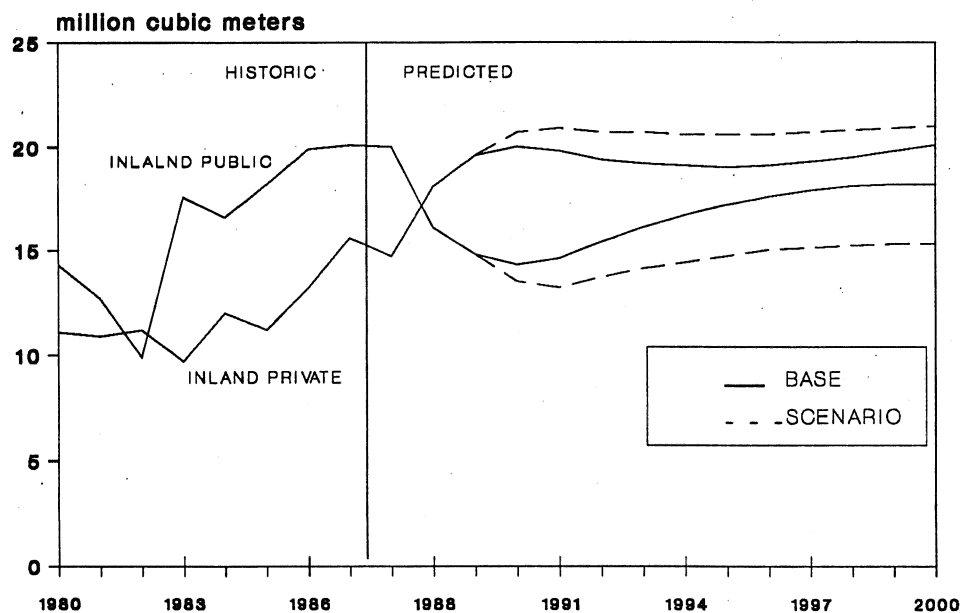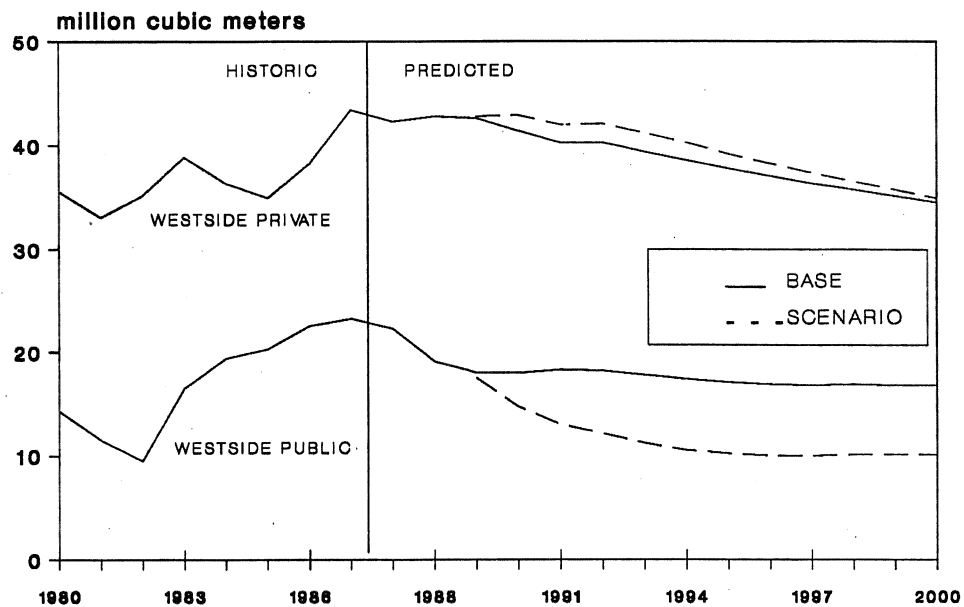SCENARIO

Figure 2: The private sector partially substitutes for public sawlog harvest decline
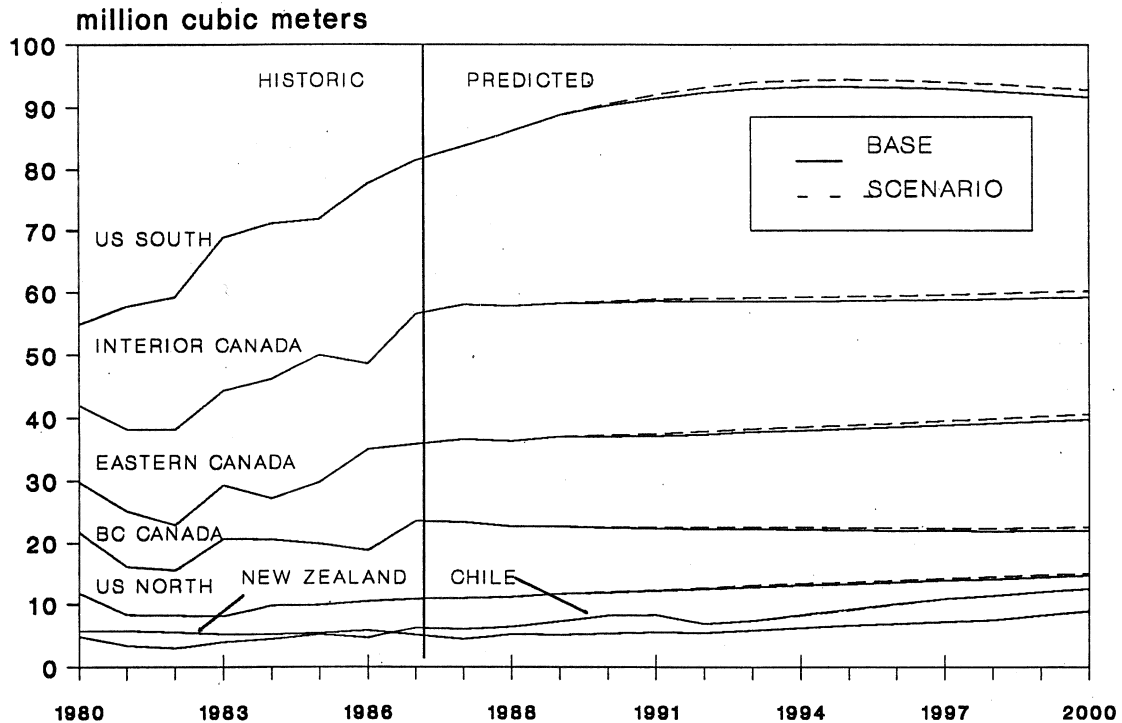
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Figure 3: Sawlog production increases in other regions

Lumber production in the US Westside and Inland regions declined to 14.1 and 14.6 mcm respectively. Figure 6 illustrates these changes for the entire forecast period. Plywood production in the US Westside region declines 0.3 mcm to 7.8 mcm. Since the trade restriction has diverted export logs into the domestic markets, lumber production for the US Westside region does not decline to levels observed in the environmental restriction scenario. The sharper decline observed in the consumption of logs in the Japanese log market requires a higher import level. Japanese lumber imports increase by 1.5 mcm, reaching 7.9 mcm in 1995. The increase in imports come mainly from the Canadian regions and a redirection of a portion of the lumber exports from the US West region, as the US South and North regions reduce their lumber imports. Figure 7 demonstrates the decline in lumber exports from the
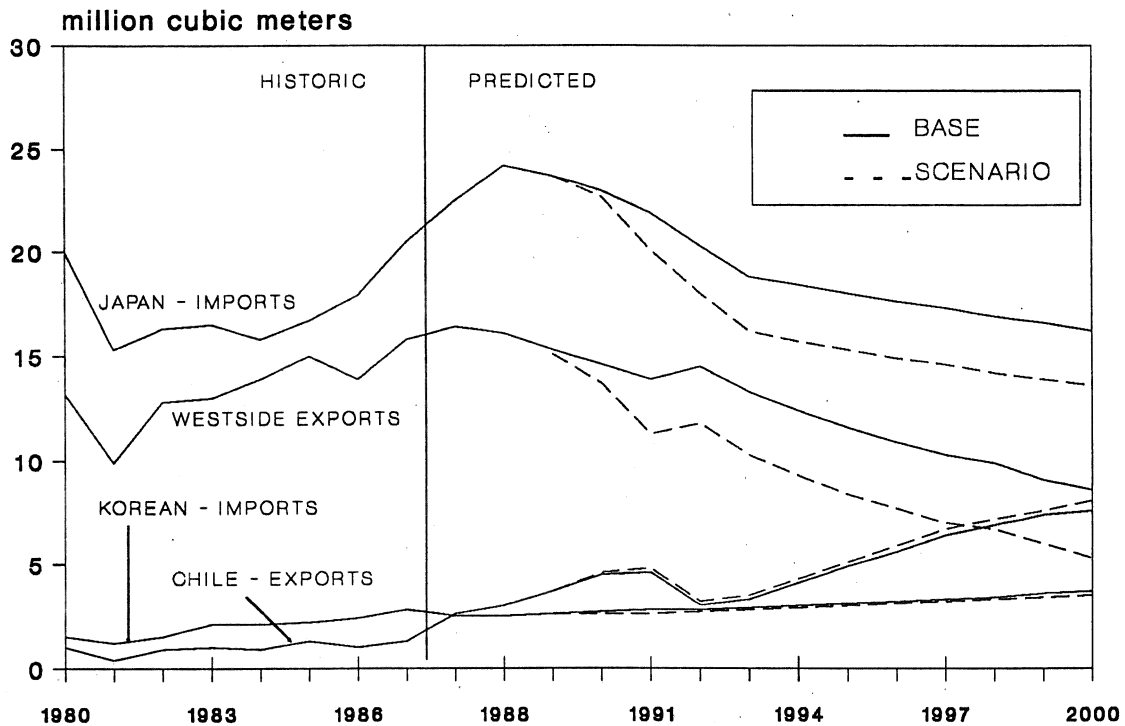
million cubic meters

Figure 4: Westside exports, Japanese and Korean imports decline while Chilean exports increase slightly

US Westside region and Japan's need to increase sawnwood imports as its own domestic production suffers from a drop in sawlog availability.

By 2000, many of the effects of the trade restriction are overshadowed by the impacts of the environmental restrictions since log trade under the environmental restrictions reached only 5.8 mcm in the US Westside region. Hence a ten percent reduction in log exports from the Westside region results in a small impact. Table 7 presents the changes in the sawlog, sawnwood and plywood markets. As can be readily seen the effects are similar to those already presented in Table 3.

Table 7: Impact summary for the environmental and trade restrictions scenario for the year 2000.

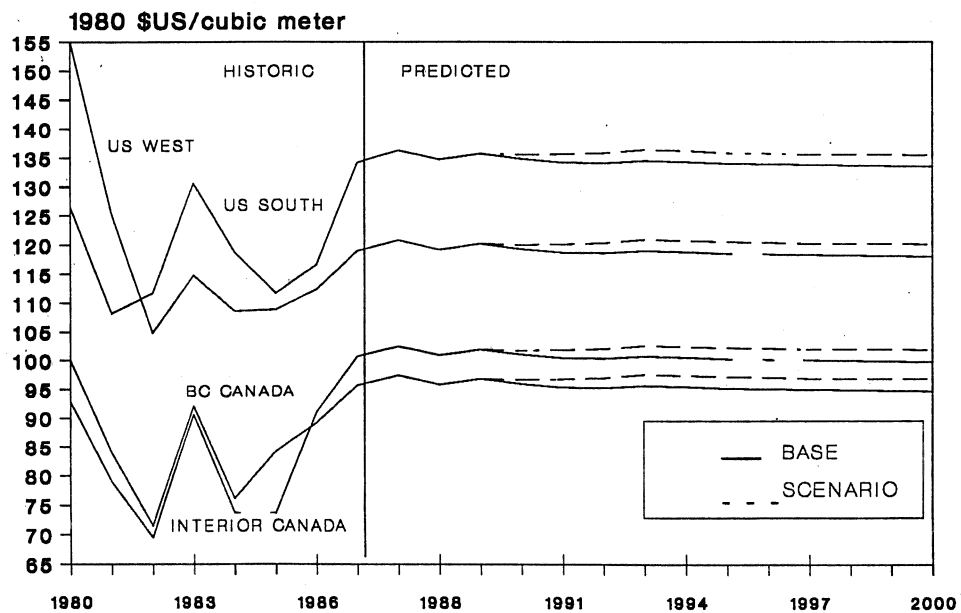| REGION	----------SAWLOGS----------					---------SAWNWOOD--------					----------PLYWOOD---------				
	prod	cons	exp	imp	price	prod	cons	exp	imp	price	prod	cons	exp	imp	price
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Westside Private	0.4	-2.3	-3.3		2.3	-1.2	-0.1	-1.9		2.1	-0.4	-0.1	-0.3		1.7
Westside Public	-6.7														
Eastside Private	0.2	0.2			0.9					2.1					1.7
Eastside Public															
Inland Private	0.9	-2.0			2.2	-0.8				2.1	-0.1				1.7
Inland Public	-2.9														
Alaska					2.3					2.1					
California															
US South	1.1	1.1			0.7	0.2	-0.1	0.1	-0.2	1.9	0.3	-0.1	0.3		1.7
US North	0.3	0.3			0.7	0.1	-0.1		-0.3	2.1		-0.1		-0.1	1.7
BC Canada	0.6	0.6			0.3	0.2	-0.1		0.2	2.1					1.7
Interior Canada	1.0	1.0			0.3	0.4		0.4		2.1					
Eastern Canada	0.8	0.8			0.4	0.4		0.4		2.0					
Chile		-0.5	0.5		2.3	-0.3		-0.2		3.3					
Japan	0.2	-2.3		-2.6	2.3	-1.5	-0.2		1.4	2.1					1.7
Korea		-0.1		-0.2	2.3	-0.1	-0.1			3.6					
China					2.3					2.1					
Taiwan					2.0					2.1					
Soviet West					0.7					2.1					1.7
Soviet East					2.3					2.1					
New Zealand			0.1		2.3	-0.1				4.7					

(see notes at the end of Table 1)
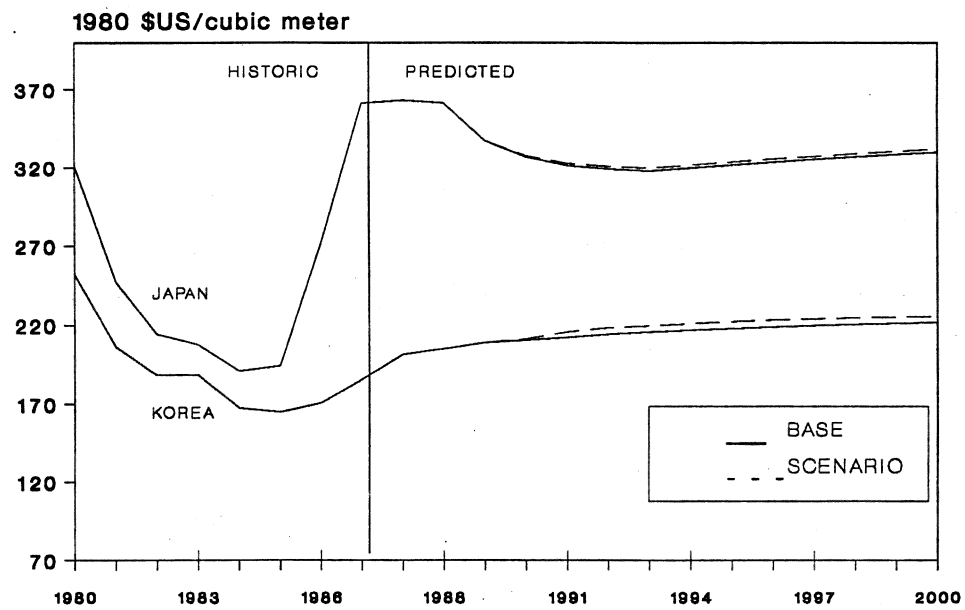
Figure 5: The decline in sawlog supply causes sawnwood prices to increase slightly
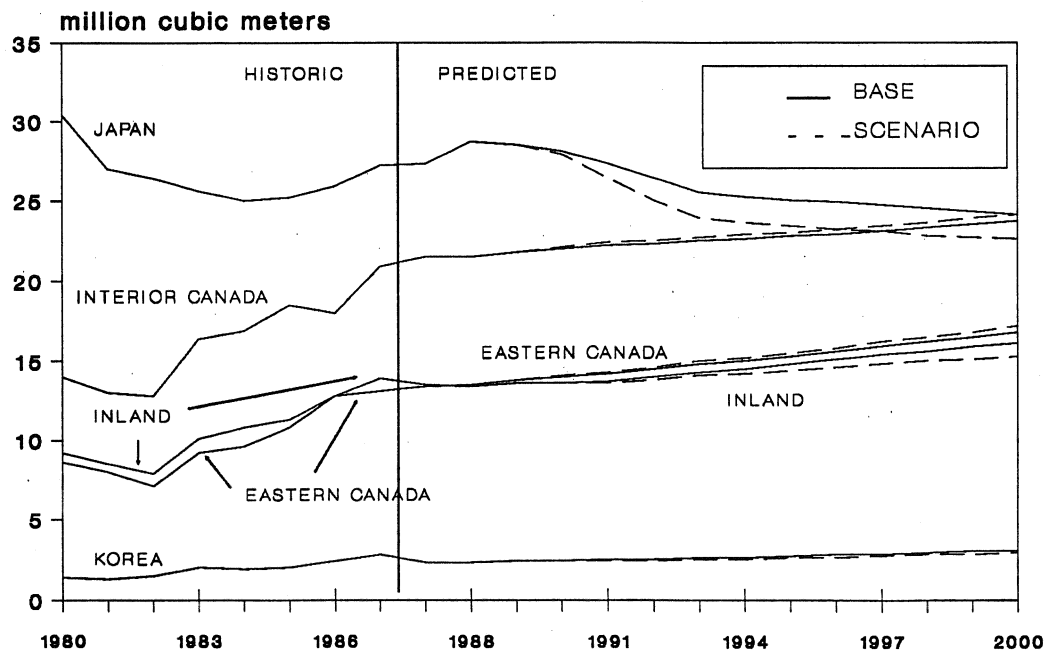
million cubic meters
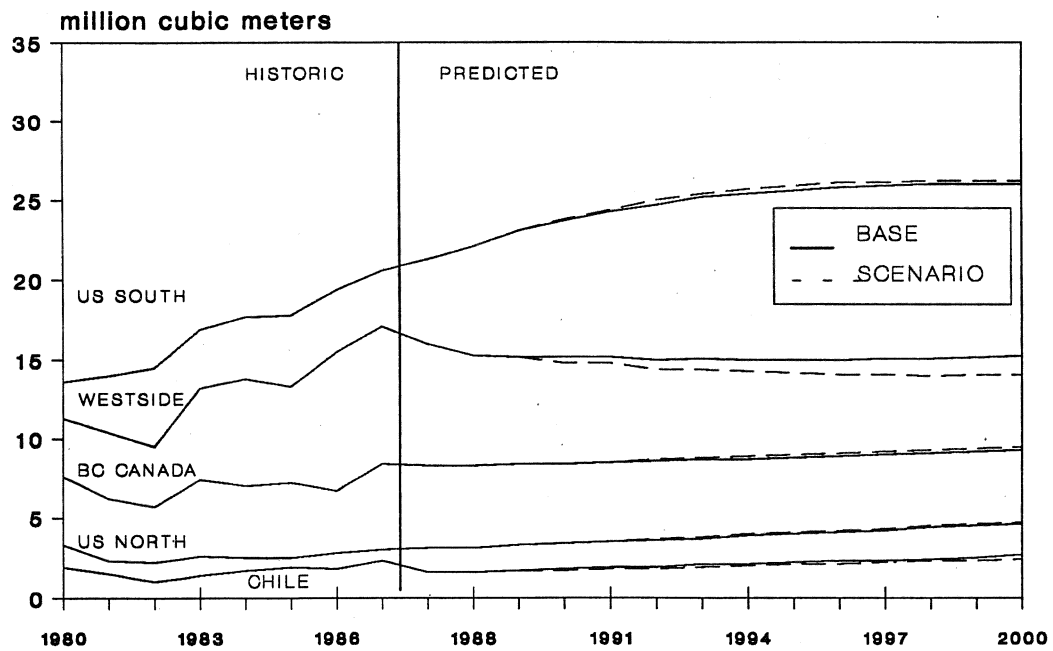

million cubic meters

Figure 6: Sawnwood production decreases in Westside (WSV), Inland (INT) regions of US, Japan (JPN), Korea (KOR), and Chile (CHI), and increase elsewhere
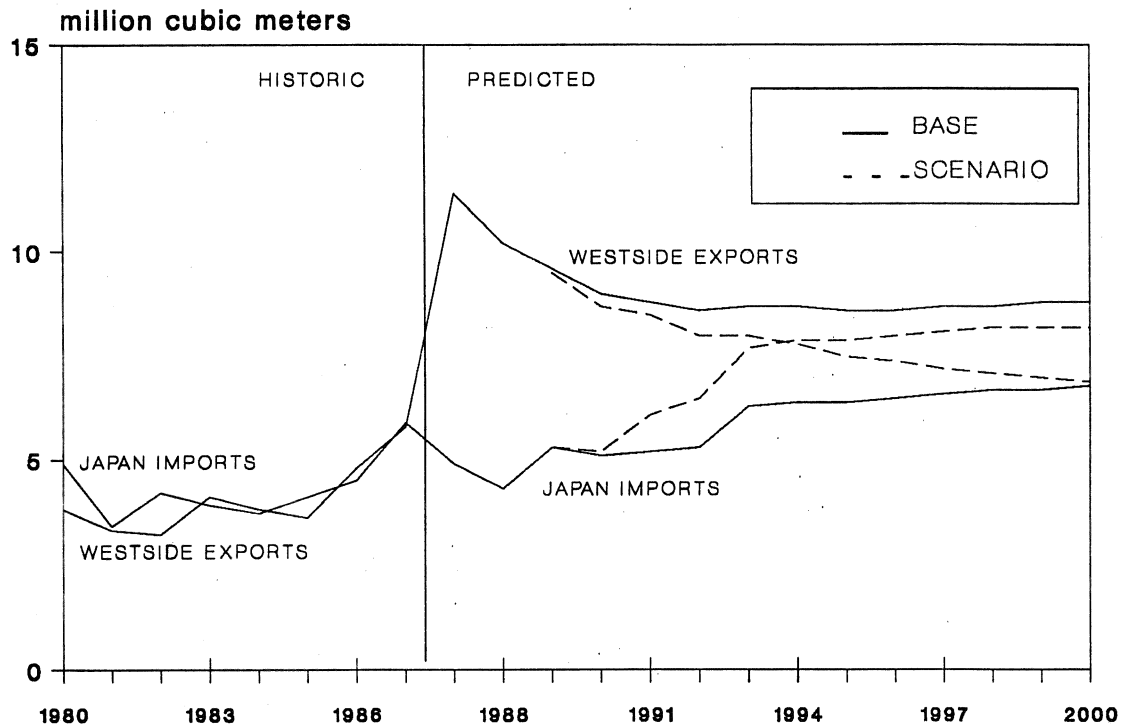
million cubic meters

Figure 7: Japanese sawnwood imports increase as Westside exports decline

ALLOWING MARGINAL LOG PRODUCERS TO INCREASE THEIR EXPORTS WOULD DIMINISH THE IMPACTS ON FINAL PRODUCT MARKETS

Many of the results obtained depend on the constraints imposed on log production in other regions. The expansion of the share in log markets by marginal producers, such as in the Soviet East, is restricted in the above analysis. Consequently the impacts observed in the final product markets depend on the behavior of the marginal log producers.

Economic intuition suggests that as log supplies in international markets are reduced, marginal timber regions become economical to harvest. Infrastructure costs, prohibitive under previous prices, may become manageable under present price increases. Whereas biological constraints restrict increased production in Chile and New Zealand, economic constraints in other countries are relaxed in the presence of higher sawlog prices.

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To illustrate the sensitivity of the results, a new base scenario is implemented where the Soviet East production and exports of coniferous logs are increased to an optimistic level; softwood log exports increase 0.8, 2.9 and 0.8 mcm in 1990, 1995 and 2000, respectively.[7] Tables 8 through 10 present these results for the respective years. As these tables illustrate, the impacts of the trade and environmental restrictions on global forest products markets are slightly reduced.

As a result of these new production and export levels by the Soviet Union, or other marginal producers, sawlog prices do not increase to the extent observed in the environmental restriction scenario. Soviet Far East log sources reduce the short supply in international markets caused by the reduced public timber production and trade restriction. The sawlog price increase which the environmental restrictions on timber harvest causes is reduced by nearly 20 percent.

As a consequence of a higher level of soviet log exports, log exports from the Westside Private region decrease by 1.7 mcm in 1990, compared to 0.9 mcm under the environment plus trade restrictions scenario. This is easily explained by the reduction in demand pressure for logs in international markets. As a result, domestic log consumption levels are slightly higher than under the environmental restriction scenario, while log consumption in net importing countries are also slightly reduced. In summary, by increasing the log production and exports of the Soviet East region, the impact of the log shortfall in international markets is reduced. The impacts of the timber harvest reduction on international sawlog prices is reduced. And the impacts on the final markets are also smaller. As a result, the sawnwood and plywood sectors do not reduce production levels and the need to import greater quantities is not as great as that observed under the environment plus trade restrictions scenario. Having greater Soviet East log production and exports slightly reduces the effect of a domestic log shortfall caused by the reduction of timber harvest in the US

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[7]A description of the optimistic scenario will be presented in a separate document.

Westside and Inland Public regions since a greater share of domestic production can be shifted towards the domestic markets. The log export market share for the Pacific Northwest, however, is severely affected.

Table 8: Impact summary for the environmental and trade restrictions with high soviet output scenario for the year 1990.

REGION	SAWLOGS					SAWNWOOD					PLYWOOD				
	prod	cons	exp	imp	price	prod	cons	exp	imp	price	prod	cons	exp	imp	price
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Westside Private	1.2	-0.8	-1.7		1.0	-0.3		-0.3		0.6	-0.1				0.5
Westside Public	-3.5														
Eastside Private	0.1	0.1			0.2					0.6					0.5
Eastside Public															
Inland Private	0.7	-0.2			0.6					0.6					0.5
Inland Public	-0.8														
Alaska					1.0					0.6					
California															
US South	0.3	0.3				0.1	0.1		-0.1	0.6	0.1		0.1		0.5
US North	0.1					0.1				0.6				-0.1	0.5
BC Canada	0.1	0.1				0.1		0.1		0.6					0.5
Interior Canada	0.1	0.1								0.6					
Eastern Canada	0.2	0.1				0.1	0.1			0.6					
Chile		-0.1	0.1		1.0	-0.1		-0.1		1.5					
Japan	0.1	-0.1		-0.3	1.0	-0.1			0.1	0.6					0.5
Korea		-0.1		-0.1	1.0					0.6					
China					1.0					0.6					
Taiwan					0.7					0.6					
Soviet West					0.1					0.6					0.5
Soviet East	0.9		0.8		1.0					0.6					
New Zealand					1.0					1.5	-0.1				

(see notes at the end of Table 1)

Table 9: Impact summary for the environmental and trade restrictions with high soviet output scenario in 1995.

REGION (1)	SAWLOGS prod (2)	cons (3)	exp (4)	imp (5)	price (6)	SAWNWOOD prod (7)	cons (8)	exp (9)	imp (10)	price (11)	PLYWOOD prod (12)	cons (13)	exp (14)	imp (15)	price (16)
Westside Private	0.6	-1.2	-5.1		1.3	-0.4	-0.1	-0.8		1.3	-0.2	-0.1	-0.2		1.0
Westside Public	-6.9														
Eastside Private	0.1	0.1			0.4					1.3					1.0
Eastside Public															
Inland Private	1.3	-1.3			1.8	-0.5				1.3	-0.1				1.0
Inland Public	-2.5														
Alaska					2.1					1.4					
California															
US South	0.9	0.9			0.5	0.3	-0.1		-0.3	1.3	0.1		0.2		1.0
US North	0.2	0.2			0.4	0.1	-0.1		-0.1	1.3					1.0
BC Canada	0.3	0.3			0.1	0.2	-0.1	0.3		1.3					1.0
Interior Canada	0.5	0.5			0.1	0.2		0.2		1.3					
Eastern Canada	0.4	0.5			0.2	0.2				1.3					
Chile	-0.1	-0.3	0.2		2.1	-0.1		-0.1		3.0					
Japan	0.2	-1.5		-1.7	2.0	-1.0	-0.1		1.0	1.4					1.0
Korea		-0.1		-0.1	2.1	-0.1	-0.1	-0.1		2.7					
China					2.1					1.3					
Taiwan					1.7					1.3					
Soviet West					0.4					1.3					1.0
Soviet East	2.9		2.9		2.0					1.3					
New Zealand		-0.1	0.1		2.0					3.6	-0.1				

(see notes at the end of Table 1)

Table 10: Impact summary for the environmental and trade restrictions with high soviet output scenario for the year 2000.

REGION	----------SAWLOGS----------					----------SAWNWOOD-------					----------PLYWOOD---------				
	prod	cons	exp	imp	price	prod	cons	exp	imp	price	prod	cons	exp	imp	price
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Westside Private	0.7	-2.4	-3.7		2.2	-0.9	-0.1	-1.7		1.9	-0.3	-0.1	-0.3		1.6
Westside Public	-6.6														
Eastside Private	0.2	0.2			0.7					1.9					1.6
Eastside Public															
Inland Private	0.7	-2.2			1.9	-0.9				1.9	-0.1				1.6
Inland Public	-2.9														
Alaska					2.4					1.9					
California															
US South	1.0	1.0			0.6	0.2	-0.1	0.1	-0.2	1.7	0.2		0.3		1.6
US North	0.3	0.3			0.6	0.1	-0.1		-0.3	1.9		-0.1		-0.1	1.6
BC Canada	0.5	0.5			0.2	0.2	-0.1	0.2		1.9					1.6
Interior Canada	0.9	0.9			0.3	0.4		0.4		1.9					
Eastern Canada	0.7	0.7			0.3	0.3		0.4		1.8					
Chile		-0.5	0.5		2.4	-0.3		-0.2		3.4					
Japan	0.2	-1.9		-2.1	2.3	-1.2	-0.2		1.1	1.9					1.6
Korea		-0.1		-0.2	2.4	-0.1	-0.1			3.3					
China					2.4					1.9					
Taiwan					2.0					1.9					
Soviet West					0.6					1.9					1.6
Soviet East	0.8		0.8		2.3					1.9					
New Zealand			0.1		2.3	-0.1				4.5	-0.2				

(see notes at the end of Table 1)

INTERNATIONAL AND DOMESTIC IMPACTS FROM REDUCED PUBLIC TIMBER
HARVESTS

The final sections present estimates of several impacts associated with the reduced

timber harvest from public lands and the change in stumpage prices globally. They offer new

estimates of public forest revenue declines in the PNW, as well as log, profit, consumer, and

trade cost impacts in the sawlog, sawnwood and plywood sectors globally. The following

section summarizes how overseas producers react to restricted timber harvest from the public

sector.

US SAWLOG HARVEST DECLINE IS SUBSTITUTED BY OVERSEAS PRODUCERS

Figure 8 illustrates the decline in sawlog production in the Westside and Inland Public

regions and the increased sawlog production of the Westside and Inland Private regions and

the rest of the world. Global production of softwood logs declines approximately ten percent

of the reduction of US public timber throughout the period as other countries increase their log

production. By 1991, the response from the US Westside and Inland Private sectors is

approximately half of the world reaction. After 1991, the US Westside and Inland Private

sectors do not maintain their share of higher harvest levels and it begins to decline in 1993.

By 2000 the contribution of the private sector is approximately 15 percent of the rest of the

world's contribution.

The global impacts of the timber harvest restrictions and log export ban are further

reduced if marginal log producers are allowed to increase their production and exports. This

situation is illustrated for the case of increased production and exports of sawlogs from the

Soviet East region. As Figure 9 illustrates, the participation of the private sector is even lower

when the Soviet East region increases its production and exports of coniferous logs.
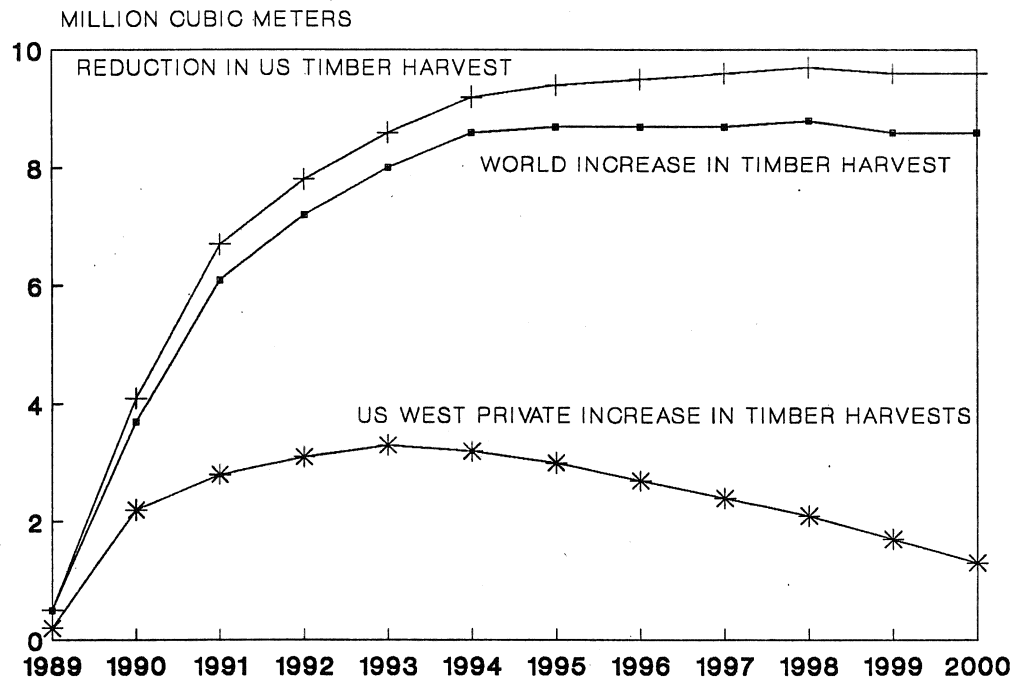
MILLION CUBIC METERS

Figure 8: Overseas response to US Westside timber harvest reduction is large

PUBLIC TIMBER REVENUES DECLINE

The study measures the decline in public timber revenues as the difference between the value of public timber harvest under the base and the environment plus trade restrictions scenarios. The equilibrium prices and quantities obtained in each scenario are used to
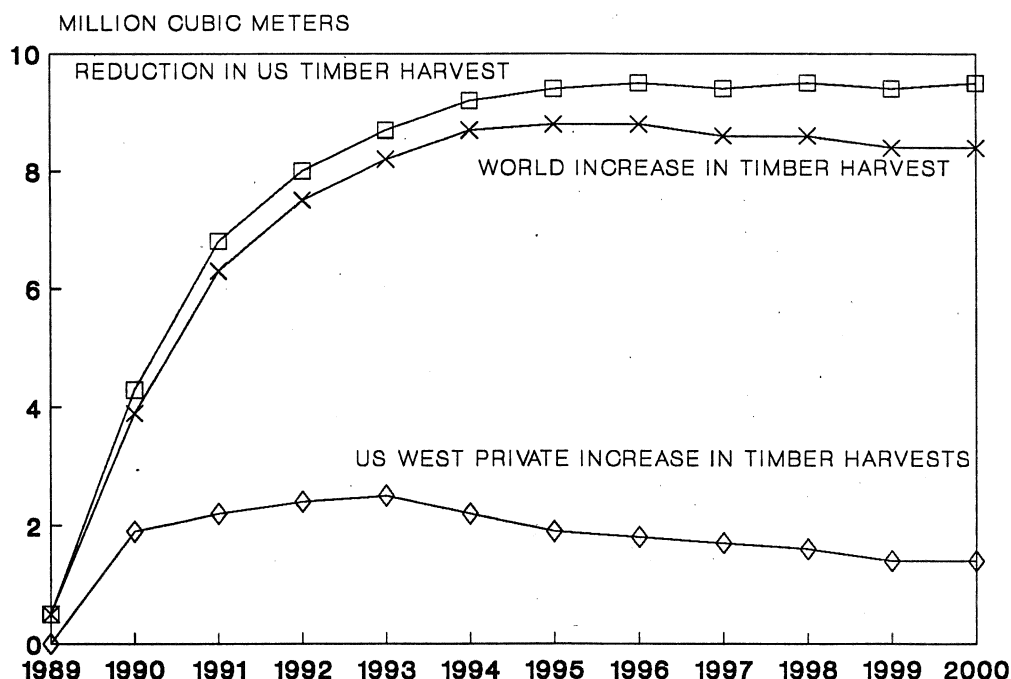
Figure 9: Optimistic sawlog production and exports from the Soviet East region further reduces the US West private response

calculate public timber revenues.[8] Public timber revenues decline $176 million (in 1988

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[8]There are several important considerations necessary in any attempt to draw comparisons with impact measures reported in previous studies, notably Hamilton et al. (1990) and Lippke et al. (1990). First, in this study the decline in public timber sales volume translate into a timber harvest reduction of approximately 9.7 mcm (2 bbf). These harvest reductions are smaller than reported in the Hamilton report -- 2.4 bbf for 1995 and 2000 -- and the Lippke report -- a 4.2 bbf. Second, the base case in the present study is different. A decline in public timber sales volume has been incorporated into the base case. Public timber sales in the base case for the Westside region decline from 26.35 mcm in 1987 to 22 mcm in 1990, remaining at this level for the remainder of the forecast period. Public timber sales volume in the base case for the Interior region decline from 17.09 to 17.00 in 1990 increasing to 17.85 in 1991 and remaining constant until 2000. Hence the present case is most similar to the proposed management case in the previous studies. Third, demand projections are different than those used in the Hamilton study. In the present study, US demand for coniferous lumber in the West decreases slightly in 1988 (0.5%) and increases an average of 1.1% per year thereafter. By 2000 total demand for softwood lumber is up nearly 15 percent. Softwood lumber demand in the US South decreases slightly in 1988 then grows to nearly the 1987 level by 2000. In the US North, softwood lumber demand decreases steadily falling nearly 8 percent by 2000. Canadian softwood lumber demand increases uniformly by 10 percent in 2000. Chilean softwood lumber demand increases by 65 percent in 2000. In Finland and Sweden, softwood lumber demand grows by 13 percent in 2000. Western Europe sees an increase of 17.5 percent in 2000. Japan's demand for softwood lumber

dollars) in 1995 and reach $188 million in 2000. The total loss in public revenues amounts to $1.9 billion dollars for the 11 year period (1989-2000). The decline in public timber harvest revenues in the Westside is $170 million in 1995 and $166 million in 2000. A total drop of $1.6 billion is observed for the 11 year period. These numbers reflect the decrease in the volume of timber harvested and are adjusted for the subsequent increase in stumpage price observed in the environmental plus trade restrictions scenario.

THE PACIFIC NORTHWEST MARKET SHARES FALL

The competitiveness of the Pacific Northwest declines as the higher timber resource costs increase production costs and decrease profit margins. Log costs for sawmills and plywood mills increase as the decrease in the supply of logs produces higher stumpage prices. Table 11 presents the impact in log costs for the sawnwood and plywood sectors. The log cost impacts are determined by multiplying the change in log costs per cubic meter of product by the total production observed in the environment plus trade restrictions scenario.

Log cost impacts are higher in the US West for both the sawnwood and plywood sectors. Log costs increase $94 million in 1990 for both sectors. By 1995, these costs are $207 million. In 2000 the growth in total log cost increase is $211 million. In the US South log cost for both sawnwood and plywood are lower. These costs amount to $14.04 million in 1990, $63 million in 1995 and $79 million in 2000. For Canada, the increase in log costs for sawnwood production is $6.88, $34.17 and $46.62 million in 1990, 1995 and 2000 respectively.

Log importing countries also experience an increase in their log costs. Japanese

decreases by nearly 12 percent in 2000. The demand for lumber in Korea increases by 50 percent in 2000. In New Zealand, softwood lumber demand increases by 13 percent in 2000. Plywood demand for the US West decreases slightly in 1988 and 1989, then increases nearly 8 percent in 2000. In the US South and North, softwood plywood demand decreases by nearly ten percent in 2000. Softwood plywood demand in Canada is held constant. Any comparison made among the measures presented in the various studies should be interpreted cautiously given these differences.

sawmills experience a growth in log costs of $58.87, $121.68 and $90.08 million dollars in 1990, 1995 and 2000 respectively. As a result, the Japanese mills will attempt to minimize these impacts by locating alternative log sources.

Table 11: Regional log cost impacts for 1990, 1995 and 2000 in million 1988 dollars

| REGION | -------SAWNWOOD------- | | | --------PLYWOOD-------- | | |
	1990	1995	2000	1990	1995	2000
US Westside	45.11	80.47	74.41			
US Eastside	2.25	9.19	12.56			
US Inland	25.49	77.66	86.10			
US West	72.87	167.32	173.04	21.11	39.51	37.90
US South	11.16	45.55	58.36	2.88	17.44	20.19
US North	1.59	7.96	11.57	0.04	0.15	0.18
BC Canada	0.98	5.28	6.68			
Interior Canada	2.59	16.18	19.78			
Eastern Canada	3.31	12.72	20.16			
Canada	6.88	34.17	46.62			
Chile	4.98	16.00	11.54			
Japan	58.87	131.68	90.08			
Korea	4.78	14.63	10.88			
New Zealand	5.38	14.35	9.50			
TOTAL	342.38	958.90	907.42	30.00	76.13	76.03

Global log cost impacts amount to $882 million in 1995 and $839 million in 2000 in the sawnwood and plywood sectors. The global increase in log costs represents a potential

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threat to the industry as non-coniferous and non-wood substitution takes place in the end-use markets.

Table 12: Processing mill profit impacts for 1990, 1995 and 2000 in million 1988 dollars

| REGION | -------SAWNWOOD------- | | | --------PLYWOOD-------- | | |
	1990	1995	2000	1990	1995	2000
US Westside	-32.97	-44.95	-36.37	-12.50	-18.29	-14.44
US Eastside	2.25	2.30	0	0.53	0.70	0.59
US Inland	-7.97	-18.57	-19.73	-0.15	-0.70	-0.56
US West	-38.69	-61.22	-56.10	-12.12	-18.29	-14.42
US South	8.37	3.04	-3.07	5.77	4.36	4.33
US North	1.20	0.96	0.55			
US	-29.12	-56.48	-58.62	-6.35	-13.93	-10.09
BC Canada	5.91	18.99	20.05			
Interior Canada	15.555	43.14	48.03			
Eastern Canada	8.26	21.81	22.18			
Canada	29.72	83.94	90.26			
Chile	-1.00	-0.25	-1.97			
Finland	4.81	8.44	6.82			
Sweden	7.322	23.31	24.50			
West Europe	4.28	23.33	14.63			
Japan	-35.98	-76.81	-31.79			
Korea	-2.81	-1.52	1.02			
New Zealand	-1.40	-1.90	0.84			
TOTAL	-24.19	6.00	45.70	-6.35	-13.93	-10.09

The impacts on profits for sawmills and plywood mills are presented in Table 12. Again these impacts are derived by multiplying the change in the profit defined on a per unit of output by the output observed in the environment plus trade scenario.

As in the case of increased log costs, mill profit impacts are substantially larger for the US West than the US South and Canada. In 1990, the US West experiences a reduction in mill profits of $51 million. In 1995, profits decrease by $80 million. In 2000, profits decline by $60 million. The US South experiences only a slight increase in profits. By 1990, the profit increase is $14 million. In 1995 and 2000, profits are only $7 million higher. Canada experiences a large growth in wood processing profits. In 1990, Canadian sawmills increase their profits by $30 million. The impacts on profits in 1995 and 2000 are $84 and $90 million respectively.

Market shares in the region will decline for the log, lumber and plywood sectors as a result of these increases in log costs and the decline in profits. Domestically, log costs have a higher impact on the US West than the US South. Profits also decline in the US West, while they increase only slightly in the US South. In Canada, profits increase dramatically. As a result, one can expect the Canadian share of sawnwood markets to increase. The South will also gain additional market share in the plywood sector. Both sawnwood and plywood market shares for the PNW decline considerably.

Also, the short supply of logs in international markets will increase the production costs of importing mills as well. One can expect, then, a substitution effect to take place. The substitutes may be in the form of the location of new sources, as the present paper describes, or substitutes of non-wood products in the final markets, as in the case of an increase in the share of non-wooden housing in Japan.

EXPORT VALUES DECLINE IN THE PACIFIC NORTHWEST

Table 13 presents a regional breakdown of the changes in the export values of

sawlogs. Export value of logs from the Westside region decrease by $28.52 million in 1990. In 1995, this figure reaches $152.17 million. By 2000 the value of log exports is reduced by nearly $166.38 million. Globally, the value of log export reductions reaches $114 million in 1995 and $106 million in 2000. The increase in exports of Chilean logs as well as higher stumpage prices around the world make up the difference.

There are two points of interest here. One point is that nearly half of the US Westside loss in log value exports is recovered by overseas regions. Secondly, the Soviet East region increases the value of its log export simply because of higher stumpage prices.

Table 13: Changes in the value of sawlog exports in million 1988 dollars

REGION	1990	1995	2000
US Westside	-28.52	-152.17	-166.38
Chile	-8.59	-24.88	33.27
New Zealand	10.18	13.97	17.49
Soviet East	10.55	30.56	22.11

The value of exports of sawnwood from the US Westside region declines by $135.19 in 1995 and $245.85 million in 2000. Total global export values increased $76.81 million in 1995 and $49.12 million by 2000. Table 14 demonstrates that the decline in export value of sawnwood in the Westside region is recovered by the Canadian regions. In 1995 BC, Interior and Eastern Canada account for $152.86 million. By 2000, the Canadian regions export nearly $206 million more sawnwood. In the plywood sector, the US South increases its share of plywood exports in value terms relative to the US Westside. Globally, there is an increase in the value of plywood exports.

Table 14: Changes in the value of sawnwood and plywood exports in million 1988 dollars

REGION	-------SAWNWOOD-------			--------PLYWOOD--------		
	1990	1995	2000	1990	1995	2000
US Westside	-34.82	-135.23	-245.85	-14.21	-44.69	-44.65
US South	0.08	0.21	16.10	19.00	56.89	57.64
BC Canada	28.23	75.44	45.57	0.14	0.38	0.40
Interior Canada	29.985	77.42	106.08			
Eastern Canada	0	0	54.11			
TOTAL	105.39	154.50	176.83	5.43	13.89	14.98

CONSUMER COSTS INCREASE GLOBALLY

The impacts of the increase in sawnwood and plywood costs to consumer are also substantial. Table 15 illustrates the impacts on a regional basis. These impacts are measured as the change in product prices multiplied by the quantity observed in the environment plus trade restrictions scenario.

The increase in product prices associated with the decline in timber harvests from public lands produces large consumer cost. Globally, consumers pay an additional $794 million in 1995 and $845 million in 2000 for coniferous sawnwood and plywood products. Within the US, these consumer costs are $162 million in 1995 and $184 million in 2000. There are slightly smaller impacts on the Canadian consumers: $115 million in 1995 and $125 million in 2000.

Table 15: The impacts on consumers of sawnwood and plywood in million 1988 dollars

REGION	-------SAWNWOOD-------			-------PLYWOOD-------		
	1990	1995	2000	1990	1995	2000
US Westside	12.15	33.29	34.71			
US Eastside	3.87	11.49	12.56			
US Inland	11.16	33.76	37.67			
US West	27.25	78.55	84.94	7.32	18.76	19.73
US South	19.53	54.65	58.36	8.65	23.26	23.67
US North	2.79	9.61	11.57	0.07	0.19	0.20
US	49.57	119.37	154.87	15.80	42.20	44.44
BC Canada	6.89	21.10	23.39			
Interior Canada	18.145	53.93	59.33			
Eastern Canada	11.57	36.34	40.33			
Canada	36.60	111.37	123.05	1.34	3.56	3.79
Chile	3.99	12.06	9.28			
Finland	6.68	21.10	23.88			
Sweden	8.532	23.65	23.39			
West Europe	29.95	92.15	102.42			
Japan	22.78	54.87	55.64			
Korea	1.97	12.80	12.24			
China	16.00	51.58	60.32			
Soviet West	53.67	146.54	147.22			
Soviet East	18.38	55.10	60.56			
New Zealand	3.79	12.24	9.92			
TOTAL	271.42	793.70	845.22	20.82	55.15	59.19

THE CONCERN FOR GLOBAL ENVIRONMENTAL IMPACTS

As a result of the environmental restrictions on timber harvests and the subsequent log export ban, both the size of the log market in the Pacific Rim and the market share of the Pacific Northwest region decline. Globally, softwood log output decreases by only ten percent of the US reduction in log production. The decline in the log market share in the Pacific Northwest is distributed to other regions in the world, particularly Chile, New Zealand and the Soviet East regions. Higher sawlog costs increase the value of timber and stimulates timber production in other regions. Forests or plantations that are under a sustainable management regime will produce more timber by reducing their rotation age and increasing management intensities. Regions where timber extraction occurs will increase production by expanding harvests into new forest areas.

Increasing timber harvest in other regions of the world may reduce the environmental gains associated with the environmental restrictions in the Pacific Northwest region. This is particularly true if the increases in timber harvest are in regions with environments that are more sensitive to timber harvest. Two environmentally important regions are the Soviet East and areas of tropical forests.

In this study, the Soviet East region is shown as potentially contributing a large portion of the increase in log production in this analysis. The increase in the value of log exports due to price inflation caused by the reduction in global log supply alone is an incentive to raise production targets by planners in the Soviet Union. The proximity of the Korean, Chinese and Japanese markets makes such a production objective even more likely. Environmental restrictions on harvesting Soviet East timber are not likely to be implemented given the current economic needs of the country.

Tropical forest are also a sensitive environment. Although these forest provide mainly hardwoods in the log markets, the increase in log costs to mill operators and finally to

consumers will stimulate the substitution of softwood logs with hardwoods. Such a transition in log use is most likely to occur primarily in mature tropical forests, since managed tropical hardwood plantations are nearly non-existent.

Finally, it is worth noting that higher consumer costs will also allow the substitution of wooden products for non-wooden items. The question arises whether increasing the production of non-wooden products will improve global environmental quality. Although habitat is conserved with the reduction of timber harvests, there may also be increased production of greenhouse gases from non-wood production.

These three examples illustrate the need to analyze environmental restrictions within a global context. It is no longer the case that environmental litigation can occur in isolation. Any environmental gain in one region is likely to cause a loss in some other region since environmental benefits and externalities are internationalized through trade.

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