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An Economic Analysis of U.S. Tariffs on Canadian Lumber Imports

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Abstract:

The economies of the Northwest are driven by natural resource industries, with an emphasis in timber. Consequently, many small communities are dependent on the production of this commodity. As population increases, demand for this resource grows. With the supply of lower cost Canadian lumber into the United States timber market, many lumber producers claim to be adversely affected.

In April 2001 the agreement that the US and Canada were trading under expired. Following the expiration of this contract US imports of Canadian lumber increased. US timber companies claim Canada dumped lumber into the US market and that Canada subsidizes its timber industry. American Lumber producers' lobbied congress to enact industry protection, which resulted in a combined countervailing duty and antidumping tariff of 32%.

The objective of this paper is to present a theoretical and empirical analysis of the effect that the new tariffs on Canadian lumber imports have had on the North American economies. The theoretical analysis provides a background on tariffs and reasons for applying tariffs. The empirical analysis evaluates the effects of the tariffs on US and Canadian timber industries.

An Economic Analysis of U.S. Tariffs on Canadian Lumber Imports.

Introduction

Historically, Inland Northwestern economies have been driven by the utilization of natural resources with an emphasis on timber. Consequently, many small communities are dependent on the production of this commodity. As population increases, the demand for this resource continues to grow. With lower cost Canadian lumber being shipped to the United States timber products market, many lumber mills and other processors in this sector claim to have been adversely affected. This resulted in members of the lumber producing industries lobbing for congress to enact protection for this industry.

The first punitive tariffs were placed on Canadian lumber in 1789. The following two centuries have witnessed a number of border skirmishes regarding the lumber issue. The latest issue in the long-standing timber dispute came in early April 2001 when the contract that the US and Canada were trading under expired. Under the 1996 United States-Canada Softwood Lumber Agreement (SLA) the Canadian provinces of Alberta, British Columbia, Ontario, and Quebec were allowed to export 14.7 billion board feet to the US duty-free each year. (A fee ranging from $50 to $146 per 1,000 board feet was administered to imports that exceed that amount. In 2000 Canada exported over 18 billion board feet to the US.) Immediately following the expiration of the SAL contract, Canadian lumber imports increased—US producers cried foul.

US timber companies claimed Canada dumped softwood lumber into the US market at 40% below cost between April 2000 and March 2001, with complete disregard

for the previous agreement (Greenwire May 17, 2001). American producers also stated that Canada subsidizes its timber industry in the form of low stumpage rates (a fee charged by the government for the right to cut timber.) Because of these claims US producers asked for a countervailing duty and, in a preliminary ruling on August 10, 2001, the Commerce Department placed a 19.3% countervailing duty on Canadian lumber shipments to the US. Then, in November, the US placed an anti-dumping penalty averaging 12.58 % on Canadian lumber shipments.

The Canadian Government challenged the ruling saying that the duties violate the World Trade Organization (WTO) rules. In the last twenty years three countervailing duty cases have been fought over the softwood lumber dispute. Canada won a 1983 case and compromise came in 1986 and in 1994.

Canadian analyst, Reid Carter, from National Bank Financial in Vancouver states that the anti-dumping penalty the United States has imposed on Canadian lumber will ensure that nearly every major Canadian forest company will lose money next year. As of October 1, 2001, approximately 15,000 forestry workers in the province of British Columbia had been laid off. Of the 35 mills on the B.C. coast, 11 are temporarily shut down, five are operating at half normal production, and eight more are only running one shift per day. At full capacity mills run three, eight-hour shifts per day (Stueck 10-01-01). With the addition of the anti-dumping penalty, the shutdowns are expected to reach into Canada's interior; affecting even more of Canada's lumber producing firms.

Objectives

The objectives of this paper are to provide both theoretical and empirical analyses of the effect that the two new Canadian lumber tariffs had on North American

timber markets. The term "timber industry" includes all lumber products, however, this paper will consider the effects of the tariff on the softwood industry, exclusively. Within the softwood lumber industry there are two major components: framing lumber (boards) and structural panels (plywood). Another subset of the softwood industry is cedar products, but for simplicity these are not considered in this study.

Organization

This paper is divided into three sections. The first part of the paper gives insights on market information and background on the American-Canadian timber issue dispute. The following section consists of a theoretical analysis of tariffs. Finally, empirical data is introduced and conclusions are drawn in the third section of this paper.

Market Analysis

North American lumber prices have remained low despite near record demand, suggesting overcapacity. In July 1995 President Clinton signed into law the "Salvage Rider" which led to accelerated salvage logging and released "green" sales from bureaucratic and environmental gridlock. Manufactures in both Canada and the US have responded to low prices by closing down older sawmills and opening up new ones. Lumber companies closed 45 sawmills between 1996 and 1999, mostly in the western US and British Columbia. A report compiled by the US Forest Service's Forest Products Laboratory in Madison, Wisconsin found that 14 major mill start-ups occurred during the same period; ten were in Canada. Two large mills were scheduled to start-up in British Columbia in late 1999. Nearly three-dozen other sawmills increased capacity. Canada's strict environmental regulations have forced its lumber-producing firms to become more efficient than U.S. firms. Mark Suwyn, C.E.O. of Louisiana-

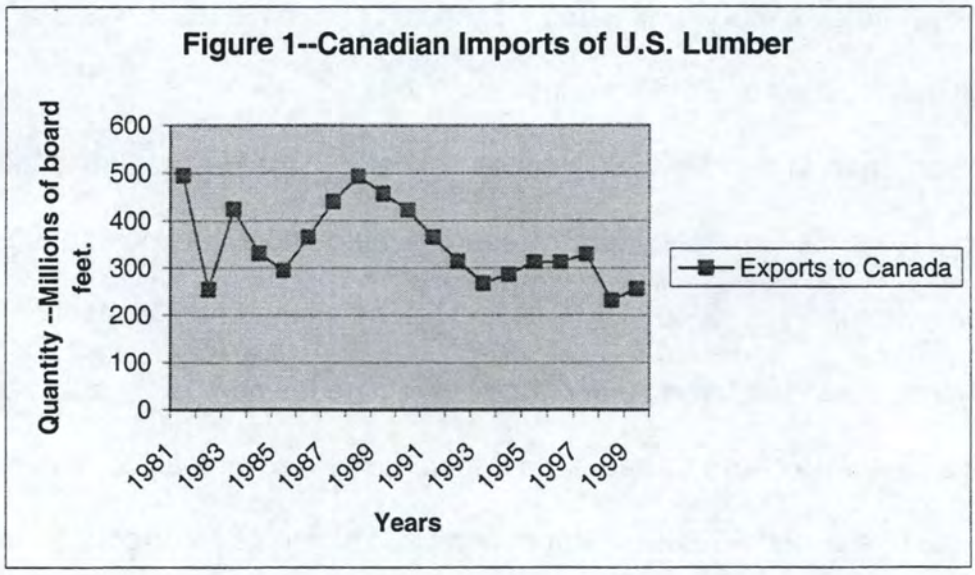
Pacific (a United States based firm) stated, "Canadian mills have modernized and built new mills at a much faster rate than producers in the U.S."

The Asian crisis in the late 1990's caused exports to the Pacific Rim to plummet. Demand in that region fell sharply, thereby reducing the number of export shipments, resulting in an oversupply of wood in the US and Canadian markets. In addition, Japan's economic downturn forced that country to reduce the number of its lumber purchases at a time when both Canada and Scandinavia were increasing market pressure. Canada shipped 26% less lumber and U.S shipments dropped 53% from the previous year's already reduced levels. Consequently, a robust American economy caused other exporters of lumber to target the US with products that otherwise would have been shipped to Asia.

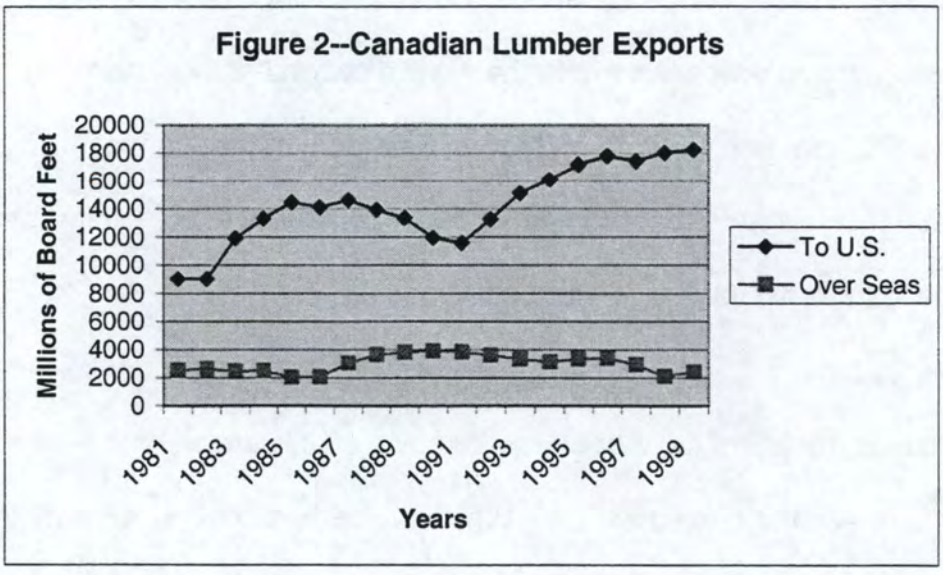
Rising energy costs in 2000 put an additional strain on US producers. Also, trucking companies began to impose fuel surcharges ranging between three and eight percent. "America wood processors face the world's second-highest taxes, and higher transportation cost," claimed Henderson Moore, President of the American Forest and Paper Association. He warns that problems both at home and overseas threaten to erode the American forest industry's competitiveness.

Industry Movement

The past twenty years have been marked by a significant change in lumber imports and exports in the United States. While the US has never been a major lumber supplier to Canada there has been a significant decrease in the number of export shipments that Canada has purchased in recent years (figure 1).

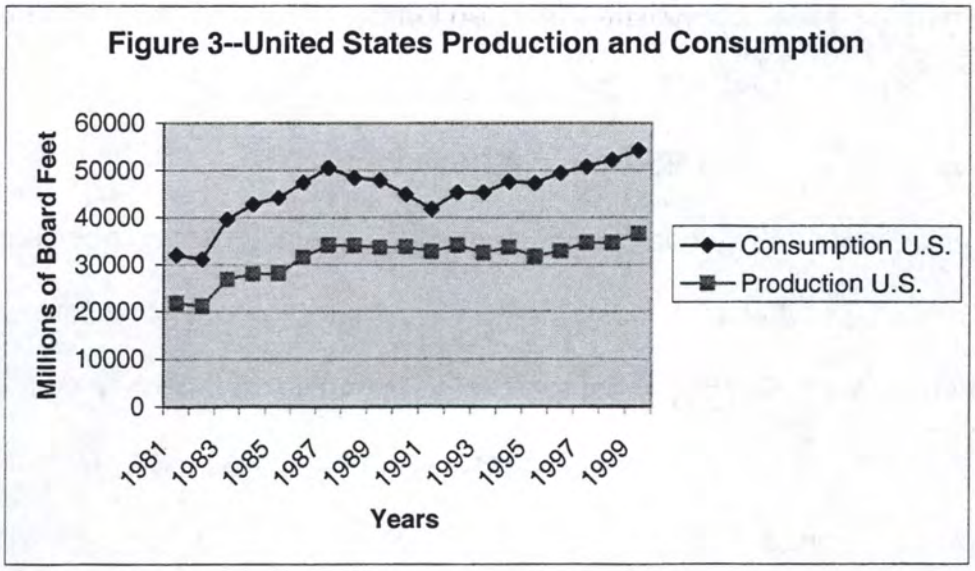


Conversely, the Canadian lumber market has progressed dramatically in the exports market. This increase is mainly in shipments to the United States (Canadian exports destined for the US have increase approximately 40%), as overseas markets have remained stable for Canadian producers (figure 2).



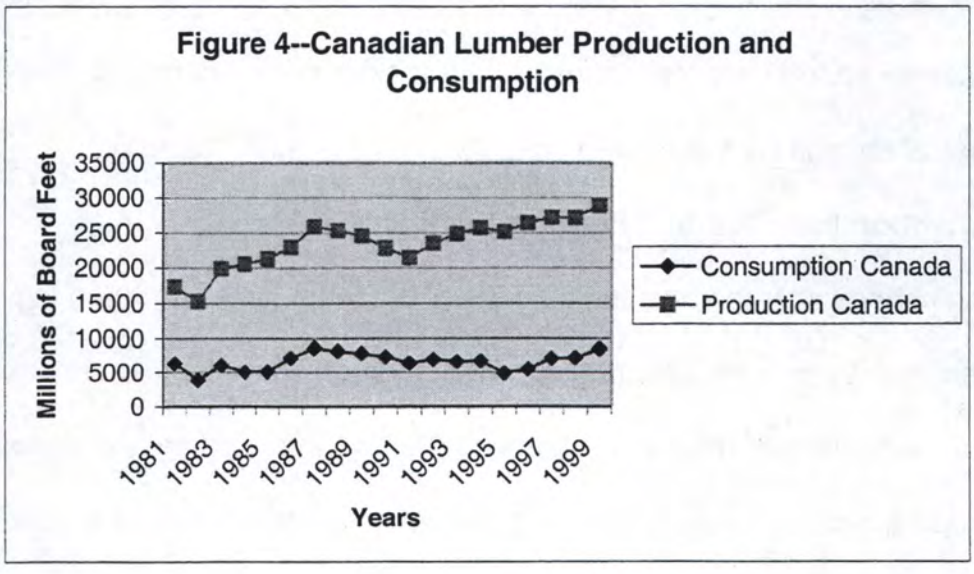
The increase in Canadian exports to the US is due in part to the significant increase in US demand for lumber products. US production has increased a substantial amount in the past two decades, but it has been exceeded by domestic demand (figure 3).

Figure 3--United States Production and Consumption



At the same time, Canadian production has increased while consumption has remained fairly level (figure 5). It is this increased production that has been used to supply the United States excess demand.

Figure 4--Canadian Lumber Production and Consumption



Reasons for Imposing Tariffs

There are two main reasons that lumber producers lobby for protection from imports. The first is, 1) protection from painful economic adjustment and the second is,

2) protection from unfair trade policy. The American lumber producers claim that they are the victims of the latter. Descriptions of each of these reasons are listed below.

1. Protection from Painful Economic Adjustment

As economies around the world change, current comparative advantages and absolute advantages erode and new ones emerge. Previously vigorous domestic industries find themselves facing heavy competition from imports of foreign goods. An increased flow of imports results in downward pressure on domestic prices. Domestic producers are forced to consider the painful choice of leaving the industry, accepting lower returns, or becoming more efficient. Consequently, it is not uncommon for industry leaders to seek government protection when imports threaten domestic markets.

It is the desire to avoid harsh economic adjustment that almost always lies behind the drive for import controls. However, aside from foreign competition, economic and technological changes may be the driving force for the adjustment.

2. Protection from "Unfair" Foreign Trade Policy

Trading nations attempt to restrict imports of competitive goods when they believe that exporters are selling below their production costs on the international market, thereby disturbing normal trade relations. Selling internationally at prices below domestic production costs is called "dumping". Generally, consumers in the importing nations favor the ability to purchase international goods at low prices; however, domestic producer groups often attempt to obtain protection by imposing restrictions (quotas and/or tariffs) on the good in question. These are called "antidumping" measures or countervailing duties.

Before the ITC can recommend trade constraints it must find that:

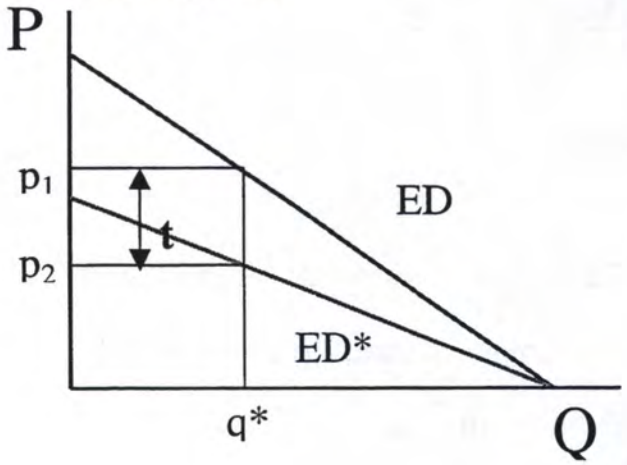
1. There is an increase in the imports of the commodity, either actual or relative to domestic production.
2. The domestic industry is either injured or threatened with serious injury.
3. Increased imports are a substantial cause of injury or threat of injury.
4. Imports must be no less important a cause of injury than any other single cause.

Theoretical Analysis of Tariffs

Tariffs are a traditional form of protective trade policy used by governments of importing nations to shield domestic producers from foreign competition. In addition to raising the domestic price for the protected good, a tariff creates revenue for the government, which is viewed as an additional benefit. An import tariff, such as is examined here, is a tax on a foreign imported item paid at the time it passes into the domestic market.

The two tariffs imposed by the US on Canadian lumber are Ad Valorem tariffs, meaning they are established percentages of the international price. The theoretical framework of this form of tariff is represented in figure 5.

Ad Valorem Tariff
Figure 5

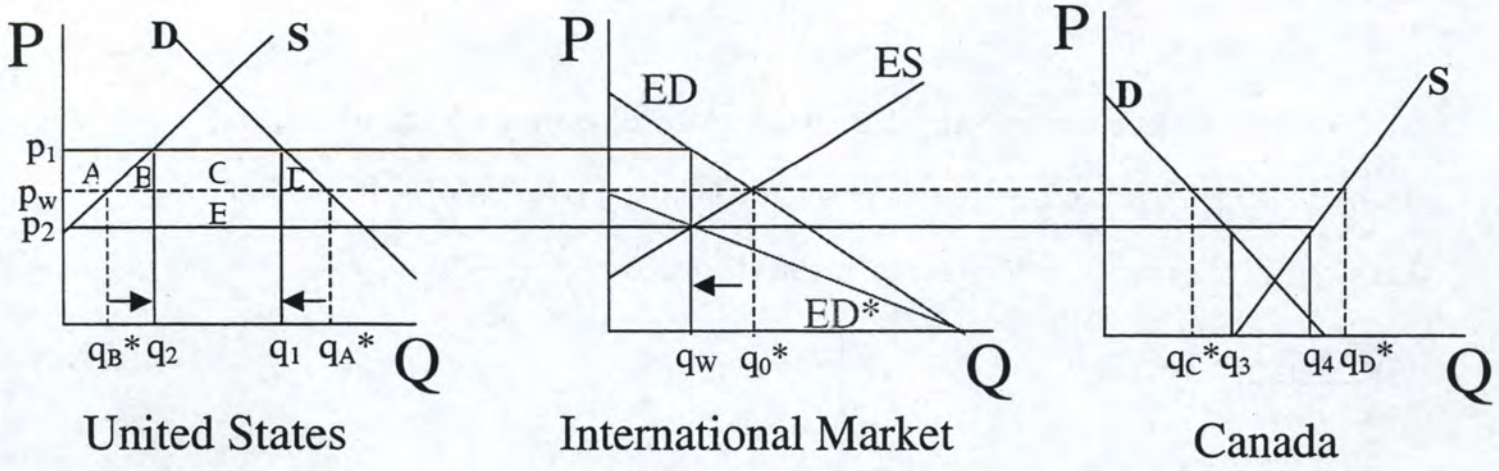


In figure 5, the line ED represents the excess demand before the tariff and the line ED* represents the excess demand after the tariff is imposed. (Excess demand is the amount of a good an importing nations "demands", above what is produces domestically.) The distance between ED and ED* is the per unit value of the tariff. Because t is a percentage of price, this value becomes larger as price for the imported good increases.

To show the effect of a tariff on the domestic market, one must consider the supply and demand curves of both domestic markets and the excess supply and demand of the international market. Because the United States is a large country, it has the ability to affect the price on the international lumber market. This is illustrated in figure 6.

International Effect of a Tariff

Figure 6



As ED rotates down to ED* the world price (p_w) falls to p_2. This results in a reduction of quantity consumed in the international market from q_0* to q_w. On the domestic market total quantity consumed reduces from q_A* to q_1, while the amount

produced increases from q_B^* to q_2. Domestically, producers and consumers face the price p_1, which equals $(p_2 + t)$. The amount of imports decreases from line segment $q_A^* q_B^*$ to the new line segment $q_1 q_2$. The government collects the tariff revenue, which is represented by areas C and E. Domestic producers gain area A; consumers lose areas A, B, C, and D.

Area B is considered a welfare loss due to producer inefficiency because the new higher price results in resources being diverted to the production of lumber products that could have been utilized more efficiently elsewhere in the economy. Area D is welfare loss due to consumer inefficiency because consumers are now paying more and receiving fewer goods than they were before the implementation of the tariff.

The welfare analysis of this type of tariff is as follows:

Producers:	+A				
Consumers:	-A	-B	-C	-D	
Government:			+C		+E
Net effect:		-B		-D	+E

If areas B and C are larger than the additional revenue generated by the tariff (area E), there is a net loss. If areas B and C are smaller than the additional tariff revenue there is a net gain. Because the United States is a large country and therefore has the ability to influence the world price it is possible for the additional tariff revenue generated to be larger than the welfare losses. This means that the government can compensate for the net social losses by redistributing the tariff revenue to those who have been affected.

Empirical Analysis

This section of the paper is designed to evaluate the effects of the tariff on the US and Canadian timber industries. To complete the empirical analysis, time series

data on market prices, production and consumption for each of the nations is required. (See Appendix A.) After variables were identified, multiple regressions were run to obtain supply and demand equations. Because supply and demand functions are systems of simultaneous equations and due to a number of shifts in the supply and demand models, a two-stage regression technique was used to estimate the coefficients for each variable. The independent variables and their expected signs are listed in Table 1.

Stage one of the two stage model was to calculate $\hat{P}$ for the US and Canada, where price is a function of Canadian and US interest rates, and US housing starts. (See equations below.)

$\hat{P}$ Canada = $P = f(i^{CAN}, i^{US}, H)$ *and* $\hat{P}$ $US = P = f(i^{US}, H)$

United States variables were included in the Canadian equation because a large portion of Canadian lumber is shipped to markets within the US.

Table 1. Regression Model Variables

Symbol	Variable	Expected sign
Demand Variables		
P	Price of Framing lumber, net F.O.B. mill	-
$\hat{P}$ Canada	Price as a function of Canadian and US interest rates, and US housing starts.	-
$\hat{P}$ US	Price as a function of US interest rates and housing starts.	-
I^{US}	US Prime Rate	-
H	Actual housing starts US	+
i^{can}	Canadian 30 year mortgage rate	-
Supply Variables		
P	Price of Framing lumber, net F.O.B. mill	+
$\hat{P}$ Canada	Price as a function of Canadian and US interest rates, and US housing starts.	+
$\hat{P}$ US	Price as a function of US interest rates and housing starts.	+

The second stage of the two-stage regression is to run a regression for all of the dependant variables against the necessary independent variables. This resulted in a total of six regressions. (The summary output for each of the regressions is located in Appendix B.) These multiple regressions yielded the following equations (t statistics are listed in parentheses under each coefficient):

Canadian Supply and Demand;

$$S^{CAN} = Q_{prod} = 14{,}220.17 + 33.595\ \hat{P}\ Canada \qquad R^2 = .82$$
$$(8.48) \qquad (5.94) \qquad F = 35.36$$

$$D^{CAN} = Q_{con} = 20{,}036 - 750.683\ I^{can} - 18.886\ \hat{P}\ Canada \qquad R^2 = .23$$
$$(2.18) \qquad (1.63) \qquad (1.24) \qquad F = 2.32$$

$$ES = 9{,}088.783 + 28.362\ \hat{P}\ Canada \qquad R^2 = .79$$
$$(8.57) \qquad (7.93) \qquad F = 62.98$$

United States Supply and Demand;

$$S^{US} = Q_{prod} = 17{,}895.12 + 49.146\ \hat{P}\ US \qquad R^2 = .58$$
$$(5.97) \qquad (4.78) \qquad F = 22.86$$

$$D^{US} = Q_{con} = 27{,}018.35 - 489.58\ I^{US} + 19.71\ H - 4.169\ P^1 \qquad R^2 = .89$$
$$(4.95) \qquad (0.28) \qquad (0.68) \qquad (3.94) \qquad F = 14.88$$

$$ED = 30{,}307.56 - 49.106\ \hat{P}\ US \qquad R^2 = .27$$
$$(3.08) \qquad (1.63) \qquad F = 2.67$$

To account for the tariff P hat is multiplied by (1+t) as is shown below.

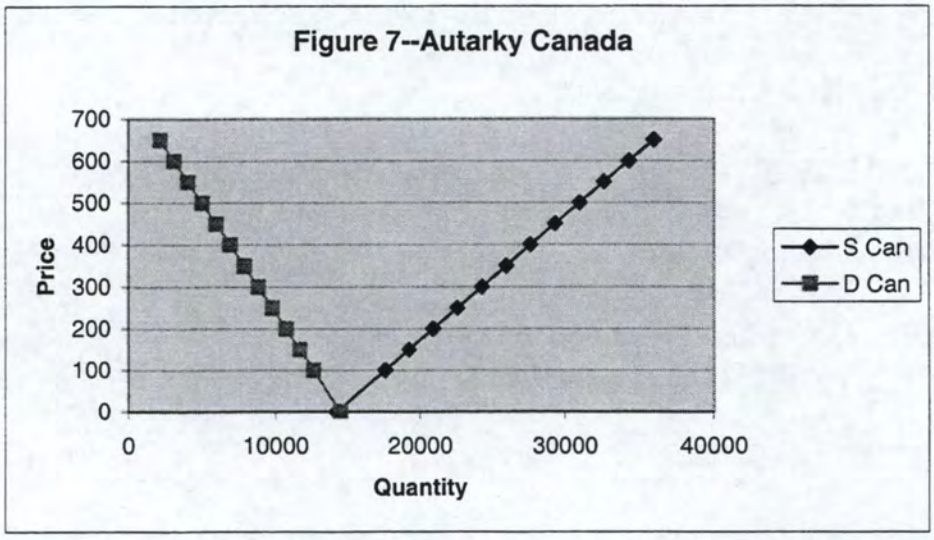
$$ED = 30307.56 - 49.106\ \hat{P}\ US\ (1+t)$$

- Where t represents the tariff, combined total of 32%.

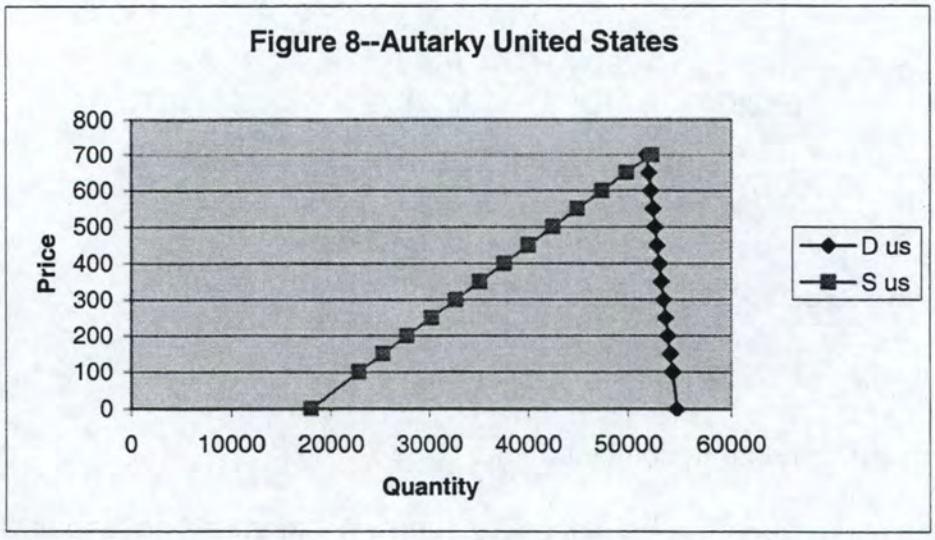
To solve for market equilibriums, the respective supply and demand equations were set equal to each other, and then price and quantity were solved for (See appendix C).

[1] The US demand equation was derived from an Ordinary Least Squares regression. This was done to avoid perfect multicollinearity between P hat and the other demand variables.

Holding other variables constant at the 1999 levels, price was varied to map the current supply and demand lines. The graphs below (figures 7 and 8) represent the respective equilibriums in an autarky situation; where autarky is defined as the nation's equilibrium point in the absence of trade.



Autarky equilibrium in Canada; Quantity—14,392, Price--$5.12.

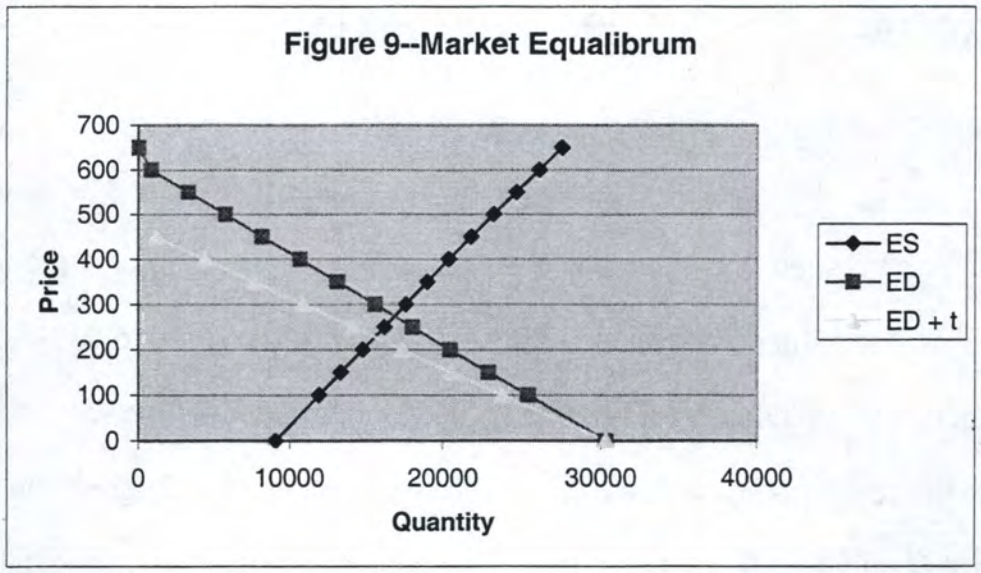


Autarky equilibrium in the United States; Quantity—50,934, Price--$672.26

Figure 9 illustrates the excess supply and demand curves derived from this model. For reasons of simplicity the model used the excess supply and excess demand

equations represented above, again holding interest rates and housing starts constant at the 1999 level in order to obtain a picture of the current market situation. Various price levels were inserted into the equation to obtain excess supply and demand lines. The ED + t line represents the excess demand after the implementation of the tariff; a rotation the excess demand curve in proportion to the tariffs.

Figure 9--Market Equalibrum



International Equilibrium—Before Tariff; Quantity—16,857, Price--$273.90

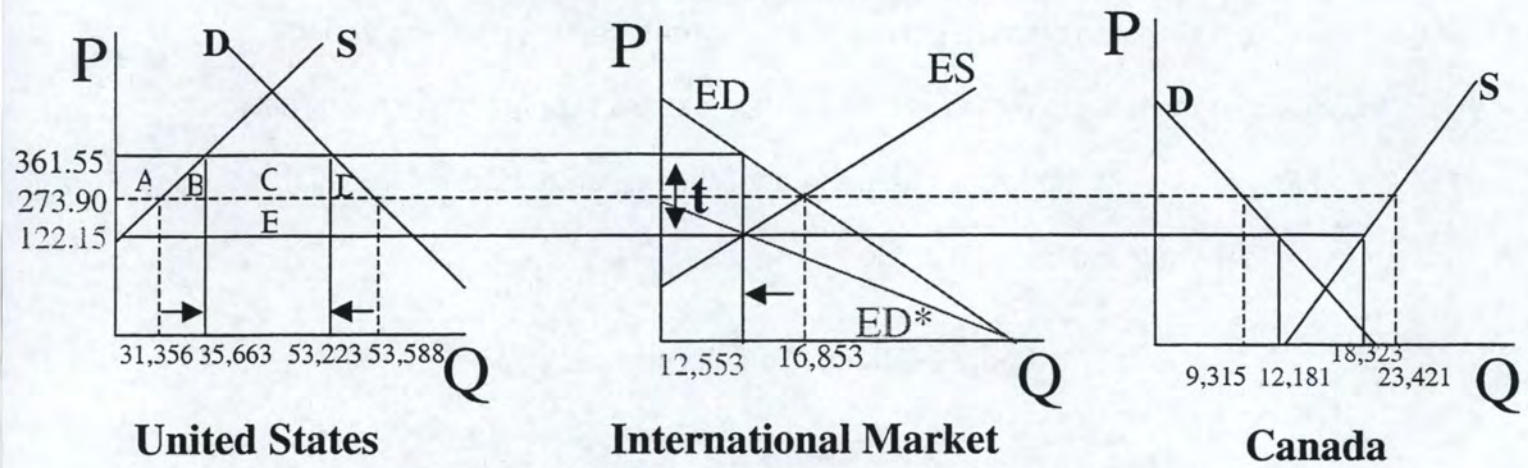
International Equilibrium—After Tariff; Quantity—12,553, Price--$361.55 US

Price--$122.15 Canada

Conclusions

The results from the empirical section are combined in a graph (figure 10) similar to the one presented in the theoretical section of this paper. While this graphic is a gross simplification of the actual United States/Canadian timber market, it does provide a general overview of the effects that the tariffs has on both nations in terms of price and quantity.

Figure 10—US/Canada Lumber Market



Here it can be seen that the addition of the tariff on Canadian lumber produces a substantial increase in the domestic timber prices (a rise from $273.90 to $361.55). Domestic production will rise from 31,356 to 35,663[2], while consumption will remain fairly close to the previous amount (a decrease from 53,588 to 53,223) given the inelastic demand curve. [3] The effect of the tariff will have a substantial negative impact on the Canadian market and the lumber producers in that country, as they will face a 44.5 percent reduction in price.

[2] The estimation of these quantities was determined by inserting the new prices into the respective supply and demand equations.

[3] The difference in quantities is due to the fact that actual data was used for the regressions instead of "forcing" the excess supply and demand curves. This graph partially takes into account the international markets and US exports. This is why demand US less supply US does not equal the intersection of the ES and ED curves.

Appendix A--Price and Quantity Data for the United States and Canada

The following data was used to estimate supply and demand functions for the United States and Canada.

United States Data

Year	Interest rates	Housing Starts	Price	Consumption US	Production US	U.S. Exports to Canada
1999	8	1554	402	54263	36605	255.5
1998	8.35	1612	349	52209	34678	230.7
1997	8.44	1441	417	50870	34663	329.5
1996	8.27	1477	401	49478	32859	312.5
1995	8.83	1354	337	47298	31782	312.7
1994	7.15	1372	411	47653	33657	285.7
1993	6	1199	394	45382	32517	267.2
1992	6.25	1095	287	45365	34151	314
1991	8.46	1014	236	41863	32800	365.7
1990	10	1193	229	45003	33819	422.9
1989	10.87	1376.1	240	47966	33703	457.4
1988	9.32	1488.1	228	48462	34100	493.9
1987	8.22	1620.5	229	50557	34198	440.8
1986	8.33	1805.4	206	47492	31572	365.5
1985	9.93	1741.8	194	44240	28068	294.4
1984	12.04	1749.5	199	42832	27995	330.8
1983	10.79	1703	221	39611	26828	424.6
1982	14.86	1062.2	169	31168	21178	253.6

*Interest rates--yearly average of the prime rate for the United States.

*Price--composite price of framing lumber. This is designed as a broad measure of price movement in the lumber industry. (The composite prices through 1992 are a weighted average of nine key framing lumber prices. After 1992, the prices represent a weighted average of 15 framing lumber prices.)

*All lumber units are in millions of board feet.

*Housing starts--actual number of starts of privately owned units in thousands.

To determine excess demand US production was subtracted from US consumption.

Canadian Data

Year	Consumption Canada	Production Canada	Canada Exports		Interest Rates
			To U.S.	Over Seas	
1999	8521.6	28917	18238	2412.9	7.39
1998	7234.1	27157	18034.4	2119.2	6.9
1997	7117.8	27173	17440.9	2943.8	7.07
1996	5498	26380	17800.1	3394.4	7.61
1995	4907	25147	17207.8	3344.9	9.22
1994	6727.2	25688	16129.3	3117.2	9.34
1993	6666.6	24855	15131.5	3324.1	8.72
1992	6974	23523	13262	3601	9.52
1991	6410.5	21467	11584.7	3837.5	11.16
1990	7336.7	22789	11963.6	3911.6	13.24
1989	7851.8	24570	13368.8	3806.8	12.05
1988	8195.3	25267	13926.8	3638.8	11.6
1987	8637.8	25870	14617.7	3055.3	11.14
1986	7146.6	22952	14115	2055.9	11.22
1985	5117.5	21328	14470	2034.9	12.18
1984	5077.6	20588	13327.9	2513.3	13.61
1983	6033.9	19984	11906.7	2468	13.29
1982	3855.3	15288	9035.4	2650.9	16.69

*In this data set Interest Rate is the thirty-year mortgage rate for Canada.

*Canadian consumption is an estimate as current data was unavailable. The numbers obtained for consumption were determined as follows; total Canadian production less Canada's total exports plus imports (See example below.) The only import data available from Canada were those imports coming from the United States.

Year--1995

Production	25147
Exports	(17207.8 + 3344.9)
Imports	312.7
Consumption	4907

To determine excess supply Canadian consumption was subtracted from Canadian production.

Appendix B—Regression Results

Table b.1. Summary Output—Supply Canada; 2-stage Regression.

Regression Statistics				
Multiple R	0.829747			
R Square	0.68848		*F*	*Significance F*
Adjusted R Square	0.66901		35.36113	2.05E-05
Standard Error	1870.479			
Observations	18			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	14220.17	1675.128	8.489001	2.55E-07
P hat	33.59532	5.649574	5.946523	2.05E-05

Table b.2. Summary Output—Demand Canada; 2-stage Regression.

Regression Statistics				
Multiple R	0.486116			
R Square	0.236309		*F*	*Significance F*
Adjusted R Square	0.134483		2.320725	0.132398
Standard Error	1237.949			
Observations	18			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	20036	9167.081	2.185646	0.045113
Interest Rates--Canada	-750.683	458.3183	-1.63791	0.122243
P hat	-18.8865	15.19308	-1.2431	0.232913

Table b.3. Summary Output—Excess Supply Canada; 2-stage Regression.

Regression Statistics				
Multiple R	0.892986			
R Square	0.797425		*F*	*Significance F*
Adjusted R Square	0.784764		62.98295	6.15E-07
Standard Error	1183.225			
Observations	18			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	9088.783	1059.65	8.577152	2.22E-07
P hat	28.36232	3.573799	7.93618	6.15E-07

Table b.4. Summary Output—Supply US; 2-stage Regression.

Regression Statistics				
Multiple R	0.76705			
R Square	0.588366		*F*	*Significance F*
Adjusted R Square	0.562639		22.86945	0.000204
Standard Error	2461.429			
Observations	18			
	Coefficients	*Standard Error*	*T Stat*	*P-value*
Intercept	17895.12	2996.546	5.971913	1.95E-05
P hat US	49.14685	10.27704	4.782202	0.000204

Table b.5. Summary Output—Demand US; years 1999-1991. [4]

Regression Statistics				
Multiple R	0.948301			
R Square	0.899275		*F*	*Significance F*
Adjusted R Square	0.83884		14.88002	0.006319
Standard Error	1547.042			
Observations	9			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	27018.35	5453.36	4.954441	0.004269
Price	-4.169732	14.63467	-0.284922	0.787129
Interest Rates US	-489.5801	710.6297	-0.688938	0.52152
Housing Starts	19.71026	4.995617	3.945511	0.0109

Table b.6. Summary Output—Excess Demand US: years 1999-1991.Appendix C—

Regression Statistics				
Multiple R	0.525617			
R Square	0.276273		*F*	*Significance F*
Adjusted R Square	0.172884		2.672158	0.146133
Standard Error	2616.064			
Observations	9			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	30307.56	9820.087	3.086282	0.017659
P hat US	-49.1064	30.04052	-1.63467	0.146133

[4]The equations for US demand and ED are derived from regressions on nine observations where the others include eighteen observations. In addition, US demand is an OLS regression; the other equations are TSLS regressions. The rational for using fewer observations in US demand and ED is numerous demand shifts during the past twenty years, therefore, the demand equation traced the supply line. Also, TSLS could not be used to obtain US demand, as P hat is a function of all other variables; all of which are included in the demand equation. An additional supply variable needs to be identified and included in the determination of P hat.

Algebraic Solutions

Autarky Equilibrium—Canada

$S^{CAN} = D^{CAN}$

Where,

$S^{CAN} = Q_{prod} = 14220.17 + 33.59532\ \hat{P}$ Canada and

$D^{CAN} = Q_{con} = 20036 - 750.683\ i^{can} - 18.8865\ \hat{P}$ Canada.

So, $20036 - 750.683\ i^{can} - 18.886\ \hat{P} = Q = 14220.17 + 33.595\ \hat{P}$

Now substituting in the constant term for i^{can}, 7.39 (the 1999 value) yields:

$14488.453 - 18.886\ P = 14220.17 + 33.595\ P$

Solving for P:

$14220.17 + 52.481\ P = 14488.453$

Then combining like terms yields the results:

$52.481\ P = 268.453$

$P = 5.12$

Now by substituting the above value in to the supply and demand equations, quantity can be determined.

$S^{CAN} = Q_{prod} = 14220.17 + 33.595\ (5.12)$

$S^{CAN} = Q_{prod} = 14392$

$D^{CAN} = Q_{con} = 20036 - 750.683\ i^{can} - 18.8865\ (5.12)$

$D^{CAN} = Q_{con} = 14488.453 - 18.886\ (5.12)$

$D^{CAN} = Q_{con} = 14392$

Autarky Equilibrium—United States

$S^{US} = D^{US}$

Where,

$S^{US} = Q_{prod} = 17895.12 + 49.146\ \hat{P}$ US

$D^{US} = Q_{con} = 27018.35 - 489.58\ I^{US} + 19.71\ H - 4.169\ P$

So, $17895.12 + 49.14685\ P = Q = 27018.35 - 489.58\ I^{US} + 19.71\ H - 4.169\ P$

Now substituting in the 1999 values for I^{US} (8) and H (1554) yields constants:

$17895.12 + 49.146\ P = 54730.7 - 4.169\ P$

Solving for P:

$49.146\ P = 35835.58 - 4.169\ P$

$53.306\ P = 35835.58$

$P = 672.26$

Now by substituting the above value of P into the supply and demand equations, quantity can be determined.

$S^{US} = Q_{prod} = 17895.12 + 49.146\ (672.26)$

$S^{US} = Q_{prod} = 50934$

$D^{US} = Q_{con} = 54730.7 - 4.169\ (672.26)$
$D^{US} = Q_{con} = 50928$

International Equilibrium—Before Tariff
ES = ED
Where,
ES = 9088.783 + 28.36232 $\hat{P}$ Canada
ED = 30307.56 - 49.1064 $\hat{P}$ US

So, 9088.783 + 28.36232 P= Q = 30307.56 - 49.1064 P
Solving for P:
30307.56 = 9088.783 + 77.468 P
21218.77 = 77.468 P
P = 273.90

Now by substituting the value for P into the excess supply and excess demand equations, quantity is reveled.
ES = 9088.783 + 28.36232 (273.90)
ES = 16857

ED = 30307.56 - 49.1064 (273.90)
ED = 16853

International Equilibrium—After Tariff
ES = ED + t
Where,
ES = 9088.783 + 28.36232 $\hat{P}$ Canada
ED + t = 30307.56 - 49.1064 $\hat{P}$ US (1+t)

So, 9088.783 + 28.36232 P= Q = 30307.56 - 49.1064 P (1 + t)
Now by substituting in the value of P (273.90) and the percentage of the tariff (32%) produces the following excess demand quantity.
ED = 30307.56 - 49.1064 (273.90) (1.32)
ED = 12553
In the US producers and consumers face a price of $361.55, ($273.9*1.32)

Now, given the new quantity demanded it is possible to solve for the Canadian producers price by using the excess supply equation.
ES = 12553= 9088.783 + 28.36232 P
ES = 3464.457 = 28.36232 P
Solving for P:
P = 122.15
The Canadian producers price is $122.15.

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