Welfare impacts of the 1996 United States – Canada Softwood Lumber (trade) Agreement

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Abstract: This paper investigates welfare impacts of the 1996 United States – Canada Softwood Lumber (trade) Agreement (SLA), which set up a tariff-regulated quota system to restrict softwood lumber export from Canada to the United States. An aggregate price model is used to estimate the price impact of the SLA, and the implied quantity and welfare effects are examined. The results show that while the anticipated change in lumber price is about S59 in 1997 U.S. dollars or 16%, on average, for the first 4 years under the SLA, the gains to U.S. producers of softwood lumber are large and the losses to U.S. consumers are much larger. In addition, Canadian producers have benefitted from the SLA in the U.S. market, and the Canadian government has collected a small amount of additional export fees. As the overall efficiency costs of the SLA are modest, the SLA can be seen as an effective means of welfare transfer from U.S. consumers to the U.S. and Canadian producers. These results should provide a framework for ongoing trade policy debate.

Résumé : Cette étude examine les impacts sociaux de l’accord commercial sur le bois d’œuvre résineux entre le Canada et les États-Unis signé en 1996. Cet accord établit un système de tarifs basé sur des quotas dans le but de restreindre l’exportation de bois d’œuvre résineux du Canada vers les États-Unis. Un modèle de prix global est utilisé pour évaluer l’impact de l’accord sur le prix. La quantité impliquée et les effets sociaux sont également étudiés. Les résultats montrent que, tandis que le changement anticipé dans le prix du bois d’œuvre est d’environ 59$ en dollars américains de 1997 ou 16% en moyenne pour les quatre premières années de l’accord, les gains pour les producteurs américains de bois d’œuvre résineux sont importants et les pertes pour les consommateurs américains sont beaucoup plus importantes. De plus, les producteurs canadiens ont bénéficié de l’accord et le gouvernement canadien a prélevé un faible montant supplémentaire de taxes à l’exportation. Étant donné que les coûts globaux d’efficacité de l’accord sont faibles, cet accord peut être considéré comme un moyen efficace de transfert de richesse des consommateurs américains vers les producteurs américains et canadiens. Ces résultats devraient constituer un cadre de référence dans le débat en cours sur la politique commerciale.

Introduction

Over the last 20 years, United States – Canada trade in forest products has received a great deal of attention in the media, from politicians on both sides of the border, and in the discussions of international organizations such as the General Agreement on Tariffs and Trade (GATT) and the World Trade Organization (WTO). A dispute over softwood lumber imported from Canada to the United States, a U.S.$7 billion business in 1999, has been the most controversial. Apparently this dispute is the largest forest-products trade dispute in the world and the largest and longest lasting trade dispute between these two countries (Zhang 1997; Cashore 1998). People involved in the dispute have described it as a “softwood lumber war”, and in recent years the two countries have experienced four rounds of accusation, threats, investigation, negotiation, and settlement. The latest government-to-government consultation between the United States and Canada has resulted in a Softwood Lumber (trade) Agreement (SLA), which set up a tariff-regulated quota system to restrict softwood lumber from Canada to the United States (Coalition for Fair Lumber Imports 1996). The SLA covers 5 years from April 1, 1996, to March 31, 2001.

The SLA has been agreed to and welcomed by the Coalition for Fair Lumber Imports, a group representing some U.S. softwood lumber producers that has lobbied for restricting Canadian softwood lumber imports in the last two decades and some Canadian producers supporting its position. On the other hand, consumer groups in the United States, led by the National Association of Home Builders and the National Lumber and Building Material Dealers Association, are firmly against the SLA. They point out that the SLA has led to higher lumber prices, which hurt U.S. homebuilders and homebuyers (Anonymous 2000). The parties in the debate tend to be polarized, and their arguments are uncompromising. The SLA has recently expired, and policy makers are discussing whether both countries should renew the SLA or try to find a long-term solution to this trade dispute. Naturally, the welfare impacts of the SLA (who gains, who loses, and how much is lost) has become the primary focus in the trade policy debate.

The purpose of this paper is to assess the economic consequences of the SLA. Specifically, we estimate the impacts of the SLA on prices, imports of Canadian lumber, U.S. production of softwood lumber, and the consequent effects on producer profits and U.S. consumer costs. The results of this paper could be used in informed debate over United States – Canada softwood lumber and other trade policy. This paper begins with a summary of the SLA, followed by literature
review and research methodology. The remaining sections present a price impact model and data, empirical findings, and conclusions and discussion.

The structure of the SLA

The SLA defines Canada’s fee-free export limit, fee level, fee collection, and trigger-price mechanism. Under this agreement, Canada agreed to impose an export control regime on shipments of softwood lumber from British Columbia, Alberta, Ontario, and Quebec to the United States. In return, the United States agreed not to bring trade action against imports of softwood lumber for the 5-year term of the agreement. The main points of this complicated agreement are the following.

(1) Fee-free export limit and fee level

Annual fee-free exports from British Columbia, Quebec, Ontario, and Alberta, which collectively account for more than 95% of Canadian softwood exports to the United States, will be limited to $146.25/mbf. The next 650 × 10^6 board feet (mbf) exports will initially be subject to a U.S. $50 per 1000 board feet (mbf) export fee. Additionally covered exports will be subject to a $100/mbf fee. Thus, softwood lumber exports from these four provinces to the United States have been under a “tariff-regulated quota system”. The fee level is adjusted annually for the difference in inflation rate between the two countries.

(2) Fee collection

A fee-free quota is allocated to individual Canadian exporters with annual softwood production of 10 mbf by the Canadian government. “Quarterly band fees” will be collected when an exporter exceeds 28.75% of its annual fee-free quota. The fee can be refunded if the total exports from the four provinces are less than 28.75% of the annual fee-free quota (4.226 bbf). Similarly, the fee can be refunded if the total annual export is less than the fee-free export quota. The fee is remitted to individual provinces on an annual basis.

(3) Trigger-price mechanism

The trigger price is defined as the mean for a complete calendar quarter of the price reported by Random Lengths Inc. for eastern, spruce–pine–fir, kiln-dried, and standard and better, delivered to the Great Lakes. If the trigger price meets or exceeds US$405/mbf in any quarter during the first 2 years, or US$410/mbf thereafter, 92 mbf of additional fee-free exports will be allocated in the subsequent quarters within 1 year of issuance. This arrangement makes increasing the fee-free export limit possible.

The agreement also covers custom procedures, reporting, monitoring, and dispute settlement systems. The structure of this agreement makes individual firms report their export volumes each month and quarter to the Canadian government, but the quotas are set annually. Since the agreement is at country level, a firm paying a $50 or $100 fee for export volume exceeding its fee-free export limits in a particular quarter or year does not mean that Canadian exporters as a whole are paying for that fee for that quarter or year. Consequently, the effectiveness and actual market impact of the SLA will rely on whether Canada as a whole exceeds its free quota and on the amount by which it is exceeded in a particular year.

Literature review and methodology

In addition to “truckloads” of studies, briefings, and other materials financed or produced by forest industry and governments in both countries and the U.S. softwood lumber consumer groups, many scholars have independently studied the softwood lumber trade issues (e.g., Irland 1986; Anderson and Cairns 1988; Fox 1991). Previous economic studies have focused on stumpage difference between the two countries (e.g., Haley 1980; Uhler 1991), the impact of hypothetical trade-restriction measures (Adams and Haynes 1980; Boyd and Krutilla 1987), the economic impact of an earlier agreement (the 1986 Memorandum of Understanding or MOU) between the two countries (Kalt 1988; Wear and Lee 1993), or ex ante estimations on the impact of the SLA and other supply constraints (e.g., Smyth 1997). In this study, we use a structural model to estimate the ex post economic impacts of the SLA.

The present study first uses an aggregate price impact model based on U.S. demand, U.S. supply, and Canadian export supply. With our price impact estimate and estimates of structural market parameters (supply and demand elasticities) from previous studies, we test for a discernible, though highly aggregate, change in price and quantity with the SLA. This will allow us to estimate changes in standard welfare measures.

Following Kalt (1988) and Wear and Lee (1993), we treat softwood lumber as a homogenous commodity and model the U.S. lumber markets in aggregate. This aggregate view will be instructive for looking at the overall impacts of the SLA. The model will not address the spatial structure of regional submarkets, transportation costs, and spatial distribution of consumption. Consumers are assumed to be indifferent to lumber sources, and demand and supply can be seen as a function of a single representative price, an assumption proven to be reasonable by Uri and Boyd (1990) and Murray and Wear (1998). This view of market structure has been used to examine United States – Canada trade in potash (Picketts et al. 1991) and poultry (Moschini and Meilke 1991).

Figure 1 shows the U.S. softwood lumber markets and illustrates our approach to estimating the market and welfare impacts of the SLA. The demand function is shown as D,
Fig. 1. Structure of the U.S. softwood lumber market. Note that since \( Q_3 = Q_2 \), \( Q_3 \) has been omitted from this figure.

shifting in response to demand factors such as housing starts, income, and the prices of substitutes. There is a two-part lumber supply with total supply \( (Q_0St) \) equal to the sum of Canadian supply \( (P_0Sc) \) and domestic supply (including supply from other Canadian territories and countries, \( Q_0So \)).

Under the SLA, an export fee of $50/mbf is placed when the total export from Canada exceeds a certain quota \( (Q_1) \) until the additional 650 mmbf annual limit \( (DQ_1) \) is reached. Any additional export beyond \( (Q_2 = Q_1 + DQ_1) \) is subject to a fee of $100/mbf. Thus, the Canadian supply curve is changed from \( P_0Sc \) to \( P_0abcde \). The total supply curve is changed from \( Q_0St \) to \( Q_0fghij \).

The effectiveness of this “tariff-regulated quota system” will depend on overall supply and demand. For example, if the demand curve is below point \( f \) and the total supply curve is \( Q_0fghij \), then Canadian exports will be less than \( Q_1 \), and price will be less than \( P_1 \). Consequently, the SLA will have no welfare effect on consumers and producers in both countries. The Canadian supply curve shifts to the left (up), which could lead to Canadian supply is priced out before reaching the 14.7 bbf fee-free quota, or the U.S. supply curve shifts to the right (down), which indicates that U.S. softwood lumber becomes cheaper, could lead to the same result, as would a combination of these changes in supply and demand.

When the demand and supply curves cross above point \( f \), the tariff-regulated quota system becomes effective. There are four possible scenarios where the demand curve crosses the supply curve \( (Q_0fghij) \) above point \( f \): between points \( f \) and \( g \), between \( g \) and \( h \), between \( h \) and \( i \), and between \( i \) and \( j \). Consequently, the market price will be between \( P_1 \) and \( P_1 + 50 \), \( P_1 + 50 \) and \( P_2 \), \( P_2 \) and \( P_2 + 50 \), and greater than \( P_2 \).

\[ \text{Note that we assume } P_0 > 0 \text{ in Fig. 1. Thus, the U.S. supply curve (and the total supply curve) intersecting with the horizontal axis mean that the U.S. producers will produce } Q_0 \text{ amount of lumber at price } = P_0, \text{ not at price } = 0. \]

\[ \text{As } Q_1 \text{ changes every year because of the trigger-price mechanism under the SLA, it is adjusted accordingly in this study.} \]
Table 1. Theoretical fee-free quota and actual Canadian softwood lumber exports to the United States (mmbf).

<table>
<thead>
<tr>
<th>Year</th>
<th>Theoretical fee-free quota</th>
<th>Actual export\textsuperscript{a,b}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EB Bonus</td>
<td>Total fee-free export</td>
</tr>
<tr>
<td>1996–1997</td>
<td>14 700 276</td>
<td>14 976</td>
</tr>
<tr>
<td>1997–1998</td>
<td>14 700 276</td>
<td>14 976</td>
</tr>
<tr>
<td>1998–1999</td>
<td>14 700 0</td>
<td>14 700</td>
</tr>
<tr>
<td>1999–2000</td>
<td>14 700 368</td>
<td>15 068</td>
</tr>
</tbody>
</table>

Note: Data are from Canadian Forest Service (various issues) Canada–United States softwood lumber agreement quarterly statistical monitor (Table 2).

\textsuperscript{a}Based on data provided by the Canadian Department of Foreign Affairs and International Trade (Table 3 of Canadian Forest Service, various issues). These numbers are slightly lower than those reported by the U.S. Customs (Table 4 of Canadian Forest Service, various issues). The difference may be due to conversion factors, product classification (e.g., softwood lumber and remanufactured softwood lumber, which is not part of the SLA), and timing (revision of data). Data in the last column of this table show that the aggregate Canadian export was above \( Q_2 \) in the first year, and just about or slightly above \( Q_2 \) in the second, third, and fourth years of the SLA. EB, established base; LFB, lower fee base; UFB, upper fee base.

\textsuperscript{b}Under the SLA, Canadian exporters are allowed to pay export fees for certain lumber exported to the U.S. even if they (either individually or collectively) have not exhausted all quota allocated to them.

\textsuperscript{c}Amount on which fee should have been paid (= total actual export – theoretical fee-free quota).

\textsuperscript{d}Seventy-three of the 723 mmbf are accounted as low fee export for the previous year.

\( P_2 + 50 \) (Fig. 1). Which scenario becomes a reality in any particular year depends on the level of U.S. supply, Canadian export supply, and U.S. demand.

Table 1 shows the theoretical fee-free quota for and the actual exports of Canadian producers in the first 4 years under the SLA. It indicates that Canadian producers as a whole paid a $50/mbf fee for export volume exceeding \( Q_1 \) in 3 years (1997–1998, 1998–1999, and 1999–2000) and that their total exporting quantity was just about equal to or slightly greater than \( Q_2 \). In the other year (1996–1997) they paid a $100 fee for export volume exceeding \( Q_2 \). In Fig. 1, we only consider the scenario when they paid a $50 fee and when they collectively exported just about \( Q_2 \) amount of lumber, the demand curve crossing the supply curve between \( h \) and \( i \). In this scenario, Canadian producers as a whole are paying a $50/mbf fee for the amount of export volume between \( Q_1 \) and \( Q_2 \).

When the Canadian exports equal \( Q_2 \), the demand curve crosses the total supply curve between points \( h \) and \( i \). If the market equilibrium price is \( P_3 \) and the equilibrium quantity is \( Q_3 \), the U.S. quantity supplied equals \( Q_3 \) (\( Q_2 = Q_2 + Q_3 \)). Had the SLA not been in place, the market quantity would have been \( Q_4 \), and the market price would have been \( P_4 \), which is not observable from the market. Canadian exports would have been \( Q_1 \) and the U.S. quantity supplied \( Q_6 \) (\( Q_6 = Q_4 \)). Thus, the change in Canadian export (\( \Delta S_3 \)) will be \( (Q_3 - Q_3) \), and the change in U.S. production (\( \Delta S_4 \)) will be \( (Q_6 - Q_4) \). The change in equilibrium quantity (\( \Delta S \)) will be \( (Q_3 - Q_3) \), which equals \( (Q_4 - Q_4) \). (\( Q_4 - Q_4 \)).

If we know the demand and supply elasticities for both the United States and Canada export supply functions and the softwood lumber price under the no-SLA scenario \( (P_4) \), the market and welfare impacts can be calculated. The change in lumber price with and without the SLA is

\[ \Delta P = P_3 - P_4 \]

From the definition of elasticity, the change in total U.S. quantity demanded (\( \Delta Q = Q_8 - Q_7 \)) can be calculated as

\[ \Delta Q = \eta Q_8 \frac{\Delta P}{P_3} \]

where \( \eta \) is the own-price elasticity of lumber demand.

Similarly, the change in the U.S. supply (\( \Delta S_4 \)) and the total Canadian exporting supply without the SLA \( (Q_4) \) are

\[ \Delta S_4 = \frac{\delta_4 Q_4 \Delta P}{P_3} \]

and

\[ Q_4 = Q_8 - Q_6 \]

where \( \delta_4 \) is the U.S. supply elasticity. Notice that \( Q_8 = Q_7 + \Delta Q \) and \( Q_6 = Q_5 - \Delta S_4 \).

Furthermore, the price when Canadian export supply equals \( Q_1 \) can be calculated as

\[ P_1 = P_4 - \frac{(Q_4 - Q_4)P_4}{\delta_4 Q_4} \]

where \( \delta_4 \) is the price elasticity of Canadian exporting supply. And finally, the price when Canadian exporting supply equals \( Q_2 \) can be calculated as

\[ P_2 = P_4 - \frac{(Q_4 - Q_4)P_4}{\delta_4 Q_4} + 50 \]

Consumer surplus, the area under the demand curve and above the price line, defines consumer benefits. The change in consumer surplus \( (\Delta CS) \) is defined by the total quantity and price changes shown in Fig. 1:

\[ \Delta CS = \frac{\Delta P(Q_7 + Q_8)}{2} \]

Producer surplus, the area above the supply curve and under the price line, defines producer profits. Change in domestic producer surplus \( (\Delta PS_d) \) also follows directly from Fig. 1:

\[ \Delta PS_d = \frac{\Delta P(Q_8 + Q_6)}{2} \]

The change in producer surplus for Canadian firms under the SLA is based on treating the shifted Canadian exporting supply curve as the effective supply. Accordingly, change in producer surplus \( (\Delta PS_c) \) is defined as follows:

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The first three components of eq. 9 are the portion of the producer surplus where price is above \( P_1 \) under the SLA. The fourth component of eq. 9 is the portion of the producer surplus where price is above \( P_1 \) under the no-SLA condition. TAX is the ex post export fees that Canadian producers paid to their government under the SLA.

Sources for elasticities used in this study are Adams and Haynes (1996), Spelter (1992), and Adams et al. (1986). Table 2 presents elasticities estimated in previous studies. Adams and Haynes (1996) and Spelter (1992) estimated \( h = -0.174 \). Support for the demand elasticity estimate can be found in McKillop et al. (1980) and Spelter (1985) who estimated demand elasticities of \(-0.173\) and \(-0.11\) to \(-0.28\), respectively. Adams et al. (1986) estimated \( d_o = 0.239 \), \( 0.460 \), and \( 0.510 \) for Pacific, Interior, and South supply regions of the United States, respectively; each provides roughly one-third of U.S. production (Wear and Lee 1993). These supply elasticities are generally consistent with previous analyses (e.g., Robinson 1974; Adams and Haynes 1980) but are lower than those (\( \delta_c = 0.572, 0.574, \) and \( 0.950 \), respectively) reported in Adams and Haynes (1996). Adams et al. (1986) also estimated the elasticity of Canadian exporting supply \( \delta_c = 0.917 \), which is close to the estimate of \( 0.89 \) by Boyd and Krutilla (1987) but higher than the estimate of \( 0.625 \) by Adams and Haynes (1996). For this study, we first calculated the market and welfare impacts using the equations defined above, with \( h = -0.17, \delta_o = 0.40, \) and \( \delta_c = 0.90 \). We then conducted a sensitivity analysis by changing the elasticity values to \( h = -0.11, \delta_o = 0.60, \) and \( \delta_c = 0.70 \).

### Price impact model, data, and results

Notice that \( P_3, Q_5, Q_7, Q_1, \) and \( Q_2 \) are observable from the market. However, the above welfare impact equations can only be solved when the price under the no-SLA scenario \( (P_4 \) in Fig. 1) is provided. In this study, we use a highly aggregated, reduced-form econometric model of the U.S. softwood lumber market to estimate the change in price \( (DP) \) under the SLA and use eq. 1 to find this value. The implication of such simplified model structure means that the results of this study only represent national average. Our price impact model is derived from the supply and demand relation in the U.S. softwood lumber market:

\[
L_{\text{demand}} = f(P, \text{demand factors})
\]

\[
L_{\text{supply}} = f(P, \text{supply factors, policy dummy variables})
\]

where \( P \) is the price of softwood lumber in the U.S. market, represented by the trigger price defined in the SLA.\(^6\)

Because the price \( P \) and quantity are simultaneously determined through the interaction of the supply and demand equations, we use a reduced form equation for our econometric estimation (e.g., see Freeman 1983, p. 31). Because the quantity supplied equals the quantity demanded, we set these two equations equal:

\[
L_{\text{supply}}(P, \text{supply factors, policy dummy variables}) = L_{\text{demand}}(P, \text{demand factors})
\]

Then solve for the price of softwood lumber:

\[
P = f(\text{demand factors, supply factors, policy dummy variables})
\]

\(^6\)This price is highly correlated with Random Lengths Inc. composite framing lumber price index (a volume-weighted average) (correlation coefficient = 0.98) and the softwood lumber price index by U.S. Bureau of Labor Statistics (correlation coefficient = 0.93).
Based on economic theory, the demand factors include housing starts, gross domestic products (GDP), the prices of substitutes, and seasonality. The supply factors include U.S. softwood lumber production capacity (fixed cost constraint), log prices (cost of raw material), wage rates (cost of labor), softwood lumber productivity (technological change), federal timber supply in the western United States, total U.S. sawlog production (log supply), interest rates (cost of capital), and exchange rates (as a Canadian exporting supply shifter). The policy dummy variables cover the period of 1987–1991 under the MOU and the period under the SLA. Because \( Q \) changes annually under the SLA, four dummy variables, one for each year, are used. 

However, several variables are highly correlated with other variables and are dropped from the final model to avoid multicollinearity.\(^7\) All variables included in the model are not correlated to each other (with \( r \leq 0.47 \)). In addition, several insignificant variables are dropped from the final model as well.\(^8\) The final model that we estimated is as follows:\(^9\)

\[
P = f(P(–1), HS, CAPA, WAGE, TECH, EXCH, \\
D_{mou}, D_{1}, D_{2}, D_{3}, D_{97}, D_{98}, D_{99}, D_{00})
\]

where \( P \) is the real lumber price in 1997 dollars \(($/mmbf/consumer price index)\) (data from Random Lengths, Inc.); \( P(–1) \) is the lagged price;\(^10\) HS is U.S. housing starts in 1000 units, not seasonally adjusted (data from the U.S. Census Bureau Web site: http://www.census.gov/const/C20/starttsua.pdf); CAPA is the U.S. softwood lumber production capacity in bbf (D.M. Adams, personal communication);\(^11\) WAGE is real hourly earnings of total production labor employed in U.S. sawmill industry (Standard Industrial Classification 242) in 1997 dollars ($/producer price index) (data from the U.S. Bureau of Labor Statistics Web site: http://146.142.4.24/cgi-bin/dsrv); TECH is a measure of technological change that led to productivity increase in softwood lumber production (board feet of lumber/cubic feet of sawlog) (generated from Howard (2001), Tables 6a and 30); EXCH is the real U.S.–Canada exchange rate (Cdn$/US$) (data from the Bank of Canada Web site: http://www.bankofcanada.ca/en/exchange-avg.htm), which is equal to nominal exchange rate adjusted for difference in the consumer price index between the two countries; \( D_{mou} \) is a policy dummy variable, taking the value of one when the quarter is between the fourth quarter of 1986 and the third quarter of 1991 (when the MOU was in force), and zero otherwise; \( D_{1} \)–\( D_{3} \) are three seasonal dummy variables, taking the value of one when the quarter is the first, second, or third quarter, respectively, and zero otherwise; \( D_{97} \)–\( D_{99} \) are policy dummy variables, taking the value of one for the first 4 years (1996–1997, 1997–1998, 1998–1999, and 1999–2000, respectively) under the SLA, and zero otherwise.

The demand variable for housing starts is expected to have a positive sign. The capacity variable increases supply and is expected to be negative. An increase in the WAGE variable reduces U.S. supply, and its coefficient is expected to be positive. The variable, TECH, is used to control technological or productivity change in softwood lumber production.\(^12\) Since technological change increases supply, this variable is expected to have a negative sign. As demonstrated by Adams et al. (1986), the variable for the exchange rate is expected to be negative. The result of Wear and Lee (1993) is sufficient to justify a positive sign on \( D_{mou} \), and the signs for the four dummy variables measuring the price impact under the SLA are expected to be positive.

Ordinary least squares (OLS) regression was applied to eq. 14 with a data series from the first quarter of 1976 to the first quarter of 2000. A linear functional form was used,\(^13\) and the results are shown in Table 3. In general, the model fits well. The adjusted \( R^2 \) is quite high. The Durbin h statistic indicates that the hypothesis of no serial correlation cannot be rejected at the 5% level.\(^14\) More importantly, all variables have expected signs. None of the 15 variables are significant at the 5% level or better. The results show that lumber price in the previous quarter, housing starts, production capacity, hourly earnings, exchange rate, seasonality, the MOU, and the SLA are significant determinants of quarterly lumber price.

The results show that after controlling for other supply and demand factors the lumber price increased by \$94.3, \$32.9, \$39.6, and \$69.5 (\( AP \) in eq. 1) in the first 4 years, respectively, and \$59.1/mmbf, on average, (all in 1997 dollars) under the SLA. In other words, the estimated impacts are

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1. These variables include U.S. gross domestic product, industrial production, U.S. sawlog production, availability of federal timber in western United States, a trend variable, and the price index of plywood. They are highly correlated with three other variables used in the model (especially CAPA, WAGE, and EXCH). Dropping the variables representing U.S. sawlog production and availability of federal timber (uncut volume under contract) in western United States is particularly disappointing as they signal the supply contraction and regional shift of production in the U.S. softwood lumber industry. The correlation coefficients between U.S. sawlog production and CAPA, WAGE, and \( D_{mou} \) are 0.64, 0.67, and 0.58. The correlation coefficient between uncut volume under contract in western United States is particularly disappointing as they signal the supply contraction and regional shift of production in the U.S. softwood lumber industry. The correlation coefficients between U.S. sawlog production and CAPA, WAGE, and \( D_{mou} \) are 0.64, 0.67, and 0.58. The correlation coefficient between uncut volume under contract in western United States, and TECH is 0.84.

2. These variables include price indices of concrete and steel and U.S. South Log price.

3. This model is similar to ones used by Kalt (1988) and Wear and Lee (1993) and its assumptions are reasonable (Uri and Boyd 1990; Murray and Wear 1998). This model is relatively simple, requires less data, and serves the purpose of this study well.

4. The hypothesis of no serial correlation cannot be rejected at the 5% level when this lagged price variable is removed from the model.

5. Data obtained from D.M. Adams (personal communication) for U.S. softwood lumber production capacity only covers the period 1955–1995. Therefore, the capacity data for 1996–2000 was estimated based on the following regression results: \( CAPA = 22,624.07 + 137.88 \times (trend) + 0.3672 \times (production) \), where \( CAPA \) is capacity in mmbf, trend is a trend variable (1955 = 1), and production is the total actual softwood lumber production in mmbf. The adjusted \( R^2 \) for the regression is 0.6611, and the \( t \) ratios for the intercept, trend, and production variables are 8.111, 4.497, and 3.540, respectively.

6. This variable changed from 6.38 to 7.15 during the study period, indicating a 12.1% productivity increase in softwood production.

7. We have also run three other commonly used functional forms (linear, semilog, and inverse semilog). The results are all similar to those reported in this paper.

8. However, the Breusch–Pagan test shows that the hypothesis of no heteroskedasticity cannot be accepted at the 5% level. Therefore, we used the White’s (1978) correction procedure to correct for the heteroskedasticity.
that the softwood lumber price increase by 24.3, 8.6, 11.7, and 19.6% annually for the first four years, respectively, or 16.1%, on average, relative to a measure of counterfactual price that presumably would have been obtained during that period without the SLA.\textsuperscript{15} Compared with the quota conditions reported in Table 1, these results reveal that lumber prices and Canadian exports under quota (either LFB or UFB or both) are positively related.

**Welfare impact of the SLA**

To estimate the market and welfare impacts of the SLA, we applied eqs. 1–9 to actual production, consumption, and price data for the first 4 years under the SLA ($D_{97}, D_{98}, D_{99}, D_0$ for each of the first 4 years under the SLA, and $P_3$ is the price observed in the market). In this way, we simulated what the market results would have had the SLA not been in place. We present the price and other market impacts in Table 4 and welfare impacts in Table 5.

Results in Table 4 show that Canadian lumber exports to the U.S. fell 12.8 bbf in the first 4 years from the otherwise open market solution, U.S. production increased by 7.4 bbf, and imports from other producers increased by 584.8 mmbf. The consequent change in U.S. consumption shows a 4.8 bbf reduction. Nearly two-thirds of this reduction took place in the first and the fourth years under the SLA.

Detailed partial equilibrium estimates on the welfare impacts of the SLA (Table 5) show that U.S. lumber producers receive the gains anticipated from such policy: profit increases by approximately $7.7 billion (in 1997 dollars) for the first 4 years. The costs to U.S. consumer, however, are much larger, with $12.5 billion. Net loss to the United States is, therefore, $4.7 billion. Canadian producers lost some as their export volume was curtailed under the SLA but gained even more with higher lumber prices. The net results are $2.9 billion profits for Canadian producers and $226 million in export fee gains for the four provincial governments in Canada.\textsuperscript{16} Thus, the net gains to Canada are about $3.1 billion. Other suppliers to the U.S. market gain $626 million. The overall impact of the SLA for the first 4 years was a net loss of $1.0 billion, about half of which took place in the first year. The results of sensitivity analysis in Table 6 show that the estimated quantity shifts between the United States and Canada and the overall welfare impact of the SLA are sensitive to the elasticities used. However, the welfare impacts for either United States or Canada are not sensitive.

Compared with the results of Wear and Lee (1993), our results indicate that the SLA had a bigger impact than the 1986 MOU. Our estimate of the price impact of the MOU ($24.5/mbf in 1997 dollars) is similar to that ($13.2/mbf in 1982 dollars) of Wear and Lee (1993) (U.S. consumer price index increased 1.68 times between 1982 and 1997). On the other hand, the price impact of the SLA is higher than that of the MOU (Table 3). Our welfare estimates for the first 4 years under SLA are higher in U.S. consumer surplus, producer surplus, and total impact for the United States than those of Wear and Lee (1993). Furthermore, Canadian producers gained under the SLA and lost slightly under the MOU. The difference in Canadian producer welfare may be that these producers have to pay for all lumber exported to the United States under the MOU, while they only pay for export volume exceeding their fee-free quota under the SLA. Furthermore, this study does not cover domestic and other foreign markets for Canadian softwood lumber.

**Conclusions and discussion**

The primary contribution of this paper is an estimate of the economic consequences of the SLA. By clearly defining the supply and demand relationships of softwood lumber and using price estimates of a reduced impact model and market parameters from previous studies, this study attempts to isolate the market and welfare impact of the SLA. While the estimated price impact is about $59.1/mbf or 16%, on average, in the first 4 years, the overall welfare loss of the SLA is modest. However, the estimated welfare impacts for U.S. producers, and to a lesser extent, Canadian producers who primarily ship their lumber to the United States (rather than their domestic and other foreign markets), are sizable. The estimated welfare impacts for U.S. consumers are even larger. Thus, the SLA can be seen as an effective measure of welfare transfer from U.S. consumers to U.S. producers and Canadian producers.

The results of this paper reflect effective rent seeking by U.S. lumber producers and Canadian producers. By effectively lobbying U.S. Congress and administration, the U.S. lumber producers were able to subdue the U.S. lumber consumers and brought various trade actions aimed at restricting Canadian softwood lumber imports in the last 20 years (Zhang 1997; Cashore 1998). The SLA has succeeded in restricting Canadian softwood exports to the United States and has boosted U.S. production. This, coupled with the consequence change in lumber price, led to considerable improvement in the competitive position of U.S. lumber producers in the home market and provided an important source of relief for U.S. producers as domestic environmental pressure caused softwood lumber inventory to contract. As a result, U.S. production has increased 16% between 1995 and 1999, while the exporting supply from the four Canadian provinces changed little (Canadian Forest Service, various issues). On the other hand, U.S. consumers have suffered as they pay higher prices for lumber they consume and buy less lumber than they would have with lower prices.

Under the SLA, Canadian producers as a whole and the Canadian governments benefitted in the U.S. market, and some Canadian producers whose softwood lumber is sold primarily in the United States rather than in their domestic and other foreign markets support the SLA. However, the

\textsuperscript{15}Since we had to exclude several time-dependent variables, such as prices of softwood lumber substitutes and U.S. timber supply, to avoid multicollinearity in the reduced price impact model, these results on price (and welfare impacts reported in next section) should not be taken “too definitely,” but rather only as estimates that are indicative of reality.

\textsuperscript{16}In theory, the four provincial (and federal) governments could gain at least another $1.1 billion from income taxes on incremental producer profit since corporate income tax rates exceed 40% in all of these provinces. Thus, the indirect benefits to Canadian governments are probably greater than the direct benefits. This fact notwithstanding, one needs to be cautioned that this study covers the U.S. market only and that Canadian producers suffer a loss in their domestic and other foreign markets because of the SLA.
Canadian producers (and governments) are far from being united in defending the SLA (Zhang 1997; Cashore 1998). First, Canadian producers suffer a loss in their domestic and other foreign markets (although the exact magnitude on producer welfare change in these markets has not been estimated). Second, the benefits for Canadian producers and the Canadian government may be somewhat dissipated because of the fact that they have to go through numerous processes including quota allocation, reporting, and monitoring. Third, some Canadian producers are unhappy with the quota they received under the SLA, and others are eager to export more to the ever-expanding U.S. softwood lumber market under free-trade conditions. Fourth, the opposition to the SLA from some Canadian producers is frequently based on concern that high U.S. lumber prices encourage substitution of two kinds: substitution of lumber produced in other regions of the world for North American lumber and substitution of alternative material (steel and

Table 3. Results of OLS regression of price as a function of supply, demand, and policy variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>t ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagged real lumber price in 1997 dollars</td>
<td>0.539</td>
<td>6.461*</td>
</tr>
<tr>
<td>Capacity (bbl)</td>
<td>−11.581</td>
<td>−2.558*</td>
</tr>
<tr>
<td>Real hourly wage of production labor in 1997 dollars</td>
<td>34.858</td>
<td>2.258*</td>
</tr>
<tr>
<td>Softwood lumber productivity (board feet of lumber/cubic feet of sawlog)</td>
<td>−5.436</td>
<td>−0.314</td>
</tr>
<tr>
<td>Housing starts (1000 units)</td>
<td>0.235</td>
<td>2.607*</td>
</tr>
<tr>
<td>Real exchange rate (Can$/US$)</td>
<td>−132.288</td>
<td>−2.930*</td>
</tr>
<tr>
<td>$D_{1996}$ (policy dummy variable measuring the effect of the MOU)</td>
<td>24.470</td>
<td>1.363</td>
</tr>
<tr>
<td>$D_{1997}$ (dummy variable measuring seasonality, first quarter)</td>
<td>40.597</td>
<td>3.891*</td>
</tr>
<tr>
<td>$D_{1998}$ (dummy variable measuring seasonality, second quarter)</td>
<td>−13.719</td>
<td>−1.050</td>
</tr>
<tr>
<td>$D_{1999}$ (dummy variable measuring seasonality, third quarter)</td>
<td>3.547</td>
<td>0.340</td>
</tr>
<tr>
<td>$D_{1996}$ (policy dummy variable measuring the effect of the SLA in 1996–1997)</td>
<td>94.292</td>
<td>5.994*</td>
</tr>
<tr>
<td>$D_{1997}$ (policy dummy variable measuring the effect of the SLA in 1997–1998)</td>
<td>32.863</td>
<td>1.646*</td>
</tr>
<tr>
<td>$D_{1998}$ (policy dummy variable measuring the effect of the SLA in 1998–1999)</td>
<td>39.589</td>
<td>2.847*</td>
</tr>
<tr>
<td>$D_{1999}$ (policy dummy variable measuring the effect of the SLA in 1999–2000)</td>
<td>69.474</td>
<td>3.302*</td>
</tr>
<tr>
<td>Intercept</td>
<td>387.423</td>
<td>1.533</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.847</td>
<td></td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.821</td>
<td></td>
</tr>
<tr>
<td>Durbin $h$ statistic</td>
<td>−0.027</td>
<td></td>
</tr>
<tr>
<td>Breusch–Pagan test for heteroskedasticity</td>
<td>27.972</td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the 5% level.
† Significant at the 20% level.

Table 4. Estimated market impacts for the first 4 years under the SLA ($\eta = 0.17, \delta_n = 0.40, \delta_c = 0.90$).

<table>
<thead>
<tr>
<th>Year</th>
<th>Price (in 1997 $/mmbf)</th>
<th>U.S. consumption (mmbf)</th>
<th>Canadian exporting supply (mmbf)</th>
<th>Other supply (mmbf)*</th>
<th>U.S. production (mmbf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996–1997</td>
<td>94.29 (24.34)</td>
<td>−1661.6 (−3.3)</td>
<td>−4 340.7 (−21.6)</td>
<td>133.9 (7.7)</td>
<td>2545.2 (7.8)</td>
</tr>
<tr>
<td>1997–1998</td>
<td>32.86 (8.61)</td>
<td>−691.9 (−1.4)</td>
<td>−1 826.5 (−10.5)</td>
<td>79.5 (3.2)</td>
<td>1055.1 (3.2)</td>
</tr>
<tr>
<td>1998–1999</td>
<td>39.59 (11.65)</td>
<td>−931.2 (−1.8)</td>
<td>−2 478.6 (−13.9)</td>
<td>127.0 (4.2)</td>
<td>1420.4 (4.2)</td>
</tr>
<tr>
<td>1999–2000</td>
<td>69.47 (19.58)</td>
<td>−1542.8 (−2.3)</td>
<td>−4 146.1 (−16.9)</td>
<td>244.4 (6.6)</td>
<td>2358.9 (6.6)</td>
</tr>
<tr>
<td>Mean or total</td>
<td>59.05 (16.05)</td>
<td>−4827.6 (−2.3)</td>
<td>−12 792.0 (−17.0)</td>
<td>584.8 (5.4)</td>
<td>7379.6 (5.4)</td>
</tr>
</tbody>
</table>

Note: Values in parentheses are percentages.
*Other supply includes exports from Canadian provinces that are not covered by the SLA and from other countries.

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Table 5. Estimated welfare impacts for the first 4 years under SLA.

<table>
<thead>
<tr>
<th>Year</th>
<th>U.S. producer surplus</th>
<th>U.S. consumer surplus</th>
<th>Total U.S. impact</th>
<th>Canadian producer surplus</th>
<th>Canadian export fee</th>
<th>Total Canadian impact</th>
<th>Other producer surplus</th>
<th>Net impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996–1997</td>
<td>2945.0</td>
<td>-4 786.5</td>
<td>-1841.6</td>
<td>1161.7</td>
<td>72.6</td>
<td>1234.2</td>
<td>154.9</td>
<td>-452.4</td>
</tr>
<tr>
<td>1997–1998</td>
<td>1075.7</td>
<td>-1 697.9</td>
<td>-622.2</td>
<td>400.3</td>
<td>40.8</td>
<td>441.0</td>
<td>81.0</td>
<td>-59.4</td>
</tr>
<tr>
<td>1998–1999</td>
<td>1319.2</td>
<td>-2 096.8</td>
<td>-777.6</td>
<td>442.7</td>
<td>49.5</td>
<td>522.2</td>
<td>117.9</td>
<td>-58.0</td>
</tr>
<tr>
<td>1999–2000</td>
<td>2420.5</td>
<td>-3 904.6</td>
<td>-1484.1</td>
<td>824.7</td>
<td>62.9</td>
<td>887.6</td>
<td>250.8</td>
<td>-282.9</td>
</tr>
<tr>
<td>Total</td>
<td>7738.8</td>
<td>-12 485.8</td>
<td>-4747.0</td>
<td>2859.4</td>
<td>225.7</td>
<td>3085.0</td>
<td>626.1</td>
<td>-1035.8</td>
</tr>
</tbody>
</table>

Note: Values are in millions of 1997 U.S. dollars.

This change in Canadian producer surplus only accounts for Canadian exports to the U.S. market and does not cover Canadian domestic and other foreign markets for Canadian softwood lumber. In theory, the SLA should reduce softwood lumber prices in the two (domestic and other foreign) markets, which in turn lower producer surplus (and raises the amount of consumer surplus) in these markets. Since the primary focus of this paper is on U.S. market, we merely point out that a full welfare analysis for Canadian producers must include all three markets. Thus, the net Canadian producer surplus, including all three markets, should be lower than what we have estimated in this paper. At one extreme, Canadian producers could experience a net decrease in well-being as result of decrease in price and output of their softwood lumber in their own domestic and other exporting markets, even they are better off in the U.S. market with the SLA. Although this extreme scenario is not likely to be true because the U.S. market (accounts for 65% Canadian production) is the largest of the three markets for Canadian softwood lumber, a further study could clarify this issue.

Other producer surplus is the gain of Canadian exporters in provinces that are not covered by the SLA and of exporters from other countries that supply softwood lumber in the U.S. market.

Table 6. Sensitivity analysis for total market and welfare impacts for the first 4 years under SLA.

<table>
<thead>
<tr>
<th>Market impact (in mmbf)</th>
<th>U.S. producer surplus</th>
<th>U.S. consumer surplus</th>
<th>Total U.S. welfare</th>
<th>Canadian producer surplus</th>
<th>Canadian export fee</th>
<th>Total Canadian impact</th>
<th>Other producer surplus</th>
<th>Net impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. consumption</td>
<td>-4 727.6</td>
<td>31.1</td>
<td>-3 123.7</td>
<td>-3 123.7</td>
<td>-3 123.7</td>
<td>-3 123.7</td>
<td>-3 123.7</td>
<td>-3 123.7</td>
</tr>
<tr>
<td>Canadian exporting supply</td>
<td>-16 774.2</td>
<td>50.0</td>
<td>-3 123.7</td>
<td>-3 123.7</td>
<td>-3 123.7</td>
<td>-3 123.7</td>
<td>-3 123.7</td>
<td>-3 123.7</td>
</tr>
<tr>
<td>Other supply</td>
<td>894.3</td>
<td>50.0</td>
<td>596.2</td>
<td>894.3</td>
<td>50.0</td>
<td>894.3</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>U.S. production</td>
<td>11 069.4</td>
<td>50.0</td>
<td>11 069.4</td>
<td>11 069.4</td>
<td>50.0</td>
<td>11 069.4</td>
<td>50.0</td>
<td>50.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Welfare impact (in 1997 million $)</th>
<th>U.S. producer surplus</th>
<th>U.S. consumer surplus</th>
<th>Total U.S. welfare</th>
<th>Canadian producer surplus</th>
<th>Canadian export fee</th>
<th>Total Canadian impact</th>
<th>Other producer surplus</th>
<th>Net welfare</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. producer surplus</td>
<td>7 615.8</td>
<td>-1.6</td>
<td>7 738.8</td>
<td>6 715.8</td>
<td>50.0</td>
<td>7 738.8</td>
<td>6 715.8</td>
<td>6 715.8</td>
</tr>
<tr>
<td>U.S. consumer surplus</td>
<td>12 485.8</td>
<td>0.0</td>
<td>12 487.8</td>
<td>12 487.8</td>
<td>0.0</td>
<td>12 487.8</td>
<td>12 487.8</td>
<td>12 487.8</td>
</tr>
<tr>
<td>Total U.S. welfare</td>
<td>-4 870.0</td>
<td>2.6</td>
<td>-4 869.9</td>
<td>-4 812.9</td>
<td>1.4</td>
<td>-4 812.9</td>
<td>-4 812.9</td>
<td>-4 812.9</td>
</tr>
<tr>
<td>Canadian producer surplus</td>
<td>2 502.1</td>
<td>-12.5</td>
<td>2 997.8</td>
<td>2 703.2</td>
<td>-5.5</td>
<td>2 703.2</td>
<td>2 703.2</td>
<td>2 703.2</td>
</tr>
<tr>
<td>Canadian export fee</td>
<td>79.6</td>
<td>-68.9</td>
<td>195.6</td>
<td>40.2</td>
<td>-82.2</td>
<td>40.2</td>
<td>40.2</td>
<td>40.2</td>
</tr>
<tr>
<td>Total Canadian impact</td>
<td>2 572.3</td>
<td>-16.6</td>
<td>3 193.3</td>
<td>2 743.4</td>
<td>-11.1</td>
<td>2 743.4</td>
<td>2 743.4</td>
<td>2 743.4</td>
</tr>
<tr>
<td>Other producer surplus</td>
<td>616.2</td>
<td>-1.6</td>
<td>626.2</td>
<td>616.2</td>
<td>-1.6</td>
<td>616.2</td>
<td>616.2</td>
<td>616.2</td>
</tr>
<tr>
<td>Net welfare</td>
<td>-1 681.5</td>
<td>62.3</td>
<td>-644.7</td>
<td>-4 534.4</td>
<td>40.3</td>
<td>-4 534.4</td>
<td>-4 534.4</td>
<td>-4 534.4</td>
</tr>
</tbody>
</table>

Note: Amount % change

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Concrete (for lumber. The increase in non-Canadian imports to the United States over this period of time suggests that these concerns are not wholly unfounded. Finally, there are strong sentiments in Canada against allegations (such as Canadian lumber producers are subsidized because of low stumpage and log export restrictions) that might have infringed on the country’s resource sovereignty.

The results of this study raise the potential of U.S. producers and some Canadian producers working together to effectively seek wealth transfer from U.S. consumers. In fact, the SLA is similar to a “market sharing agreement” by a bilateral duopoly. Since British Columbia accounts for about half of all Canadian softwood lumber exports to the United States, it is not surprising to see that facing the possibility of U.S. trade action the provincial government of British Columbia in consultation with some lumber producers in the province first came up with the SLA. Any efforts undertaken by U.S. lumber manufacturers, through their government, to secure this trade regulation would also be rational from the standpoint of political economy. However, the benefits obtained by these groups came at the greater expenses to U.S. consumers.

Further studies could be done on several fronts. One is the producer and consumer welfare in Canadian domestic and other foreign (non-U.S.) markets. The other is if there exists an optimal export tax or optimal export quota from Canadian perspective. Since Canada is a large player in global softwood lumber market and has some market power in the U.S. market, it is possible that an optimal export tax or quota could enhance Canadian social welfare. Conversely, there may be an optimal import tariff or optimal quota for the United States. Finally, a study on the political economy and the role of environmental politics played in shaping up the SLA could enhance future trade policy debate.
Zhang

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References


