The Users of Lumber and the US-Canada Softwood Lumber Agreement: An Event Study

Nisha Malhotra and Sumeet Gulati[#]

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Food and Resource Economics, University of British Columbia
Vancouver, Canada, V6T 1Z4
http://www.agsci.ubc.ca/fre

[#] Nisha Malhotra is a Sessional Lecturer at the Department of Economics at the University of British Columbia, and Sumeet Gulati is at Food and Resource Economics at the University of British Columbia,. Please address all correspondence to Nisha Malhotra, 213-2875 Osoyoos Crescent, Vancouver, V6T 2G3, Canada; phone: (604) 221-5780, email: malhotra@econ.umd.edu

The Users of Lumber and the SLA: An Event Study

Abstract

In this paper we analyze whether the Softwood Lumber Agreement between US and Canada imposed significant economic costs on the users of Lumber in the US. To ascertain this impact we use an event study. Our event study analyzes variations in the stock prices of lumber using firms listed at the major stock markets in the US. We find that events leading to the Softwood Lumber Agreement had significant negative impacts on the stock prices of industries using softwood lumber. The average reduction of stock prices for our sample of firms was approximately 5.42% over all the events considered.

Key Words and Phrases: SLA, International Trade Disputes, Event Study

JEL Classifications. Primary: F13**; Secondary:** G1.

1 Introduction

The softwood lumber trade dispute between the US and Canada can be traced back to a countervailing duty investigation by US authorities in 1982/83. The US claimed, and still claims, that fees charged for harvesting softwood on public lands by certain Canadian provincial governments are artificially low. It also claims that artificially low fees set by provincial governments constitute countervailable subsidies.

A recent bilateral settlement of this dispute was the Softwood Lumber Agreement (SLA). Signed in May 1996, under the Softwood Lumber Agreement the first 14.7 Billion Board Feet (BBF) of softwood lumber exports from Alberta, British Columbia, Ontario, and Quebec would enter the US market duty free. The first 650 million board feet over 14.7 BBF were subject to a tax of $50 per thousand board feet. Further exports were subject to a tax of $100 per thousand board feet.

The question addressed in this paper is: what is the effect of restricting Canadian exports on industries that use lumber in the US? Restrictions on Canadian lumber exports raise lumber prices in the United States. While this raises profits for US lumber producers, it also raises costs for lumber using (or downstream) industries. Lindsey et. al. (2000) estimate that the fees on additional shipments due to the SLA raise the cost of lumber in an average new home by 800 - 1300 US Dollars. They also estimate that for every $50 increase in the price of 1,000 board feet of framing lumber, 300,000 potential homeowners are priced out of the housing market. When customers can no longer afford to buy homes, suppliers lose business and their employees suffer.

Furthermore, less remodeling is done when the cost of key materials, such as lumber, rises. A reduction in the demand for housing and remodeling, affects home builders and manufactured-home builders. Lumber dealers who supply home builders and manufacturers are also hurt by reduced residential construction.

To assess the effect of restricting Canadian exports on industries that use lumber, we use an *event study*.[3] The event study allows us to assess the impact of events leading to the Softwood Lumber Agreement. We assume that capital markets are efficient, and can evaluate the impact of new information on a firm's expected future profits. This implies that 'abnormal' changes in a firm's stock price can be interpreted as the present discounted value of future gains or losses expected due to the agreement.[4]

We consider three events. The first event date is February 2, 1996. Seeing that negotiations between US and Canadian governments had made little headway, on February 2, 1996 the Council for Fair Lumber Imports (CFLI - a coalition representing US lumber interests) announced its own deadline. It announced its intention to file a petition for a countervailing duty if an agreement between US and Canada was

[3] An *event study* is an empirical study of prices of an asset just before and after some event, like an announcement, merger, or dividend.

[4] To calculate 'abnormal' returns we first calculate the relationship between the firm's stock price and the stock market in the absence of the event under consideration (in this case the Softwood Lumber Agreement). This relationship generates predicted returns in the absence of the agreement. These predicted returns are then compared with the actual returns on the event dates (dates specific to the agreement) giving us *abnormal* returns.

not reached by February 15th, 1996. The second event date is February 15, 1996, this day an agreement between the two countries was reached in principle. The final event date we consider is April 3, 1996, this day Canada finalized the agreement and announced its details. We find that events leading to the Softwood Lumber Agreement had significant negative impacts on the stock prices of industries using softwood lumber. The average reduction of stock prices for our sample of firms was approximately 1.5% for each of the first two events. For the final event (Canada finalizing the agreement) the average reduction in stock prices was significantly higher at approximately 2.5%. Cumulating the losses over all three events, we find that the average reduction in stock prices for the firms in our sample was 5.42%, indicating that the Softwood Lumber Agreement imposed significant economic costs on the users of lumber.[5]

This paper is not the first to study stock price changes in response to bilateral agreements. In a related study, Begley et al. (1998) assess the impact of export taxes (imposed during the Memorandum of Understanding (1986-91)) on the stock prices of the producers of Canadian Lumber. Lenway et al. (1996) examine the returns to the steel industry from the trigger price mechanism of 1977 and 1980, and the voluntary export restrictions of 1982 and 1984. Ries (1993) examines the effect of

[5] Disaggregatin amongst the users of lumber, we find that retailers and wholesalers of lumber and other building materials (Standard Industrial Classification (SIC) 5211) had the largest depreciation in their market value (at -12.99%). Single-family housing construction firms (SIC 1521) were next at -6.19%.

voluntary export restraint agreements in 1981 on profits in the Japanese automobile industry. Most of these papers evaluate the industry directly affected by the trade policy (the exporting or the import competing industry). This paper is one of the few to evaluate the impact of a trade agreement on an indirectly effected industry (in this case the users of the restricted good).

The structure of the paper is as follows. In Section 2 we provide a brief history of the US-Canadian softwood lumber dispute. In Section 3 we describe our event study. In Section 4 we discuss the data and its sources. We present the results in Section 5, and conclude in Section 6.

2 The US-Canada Softwood Lumber Dispute: A Brief History[6]

In Table 1 we list the main countervailing duty investigations involving softwood lumber and their outcomes. The first countervailing investigation is commonly termed Softwood Lumber I. Concern over rising Canadian lumber imports resulted in a petition for a Countervailing Duty (CVD) in October 1982. The petition alleged that Canadian Provincial and Federal governments were subsidizing softwood lumber production by selling the right to cut timber on public lands at artificially low prices. In the ensuing investigation the International Trade Administration (ITA), a dispute settlement body in the US Department of Commerce, ruled that Canada's policies regarding allocation and pricing of softwood lumber did not constitute a

[6] For a more comprehensive description of the US-Canada lumber dispute please see Braudo and Trebilcock (2002).

countervailable subsidy to its softwood lumber industry.[7]

The dispute was revived in May 1986 by US interests grouped under the Coalition for Fair Lumber Imports (CFLI). The Coalition requested US authorities to impose a countervailing duty on Canada's softwood lumber exports to the US. In this new phase (called Softwood Lumber II), the facts of the case as well as the applicable law had not materially changed from the first phase in 1982/83. However, the Canadian share of the US softwood lumber market had risen from 28.5 percent in 1983 to 31.6 percent in 1985 (see Gagné (1999)). This time the International Trade Administration reversed its prior decision. It found Canadian stumpage rates to be countervailable, and imposed a 15 percent provisional duty.[8] In December 1986, US and Canada agreed to a Memorandum of Understanding (MOU) under which Canada imposed a 15 percent tax on its exports to the US.

In Canada there was resentment against the MOU. Further, during this period British Columbia (the single largest exporter of softwood lumber) replaced its export charge by permanently increased stumpage rates. In October 1991, Canada unilaterally terminated the Memorandum of Understanding. This was met almost immediately by interim duties on Canadian lumber. A third countervailing duty investigation (Softwood Lumber III) was initiated. In May 1992, the ITA issued a

[7] The 'specificity test' of an export subsidy was not met. This was because this stumpage rate was valid for all producers and did not target exporters specifically.

[8] The difference between stumpage revenues received by provincial governments and applicable government costs was used to determine whether subsidy existed.

final determination which set the countevailing duty at 6.51 percent.[9] Subsequently, Canada appealed the ruling at the dispute settlement body of the Canada US Trade Agreement (CUSTA).

A prolonged period of litigation under the CUSTA followed.[10] The duty imposed was disallowed by CUSTA, and finally revoked by the US government in 1994. Following this revocation a period of mostly free trade followed. This was a phase of euphoria in bilateral relations between US and Canada. When President Clinton visited Ottawa (February 1995) after the North American Free Trade Agreement both US and Canadian governments viewed trade disputes such as Softwood Lumber as minor irritants in a phase of increasing integration (as reported by Leo Ryan in a news report for the Journal of Commerce on February 23rd 1995).

Nevertheless, in late 1995 there was renewed pressure on the US government to limit softwood imports. Given that the Canadian softwood lumber industry had incurred large litigation costs to win Softwood Lumber III they were willing to look for a negotiated bilateral solution. Despite ongoing negotiations, on February 2, 1996 the US coalition for fair lumber imports announced its intentions to petition if no pact was reached by February 15th. Under this pressure, the five year SLA ,

[9] The methodolgy used to determine the counterviable duty dffered from the one used in the Softwood Lumber II. This time round the finding of subsidy was based on the difference between stumapge rates under the small business program in Canada and rates of major licenses.

[10] The panels overturned ITA's and ITC's findings. The US went on to challenge the panel's decision. After a further investigation the panel upheld its previous decision.

(from April 1, 1996 to March, 31, 2001), was accepted by both the sides. Even these five years of SLA were marred by further disputes. The US customs, on at least three occasions, reclassified products from tariff codes outside the SLA into codes covered by the agreement. Also, during this period British Columbia's stumpage reduction was challenged by the US under the dispute settlement provisions of the agreement.

3 An Event Study

3.1 The Market Model

This event study is based on the market model, relating the return of an individual firm's stock to the return of a market index and a firm-specific constant.

$$R_{it} = a_i + B_i R_{mt} + e_{it}, \tag{1}$$

where R_{it} is firm i's return at date t; R_{mt} is the return of the value weighted NYSE/AMEX/NASDAQ index at date t; a_i and B_i, are the parameters to be estimated; and e_{it} is a serially uncorrelated error term with mean 0 and constant variance σ_i^2 for stock i.

The above traditional market model equation can be expanded to include separate dummy variables for each event date. Thus, an event window of N observations requires N dummy variables. The estimated equation is of the following form:

$$\begin{aligned} R_{it} &= a_i + B_i R_{mt} + \sum_{n=t+1}^{T+N} EW_{nt} A_{in} + e_{it} \qquad (2) \\ (t &= 1, ..T, \quad T+1, ...T+N); \ (i = 1, 2, ..., I), \end{aligned}$$

where EW_{nt} is a dummy variable that takes the value 1 for the nth day of the event window and 0 otherwise, and the A_{in} are additional parameters to be estimated. Equation 2 is estimated using ordinary least squares.

The coefficient of the dummy variable (EW) is the abnormal return (A).

$$\widehat{A}_{it} = R_{it} - (\hat{a}_i + \hat{B}_i R_{mt}) \quad t = T+1, ...T+N.$$

There are I set of equations, one for each firm, with $(T+N)$ observations for each i. In the above model, the estimation period for the slope and the intercept is $(t = 1, ..., T)$. These T observations without the dummy variables determine the estimated slope and the intercept as well as the estimated variance s_i^2 . The estimation period for the market model is 365 days, beginning 396 days prior to the event t$_0$ and ending 30 days before the event, as shown in Figure 1. The remaining N observations $(t = T+1, ...T+N)$ include the event dummies and do not affect the estimated slope, since the observations in the event window are "dummied out". There are N days in the event window. The A_{in} coefficients for these N observations are nothing but the prediction errors or the abnormal returns.[11] See Appendix A.1 for further discussion. The above regression provides an unbiased estimate of σ_i^2.[12]

$$s_i^2 = \frac{\sum_{t=1}^{T} \hat{e}_{it}}{T-2} \; ; t = 1, 2, 3.....T.$$

The dummy variables can be aggregated to obtain cumulative daily abnormal

[11] Also, the variance s_i^2 is estimated with the first T observations, since the regression residuals for the event window, the last N observations, are zero.

[12] Refer to Appendix A.2 for more detail on the variance and covariance for abnormal return.

returns (CA). Over an interval of two or more trading days beginning with day $T+1$ and ending with day $T+N$, the average cumulative abnormal return across the I firms is

$$ACA = \frac{1}{I}\sum_{i=1}^{I} CA_i$$

where the cumulative abnormal return over the event window (N) for firm i is defined as

$$CA_i = \sum_{t=T+1}^{T+N} \widehat{A}_{it}$$

3.2 Hypothesis Testing

Abnormal returns by design exhibit sampling error. The abnormal return, $\widehat{A}_i$, has an expected mean of zero and covariance matrix given by[13]

$$\begin{aligned} V(\widehat{A}_i) &= \sigma_i^2[I_N + X_N(X_T'X_T)^{-1}X_N']; \\ T &= \text{Estimation Period; } N = \text{ Event Window} \end{aligned}$$

where X_T is a matrix of explanatory variables over the estimation period and X_N a matrix of explanatory variables over the event window. The covariance matrix, $V(\widehat{A}_i)$, has two parts. The first term in the covariance matrix is the variance due to random disturbances and the second term is the additional variance due to the sampling error in $(\hat{a}, \hat{B})$ (prediction outside the estimation period).[14] Testing for the statistical significance of CA (aggregated abnormal returns over the event window)

[13] Refer to Appendix A.2 for more detail on the covariance of abnormal return.

[14] Refer to Appendix A.2 for more detail on the variance and covariance for abnormal return.

requires us to account for this sampling error, which further leads to serial correlation of the abnormal returns.[15] Abnormal returns are serially correlated despite the fact that the true disturbances, e_{it}, are independent across time.

Furthermore, it is reasonable to believe that there exists cross-sectional contemporaneous correlation between the returns of firms belonging to the same industry; this is referred to as industry clustering. The cross-sectional correlation of shocks within an industry cannot be eliminated by controlling for the market return, since the correlation within the same industry is generally over and above that of the market.

A test statistic introduced by Boehmer, Musumeci and Poulsen (1991) is used to test for statistical significance of cumulated abnormal returns[16]. This test statistic is an extension of the standardized abnormal return test (also known as the Patell test) and corrects for both serial correlation and contemporaneous correlation. Boehmer et al. (1991) report that this test is well specified and quite powerful.

4 Data

4.1 Consumers of Softwood Lumber

Our sample of lumber using industry (also referred to as *downstream* industry) draws from the membership of the American Consumers for Affordable Homes (ACAH).

[15] For a firm, all the abnormal returns estimate use the same intercept and slope parameters.

[16] Please see the appendix A.3 for more detail on the test statistic used.

The ACAH claims that it represents approximately 95 percent of softwood lumber use in the US.[17] However, not all members of this associations are direct consumers or users of softwood lumber. In the US, softwood lumber is largely used for constructing new homes and remodeling existing structures. It is also used for building manufactured homes. Accordingly, we shortlist firms from the ACAH that belong to the following four digit Standard Industrial Classification (SIC). These are: SIC 1521 (Single-Family Housing Construction), SIC 1531 (Operative Builders), 2451(Mobile Homes), and 2452 (Prefabricated Wood Buildings). Besides the direct users, we also include suppliers, in other words, the wholesale lumber dealers, their relevant SIC code is 5211 (Lumber and other Building Materials).[18]

Depending on the availability of stock price data we shortened the list further. Our data for stock price data comes from the Centre for Research on Security Prices (CRSP) database. We use firms that were listed either on the American Stock exchange (AMEX) or the New York Stock Exchange (NYSE). We also require the

[17] The members of ACAH include CHEP USA, Citizens for a Sound Economy, Consumers for World Trade, Free Trade Lumber Council, The Home Depot, International Mass Retail Association, International Sleep Products Association, Leggett & Platt Inc., Manufactured Housing Association for Regulatory Reform, Manufactured Housing Institute, National Association of Home Builders, National Black Chamber of Commerce, National Lumber and Building Material Dealers Association, National Retail Federation, and the United States Hispanic Contractors Association (source: the website for ACAH).

[18] We further checked the websites of these firms to confirm that they either used softwood lumber as an input or were softwood lumber dealers.

availability of stock price data during the entire time period relevant for the SLA. The relevant time period begins a year before the first news report regarding possible export restrictions in 1995 and ends 40 days after the last news report regarding the SLA. This process of elimination leaves us with data for 37 firms.

In Table 5 we list all the firms used in this analysis. The last two columns include their ranking in terms of revenue in the domestic industry.[19] A few large firms can be classified into both Single Family Housing and Operative Builders. We sorted these firms into a single classification depending on their ranking and their primary SIC listing in the Compustat Database.[20] However, as most of the industry leaders are being considered, the sample does represent a significant share of the market.[21]

The Single-Family Housing Construction industry is highly fragmented and dispersed.[22] The industry consists of contractors that are primarily engaged in building, remodeling, and repairing houses. Some large contractors in the industry are also listed as operative builders. However, around 75 percent of the establishments engage solely in the construction of single-family housing. In 1997, the five largest contractors accounted for 14 percent of the revenue share in the industry, their total revenue

[19] The revenue share data is drawn from Gale Group (2001a, b, and c).

[20] For example, Centex Corporation (refer to Table 5), which ranked 1 under SIC 1531 and 2 in SIC 1521, was placed under SIC 1521. In case the ranking was not available we placed them under their primary SIC, as specified in the Compustat Database.

[21] The revenue share data is drawn from Gale Group (2001a, b, and c).

[22] Much of the descriptive information below regarding each industry is drawn from Gale Group (2001a, 2001b, and 2001c).

being $11.3 billion. The industry revenue leader, Pulte Corporation, accounted for 2.3 percent of the housing starts. Other large single-family home contractors include Centex Corporation, Kaufman & Broad Home Corporation, D. R Horton and Lennar Corporation.

Operative Builders account for a smaller percentage of construction. Their also undertake site development, real estate management activities, land acquisition, land sales and other miscellaneous operations. Unlike general contractors, operative builders own the structures they erect and act as their own general contractors. The largest operative builder, in 1999, with sales of $5.2 billion was Centex Corporation followed by Pulte Corporation, Ryland Group, Toll Brothers and Beazer homes.

Lindsey et. al. (2000) provide the information that in 1997, 23.8 percent of single-family housing starts, and 30.5 percent of new single-family homes sold were Manufactured Homes.[23] In other words, this too is also an important industry for our analysis. This industry is relatively more concentrated. There are only 88 manufactured home corporations in the US, and in 1998, the top 10 manufactured home producers accounted for 78 percent of total industry shipments. The industry leader was Champion Enterprises, followed by Fleetwood Enterprises, Oakwood Home Corporation, Clayton Homes, and Cavalier Homes.

[23] According to Lindsey et. al. (2000), this figure was calculated at the request of the National Association of Home Builders by the Bureau of the Census. The calculation was based on Census Bureau analysis described in Howard A. Savage, "Who Could Afford to Buy a House in 1995," Current Housing Reports, H121/99-1, August 1999.

Several types of establishments fall into the Retail Lumber and Building Materials category. The largest categories, by far, are Lumber Yards, Home Centers and Warehouse Home Centers. The industry leaders are Home Depot, Lowes, Menard Incorporated (a private firm not listed on any stock exchange), and The 84 Lumber Company (also a private firm).

4.2 Event Dates

To find the dates for public media announcements related to the SLA, we use two databases. These are the Lexis Nexis Academic Database and the Business and Company Resource Center of Gale Group Database. In Table 2 we list what we consider to be the three important announcements or events related to the SLA. The second column of the table contains the headline for the news report and the third column lists the news source in which the report was published.

The first event date considered is February 2, 1996. On this date the Council for Fair Lumber Imports (CFLI - a coalition representing US lumber interests) announced its intent to file a petition for a countervailing duty if an agreement between US and Canada was not reached by February 15th, 1996. This announcement was probably prompted by the lack of progress made in the negotiations between US and Canadian governments. The second event date considered is February 15, 1996. On this day, under pressure from the CFLI announcement, an agreement between US and Canada was reached and announced in principle. The final event date we consider is April 3,

1996. On this day Canada finalized the Softwood Lumber Agreement and announced its details.

5 Results

We expect the Softwood Lumber Agreement to have a negative impact on the users of lumber. We also find results consistent with that hypothesis. Protection for the domestic lumber industry in the form of the Softwood Lumber Industry had a significantly negative impact on the market value of firms that use lumber as an input. In Table 3 we report the stock price response for the users of lumber to the three events listed above. The Average Cumulative Abnormal returns (ACA) for the event window (-1,+1) (cumulating the average return of firms from one day before the news release to one day after the news release) is reported in the table. The ACA is significantly negative for all events.

For the first event, that is the warning by the CFLI (or US producers), the ACA is significantly negative at the 5 percent level. The second event, the day the agreement was announced in principle, had a relatively smaller, but still statistically significant, effect on the stock prices. There are two possible reasons for this smaller impact. The first being that the market anticipated this announcement. If the threat by CFLI was seen as credible, the market would have anticipated the announcement of the agreement on the second event date (the earlier threat included this event date as a deadline). The second reason could be that the market did not consider the

agreement announced as being credible. Till a few hours before the agreement was announced several Canadian provincial representatives disagreed over the details of the SLA.[24] The disagreement between Provinces was widely known and is likely to have reduced the market's expectation about whether the SLA would be finalized or not. Consistent with the second possible reason above, the final signing of the SLA greatly caused significant depreciation in the market value of our sample of lumber using firms. We find a negative 2.38% abnormal return during this event, significant at the 1 percent level. In the sixth column of Table 3 we report the number of firms with positive and negative average abnormal returns for the event window.

For all three events, firms with negative returns outnumber the firms with positive returns. For the final event, when Canada finalized the agreement, the number of firms that lost market value are more than three times those that gained value. In the last column of Table 3 we report the test statistic for the generalized sign test. This tests whether the fraction of positive returns for the event window is the same as in those during the estimation period. For each of the events the null hypothesis that the number of positive returns is the same as those during the event window is rejected. In other words, the decrease in the number of firms losing value during each event is statistically significant. For the final event, when Canada finalized the agreement, 28 of the 37 firms reported negative abnormal returns, and this is significantly different from similar ratios during the estimation period at the 1 percent level.

[24] There are some details regarding this disagreement in the newsreport regarding the announcement of this agreement.

We add the cumulative abnormal returns for all three events to obtain the Total Cumulative Abnormal Return(TACA). In Table 4 we present the TACA for each of the 4 digit SIC industry considered (1521, 1531, 2451 & 2452, 5211 and others). The results suggest that the response to SLA varied across industries. Firms belonging to SIC 5211 (Lumber and Other Building Materials) had the largest depreciation in their market value. Their TACA was -12.99% and is significant at the 1 percent level. The next largest impact occurred in Single-Family Housing Construction. Their TACA was -6.19% and was significant at the 1 percent level. Though TACA for SICs 1531, 2451 and 2452 are negative, they are not statistically significant. This is probably because the consumption of softwood lumber in Mobile Homes and Prefabricated Wood Buildings is relatively small. Also, firms belonging to Operative Builders (SIC 1531) are involved in many other activities like site development work, real estate management activities, land acquisition, and land sales. The impact on these firms is thus likely to be less than for firms belonging to Single-Family Housing Construction, where 75 percent of establishments engage in the same single activity. In the last row of Table 4 we present results cumulated for all three events, for all firms in our sample. We find that the market value of all firms in our sample depreciated by 5.42 percent, and this is significant at the 5 percent level.

We test the sensitivity of these results to the definition of the event window by trying other event windows. In Table 6, we report TACA for various event windows. Irrespective of the definition of an event window the TACA is negative and significant

at the 5 percent level, and point estimates are similar across windows. We report the results for an event window of 5 days, (-2,+2) in Tables 7 and 8. As with the 3 day event window, the last event (Canada's finalizing of the agreement) had the biggest impact, and again this is significant at the 1 percent level. The other events also reduced market value but the reduction is not statistically significant for the first event. Even at the industry level results do not vary much across event windows. We conclude that the SLA was detrimental to the users of lumber. This is especially true for Lumber Dealers and the Single Family Construction Industry.

6 Conclusion

In this paper we evaluate whether the Softwood Lumber Agreement had a significant economic impact on the industrial users of lumber. To ascertain the impact of the SLA on users of lumber we study stock price variations of lumber using firms. We find that events leading to the Softwood Lumber Agreement brought about large and statistically significant reductions in the stock values of the firms in our sample. If we assume that the stock market processes information efficiently this reduction in stock value can be interpreted as the economic loss expected from the SLA.

Nevertheless, a few caveats are due. This study analyzes the major industrial users of lumber alone. We do not include the final consumers of lumber, for example, the homeowners. It is likely that the economic costs of the Softwood Lumber Agreement would be even larger if this group were included. Further, we only include

firms listed in the major stock exchanges in the US. While we believe that our sample covers a significant share of the relevant industries, it is important to remember that the sample is not comprehensive.

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A Appendix

A.1 Methodology

For each firm the equation is :

$$R = XZ + e$$

where R is a $[(T+N)*1]$ vector; X is $[(T+N)*(2+N)]$ matrix; Z is a $[(2+N)*1]$ vector of coefficients; and e is a $[(T+N)*1]$ vector.

The partitioned X matrix can be written as:

$$X = \begin{bmatrix} X_T & 0 \\ X_N & I \end{bmatrix}$$

Where X_T is a $[T*2]$ matrix and X_N is a $[N*2]$ matrix. The upper right hand corner is a $[T*N]$ matrix of zeros, and the lower right hand corner is a $[N*N]$ identity matrix. The estimated coefficient matrix is:

$$\widehat{Z} = [X'X]^{-1}[X'Y]$$

Inverting the above X matrix and solving for $\widehat{Z}$

$$[X\prime X]^{-1} = \begin{bmatrix} (X_T'X_T)^{-1} & -(X_T'X_T)^{-1}X_N' \\ -X_N(X_T'X_T)^{-1} & I + X_N(X_T'X_T)^{-1}X_N' \end{bmatrix}$$

$$[X\prime X]^{-1}X'R = \begin{bmatrix} (X_T'X_T)^{-1}X_T'R_T \\ -X_N(X_T'X_T)^{-1}(X_T'R_T) + RN \end{bmatrix} = \begin{bmatrix} \widehat{Z}_T \\ \widehat{Z}_N \end{bmatrix}$$

Since there is a dummy variable for each day in the event window that takes the value 1 on the nth day and 0 otherwise. Only the first T observations without the dummies are used to estimate the slope and the parameters $\widehat{Z}_T' = \hat{a}_i$, $\hat{B}$, as is in the traditional market model. $\widehat{A}$ are the abnormal returns which are estimated using the estimates of $\hat{a}_i$, $\hat{B}$ from the first T observations and is reduced to $R_N - X_N\widehat{Z}_T$.

A.2 Covariance

In order to design a statistic to test the significance of ACA, characteristics of abnormal returns needs to be studied in a little more detail. Abnormal return by design exhibit sampling error. Abnormal return, $\widehat{A}_i$, has an expected mean of zero and the covariance matrix is given by

$$\begin{aligned} V_i &= \sigma_i^2[I + X_N(X_T'X_T)^{-1}X_N']; \\ T &= \text{Estimation Period; } N = \text{ Event Window} \end{aligned}$$

where X_T is the matrix of explanatory variables over the estimation period and X_N is the matrix of explanatory variables over the event window. The covariance matrix, $V(\widehat{A}_i)$, has two parts. The first term in the covariance matrix is the variance due to random disturbances and the second term is the additional variance due to the sampling error.[25] The maximum likelihood estimate of the variance $cov(A_{ip}, A_{is}),\ for\ p = s$ [26]is

$$S^2(\widehat{A}_i) = s_i^2 \left[1 + \frac{1}{T} + \frac{(R_{mt} - \overline{R}_m)^2}{\sum_{t=1}^{T} (R_{mt} - \overline{R}_m)^2} \right]$$

$$where, \overline{R}_m = \frac{1}{T} \sum_{t=1}^{T} R_{mt}.$$

Testing for the statistical significance of CA (aggregated abnormal returns over the event window) is complicated by serial correlation of the abnormal returns.[27] Abnormal returns are serially correlated despite the fact that the true disturbances, e_{it}, are independent through time. The variance of the cumulative abnormal return, given serial correlation in the series of abnormal return, is equal to the sum of the variances of the individual abnormal returns plus twice the sum of the their covariances.[28]

$$V(CA_i) = \sigma_i^2 i'[I + X_N(X_T'X_T)^{-1}X_N']i$$

[25] Due to prediction outside the estimation period.

[26] In other words variance of abnormal return.

[27] For a firm, all the abnormal returns estimates use the same intercept and slope parameters.

[28] $var(CA) = var(A_t) + 2((T+N) - (T+1) - 1)cov(A_t, A_{t+1})$

where i is a $(N * 1)$ unit vector. In other words for an event window that extends from t=1 to t=N the estimate of covariance is

$$S^2(CA_i) = (N+1)\sigma_i^2 \left[\left(1 + \frac{N+1}{T} + \frac{(\sum_{t=p}^{s} R_{mt} - 2\overline{R}_m)^2}{\sum_{t=1}^{T} (R_{mt} - \overline{R}_m)^2} \right) \right]$$

A.3 Test Statistic

The standardized cumulative abnormal return for firm i is

$$Z(CA_i) = \frac{CA_i}{S^2(CA_i)}$$

The following Z statistics is used to test for the statistical significance of cumulated average abnormal return for an event

$$Z(ACA) = \frac{\sum_{i=1}^{I} Z(CA_i)}{I^{1/2} \left[\frac{1}{I-1} \sum_{i=1}^{I} \left(Z(CA_i) - \frac{1}{I} \sum_{i=1}^{I} Z(CA_i) \right) \right]}$$

The following Z statistic is used to test for the statistical significance of the total cumulated average abnormal return for all the events considered.

$$Z(TACA) = \frac{\sum_{e=1}^{E} \sum ACA_e / [V(ACA_e)]^{1/2}}{N^{1/2}}$$

The market response for each event should be independent of the others, since each event releases different information to the market.

Figure 1: The Estimation Period

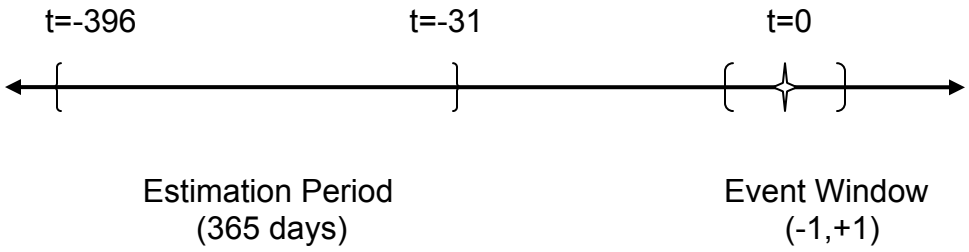

Table 1: History of the Softwood Lumber Agreement

Countervailing Duty Investigations	*Outcome*
Softwood Lumber I: 1982	US authorities decided no subsidy
Softwood Lumber II: 1986	15% provisional duty. Replaced by 15% export tax in MOU
Softwood Lumber III: 1991	After Canada unilaterally terminates MOU Countervailing case filed: Interim bonding requirement Canada wins appeal against countervailing duty in CUSTA (1993 and 1994) US revokes duties against Canadian lumber (Aug 1994) Bilateral consultation process for softwood established
Threat of a Countervailing Duty Investigation : 1996	Softwood Lumber Agreement is signed: The first 650 million board feet over 14.7 BBF was subject to a tax of $50 per thousand board feet, and any further exports were subject to a tax of $100 per thousand board feet.

Table 2: Chronology of Events

Important Events	Headlines	Article
Event 1: February 2, 1996 (Warning by US Producers)	Trade Reprisals Loom For Canada US Group Sets Feb. 15th Deadline for Lumber Pact	The Journal of Commerce Inc.
Event 2: February 15, 1996 (Agreement Reached in Principle)	US Lumber Industry Welcomes Agreement in Principle over Subsidized Canadian Imports	PR Newswire Association Inc.
Event 3: April 3, 1996 (Canada Finalizes the Agreement)	Canada Agrees to Tax Softwood Exports to US. Ottowa-Washington Deal Averts another Trade War over Lumber	The Journal of Commerce Inc.

Search Engine: LexisNexis Academic

Table 3: Stock Price Response to SLA; Event Window (-1,+1)

EVENT	News	No. of firms	ACA	Z STAT	Positive: Negative	Z Stat
event 1	Warning by US Producers	37	-1.50%	-2.61**	13:24	-1.42*
event 2	Agreement Reached in Principle	37	-1.45%	-2.63**	11:26	-2.08**
event 3	Canada Finalizes the Agreement	37	-2.47%	-3.18***	9:28	-2.74***

* significant at 10% confidence interval level; ** significant at 5 % confidence interval level;
*** significant at 1 % confidence interval level

Table 4: Stock Price Response, Cumulated over all events[a] , by 4-Digit SIC, Event Window (-1, +1)

SIC 3-digit	*Industries*	*Event Window*	*No. of firms*	*TACA*	*Z STAT*
1521	Single-family Housing Construction & Residential Construction, Nec	(-2,+2)	9	-6.19%	-2.90***
1531	Operative Builders	(-2,+2)	11	-4.22%	-0.88
2451 & 2452	Mobile Homes & Prefabricated Wood Buildings	(-2,+2)	11	-1.88%	0.04
5211	Lumber and Other Building Materials	(-2,+2)	6	-12.99%	-2.08**
ALL	ALL	(-2,+2)	37	-5.42%	-1.84**

* significant at 10% confidence interval level; ** significant at 5 % confidence interval level;
*** significant at 1 % confidence interval level
[a]event 1 : US producers warn they will petition if no pact by feb15th; event 2 : Agreement in principle reached; event 3 : Canada finalizes the SLA agreement
[b] Others consists of 4-digit SICs: **2515-**Mattresses and Bedsprings; **5031-**Lumber, Plywood, and Millwork; **5271-M**obile Home Dealers

Table 5: Names of Firms Used in the Analysis and their Classifications

Names	4-Digit SIC	Ranking* For 1521	Ranking* for 1531
B M C WEST CORP	5211		
BEAZER HOMES USA	1531		7
CALPROP CORP	1521		
CAPITAL PACIFIC H	1521		
CAVALIER HOMES IN	1531		
CENTEX CORP	1531	2	1
CHAMPION ENTERPRI	2451		
CLAYTON HOMES INC	2451		
D R HORTON INC	1521	4	
DYNAMIC HOMES INC	2451		
ENGLE HOMES INC	1531		6
FLEETWOOD ENTERPR	2451		
GROSSMANS INC	5211		
HOME DEPOT INC	5211		
HOVNANIAN ENTER A	1531		8
KAUFMAN & BROAD H	1521	3	
LENNAR CORP	1531	6	
LIBERTY HOMES I B	2452		
LOWES COMPANIES I	5211		
M D C HOLDINGS IN	1531		
M I SCHOTTENSTEIN	1531		
MANUFACTURED HOME	1521		
N V R INC	1531		
NOBILITY HOMES IN	2451		
OAKWOOD HOMES COR	2451		
PULTE CORP	1521	1	2
RYLAND GROUP INC	1531	7	3
SKYLINE CORP	2451		
SOUTHERN ENERGY H	2452		
STANDARD PACIFIC	1531		
STARRETT HOUSING	1521		
TOLL BROTHERS INC	1531		
U S HOME CORP	1521	8	4
UNITED MOBILE HOM	2451		
WEITZER HOMEBUI A	1521		
WICKES LUMBER CO	5211		
WOLOHAN LUMBER CO	5211		

- Ranking in terms of level of revenue.

Source: Encyclopedia of American Industries, 3rd ed, Gale Group, 2001

Table 6: Stock Price Response for all the events[a]; Various Event Windows

Event Window	*No. of firms*	*TACA*	*Z STAT*
(-1,+1)	37	-5.42%	-1.84**
(-2,+2)	37	-5.11%	-2.03**
(-3,+3)	37	-3.55%	-2.27**
(-5,+5)	37	-5.10%	-2.19**

* significant at 10% confidence interval level; ** significant at 5 % confidence interval level;
*** significant at 1 % confidence interval level
[a]event 1 : US producers warn they will petition if no pact by feb15th; event 2 : Agreement in principle reached; event 3 : Canada finalizes the SLA agreement

Table 7: Stock Price Response to SLA; Event Window (-2, +2)

EVENT	**News**	**No. of firms**	**ACA**	**Z STAT**	**Positive: Negative**	**Z Stat**
event 1	Warning by US Producers	37	-1.14%	-1.94*	14:23	-1.09
event 2	Agreement Reached in Principle	37	-1.01%	-2.13*	10:27	-2.41***
event 3	Canada Finalizes the Agreement	37	-2.96%	-3.52***	12:25	-1.75**

* significant at 10% confidence interval level; ** significant at 5 % confidence interval level;
*** significant at 1 % confidence interval level

Table 8: Stock Price Response for the all the events[a] at 4-Digit SIC; Event Window (-2, +2)

SIC 4-digit	*Industries*	*Event Window*	*No. of firms*	*TACA*	*Z STAT*
1521	Single-family Housing Construction & Residential Construction, Nec	(-2,+2)	9	-5.98%	-2.74***
1531	Operative Builders	(-2,+2)	11	-7.20%	-0.92
2451 & 2452	Mobile Homes & Prefabricated Wood Buildings	(-2,+2)	11	-0.84%	0.01
5211	Lumber and Other Building Materials	(-2,+2)	6	-7.79%	-1.76**
ALL	ALL	(-2,+2)	37	-5.11%	-2.03**

* significant at 10% confidence interval level; ** significant at 5 % confidence interval level;
*** significant at 1 % confidence interval level

[a]event 1 : US producers warn they will petition if no pact by feb15th; event 2 : Agreement in principle reached; event 3 : Canada finalizes the SLA agreement

[b] Others consists of 4-digit SICs: **2515-**Mattresses and Bedsprings; **5031-**Lumber, Plywood, and Millwork; **5271-M**obile Home Dealers