TWO PAPERS IN INTERNATIONAL TRADE

By

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ABSTRACT

This thesis presents two papers dealing with international trade policy in North America. The first is "An Empirical Analysis of Protectionist Forces in the United States and Canada" and the second is "Imports as a Cause of Injury: the Case of the 1986 Softwood Lumber Dispute".

The first paper addresses the question of what motivates firms and industries to initiate "less than fair value" (LFV) complaints. The theory of rent-seeking is tested by analyzing data on the frequency of countervailing duty and antidumping complaints from 1975 to 1987 in both Canada and the U.S. A reduced form model is specified that explicitly incorporates factors that are assumed to affect the supply and demand for protection, including federal elections, business cycles, and statutory changes to laws governing antidumping and countervailing duty procedures. The results indicate that the frequency of LFV cases, in both the U.S. and Canada, rise during low points in the business cycle, and when relative competitiveness and profitability in manufacturing decline.

The second paper takes a specific countervailing duty case, that of the Canada-U.S. softwood lumber dispute of 1986, and addresses the question of whether the U.S. industry suffered injury from the alleged less than fair valued Canadian lumber imports. The relationship between various measures of injury for the U.S. industry and various hypothesized causal factors, including stumpage prices, is analyzed. The six measures of injury are: prices, output, market share, employment, accounting profits, and stock market profits. Structural models are specified and reduced form models tested for the 1975 to 1987 time period.

The analysis indicates that stumpage prices, as proxied by B.C. stumpage levels, appear to have had little effect on any injury sustained by the U.S. industry. Alternative specifications, using "leaked rents" to the B.C. industry as a proxy for the alleged subsidy, also showed little effect on the U.S. industry. Business cycle effects and the exchange rate are the most important determinants of performance. Counterfactual simulations using the estimated equations permit the hypothesizing of how the U.S. industry would have fared under alternative economic scenarios. This provides a useful framework for evaluating causes of injury, since one can control for all other factors besides those alleged to be unfair.

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1. INTRODUCTION

This thesis presents two papers dealing with international trade policy in North America. The first is "An Empirical Analysis of Protectionist Forces in the United States and Canada" and the second is "Imports as a Cause of Injury: the Case of the 1986 Softwood Lumber Dispute".

The first paper addresses the question of what motivates firms and industries to initiate countervailing duty and antidumping complaints (or "less than fair value" (LFV) complaints). The theory of rent-seeking would suggest that firms will tend to file complaints when it will most benefit them to do so. The hypothesis tested in this paper is that business cycles significantly affect firms' decisions to initiate. It is hypothesized that rent-seeking pressures will tend to be highest at the low points in the business cycle. This hypothesis is tested by analyzing data on the frequency of countervailing duty (CVD) and antidumping complaints from 1975 to 1987 in both Canada and the U.S. A reduced form model is specified that explicitly incorporates factors that are assumed to affect the supply and demand for protection; for example, degree of import penetration and level of manufacturing profits. Shift variables that account for the impact of federal elections (petitions are expected to rise during federal election years) and for statutory changes to laws governing dumping and CVD procedures are also included. The impact of business cycle variables are explicitly accounted for. This study followed from an orderly specification of a structural model that relates to the theory of the firm and presents comparable structural models for the U.S. and for Canada.

The results indicate that the frequency of LFV cases in both Canada and the U.S. rise during low points in the business cycle, and when relative competitiveness and profitability in manufacturing decline. While there is significant disagreement concerning the importance of various potential determinants of LFV complaints (Feigenbaum, Ortiz and Willett 1985), there is broad interest in being able to predict the timing of protectionist pressures.

The second paper takes a specific countervailing duty case, that of the Canada-U.S. softwood lumber dispute of 1986, and addresses the question of whether the U.S. industry suffered injury from the alleged less than fair valued Canadian lumber imports. Since business cycle variables are significant in whether or not a LFV case is initiated, and more cases appear to be initiated in troughs, then clearly some of the injury attributed to imports may in fact result from the basic economic conditions of the industry.

The Canadian lumber industry has asserted that the injury allegedly suffered by the Americans at the time of the dispute was primarily due to external influences such as the business cycle and exchange rate changes and not a result of subsidized timber pricing policies as the Americans had claimed.

The relevancy of this issue is clear in the light of the most recent CVD case initiated by the Department of Commerce against the Canadian softwood lumber industry in December, 1992. In 1986, a negotiated settlement was reached between Canada and the U.S. (the Memorandum of Understanding or MOU) before the ITC completed its final injury determination. In October 1992, Canada announced that it was terminating the MOU, since it felt that significant changes in its forest management pricing policies and economic conditions had taken place. The United States subsequently self-initiated another CVD investigation, the third against the industry in nine years. Again thc allegation was that stumpage prices charged by the provinces for timber were subsidized.[1] While this analysis was carried out before this most recent CVD initiation, and does not include data from the most recent years of this dispute, the estimated relationships are likely still valid.

This analysis takes various measures of injury for the U.S. industry and determines the relationship between these measures and various hypothesized causal factors including stumpage prices. The six measures of injury are: prices, output, market share, employment, accounting profits, and stock market profits, since these are the major factors considered by the International Trade Commission (ITC) in its determination of injury. Structural models are specified and reduced form models tested for the 1950 to 1986 time period.

The analysis indicates that stumpage prices, as proxied by B.C. stumpage levels, appear to have had little effect on injury sustained by the U.S. industry. Alternative specifications, using "leaked rents" to the B.C. industry as a proxy for the alleged subsidy, also showed little effect on the U.S. industry. Business cycle effects and the exchange rate are the most important determinants of performance. Counterfactual simulations using the estimated equations permit the hypothesizing of how the U.S. industry would have fared under alternative economic scenarios. This provides a useful framework for evaluating causes of injury, since one can control for all other factors besides those alleged to be unfair.

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1 The investigation also included allegations that log export restrictions constitute a subsidy by artificially lowering domestic log prices.

The two papers are presented as separate, fully contained chapters in this thesis. Chapter 2 is "An Empirical Analysis of Protectionist Forces in the United States and Canada" and Chapter 3 is "Imports as a Cause of Injury: the Case of the 1986 Softwood Lumber Dispute". The Literature Cited section lists references for both papers.

2. AN EMPIRICAL ANALYSIS OF PROTECTIONIST FORCES IN THE UNITED STATES AND CANADA

2.1 Introduction

This paper addresses the positive question of what motivates firms and industries to initiate countervailing duty and antidumping complaints. Presumably, firms make such complaints when it is in their interest to do so. This is the basic "rent-seeking" idea: firms will seek to influence the policy process to protect or create "rents" or profits. It is, of course, not obvious what rent-seeking implies about the timing of complaints. One hypothesis is that rent-seeking pressures are more acute at low points in the business cycle. If this is so, then we should expect to observe that business cycle variables have significant explanatory power in anticipating antidumping and countervailing duty actions. The principle objective of this paper is to investigate this hypothesis.

The legislation relating to dumping and countervailing duties is intended to limit imports sold at "less than fair value" (LFV). Dumping and countervail cases are, therefore, sometimes referred to as LFV cases. I investigate such cases for the U.S. and Canada. Interestingly, U.S. cases trended upward much more rapidly than Canadian cases during the 1975 to 1987 period. In both countries, however, the number of cases seems to be closely related to the business cycle.

The basic method of analysis in this paper is based on the empirical estimation of reduced form models of the number of LFV cases in the U.S. and Canada. The models, estimated using data for the years 1975 to 1987, follow from a specification of a structural model that explicitly incorporates the factors affecting the demand and supply for LFV protection. Basically, the reduced form models for the U.S. and Canada are based on the hypothesis that the frequency of LFV cases will rise when economic conditions required by dumping and countervailing duty legislation are present. Thus, the models test if the number of cases rise when import penetration is high and manufacturing profits are are low. In addition, the models test the hypothesis that LFV petitions will rise during federal elections. Finally the models test the importance of statutory changes to the laws governing dumping and countervailing duty procedures.

The main results of this study are that the frequency of LFV cases in the U.S. and Canada rise during low points in the business cycle and when relative competitiveness and profitability in manufacturing decline. That is, LFV cases were found to rise during general recessionary periods and fall during periods of economic growth. The close relationship between LFV cases and economic conditions that are broadly independent of imports found in this study also supports the hypothesis that rent-seeking is among the factors that motivate industries to initiate dumping and countervailing duty complaints. This is an interesting finding because it means that rent-seeking activity may be more vigorous during economic downturns and during economic upturns.

This research is relevant because there is disagreement concerning the importance and magnitude of the determinants of LFV complaints (Feigenbaum, Ortiz and Willett 1985). In addition, there is broad interest in the ability to predict the timing of protectionist pressures. This is because foreign firms and governments are keenly interested in the well being of the international trading system, and thus they want to know both when and to what extent protectionist pressures will be present given perturbations in their export markets. Furthermore, studies discussed in the literature review, such as those done by Takacs (1981), Grilli (1988), Coughlin, Terza and Khalifah (1989) and Feinberg (1989) have looked at the frequency of LFV cases in the United States. However, the research reported here is unique in that it empirically analyses the cyclical determinants of Canadian LFV cases. In addition, with the exception of Grilli (1988) and Coughlin et al. (1989), the selection of independent variables in studies of LFV cases has not followed from an orderly specification of a structural model that relates to the theory of the firm and has thus been quite ad hoc. The analysis in this study follows from the specification of a structural model that specifies determinants of the demand and supply for LFV protection. Also, this study presents different, but comparable, structural models for the U.S. and for Canada. The time period used in this study allows (for the first time) a comparison of the U.S. Trade Act of 1974, the Trade Agreements Act of 1979 and the Trade and Tariff Act of 1984 with respect to their effect on the incidence of U.S. LFV petitions. Finally, this study is the first to empirically test the significance of election years on the supply of LFV protection.

The outline of the remainder of this paper is as follows. First there is a brief review of the primary literature dealing with the determinants of escape clause and less than fair value petitions. Following this, the paper reviews the domestic economic conditions found in the U.S. and Canada during the time period studied. The paper then develops structural models and presents the reduced form models to be estimated for the U.S. and Canada. Following this, there is a presentation and discussion of trade laws in the U.S. and Canada. The sources of the variables used in this analysis are then presented. Finally, the paper presents the results of the analysis of U.S. and Canadian LFV cases.

2.2 Literature Review

Although the literature dealing with protectionism in general and with the political economy of trade disputes is quite large, the quantitative literature explaining the incidence of escape clause and LFV petitions consists of a relatively small number of studies dating back to the early 1980s. Furthermore, this literature deals almost exclusively with U.S. petitions.

Analyses of escape clause and LFV petitions can be divided into those which focus on the structural factors (e.g., capital intensity) of petitioning industries and those which focus on the cyclical economic factors (e.g., exchange rates) affecting the number and timing of petitions. Although similar in approach, the main questions motivating these two areas of research are different. Studies of structural determinants attempt to answer the question of which firm or industry characteristics explain the incidence of escape clause and LFV petitions over time. On the other hand, studies of cyclical determinants attempt to identify the primary economic pressures that affect the decision to file a petition. Good examples of studies focusing on the structural determinants of LFV cases are Finger (1981), Finger, Hall and Nelson (1982) and Feinberg and Hirsch (1989).

Finger (1981) was among the first to explain the industry incidence of U.S. LFV petitions. He hypothesized that U.S. firms used LFV mechanisms to build a public case for protection. Finger constructed two indices of LFV complaints divided into 2-digit SIC[1] commodity groups filed over the life of the U.S. Trade Act. The first index, referred to as the complaints index, was the percentage of total imports covered by complaints, and the second index, referred to as the affirmative cases index, was the percentage of total imports covered by affirmative cases. Using ordinary least squares regression (OLS), Finger found that the complaints index rose with increases in import penetration, the size of the capital stock and the level of unemployment in an industry. He also found that the affirmative cases index rose with the complaints index, the degree of product differentiation and declining domestic shipments. However, when the reduced form models were estimated using two-stage least-squares, the complaints index became insignificant; thus, the LFV decision process may be more objective than the OLS results suggested.

In a paper, using a similar data set, Finger, Hall and Nelson (1982) studied the influence of political and economic variables on the likelihood of a positive finding in U.S. LFV cases filed between 1975 and 1979. The authors chose the case decision (affirmative or negative) in the LFV pricing and injury investigations as dependant vari-

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1 SIC refers to the standard industrial classification system.

ables. Using logit analysis, this study found that the likelihood of a positive LFV pricing decision was related to cost disadvantages for American industries and specificity of the complaint (measured by the number of products mentioned in the complaint). The likelihood of a positive LFV injury decision was found to be related to domestic political factors (e.g., regulatory changes and size of industry affected).

Feinberg and Hirsch (1989) adopted an industry rent-seeking framework to formulate a reduced form model designed to explain the incidence of U.S. LFV cases. After dividing the LFV cases for the years 1980 to 1986 into 3-digit SIC industries, this paper used tobit analysis to examine the relationship between the number of LFV petitions and rent-seeking factors such as industry concentration, unionization, capital intensity, employment, profits and import penetration. After correcting the number of cases filed by an estimate of the number of manufacturing enterprises, Feinberg and Hirsch found that capital intensive industries with many employees suffering from high unemployment and rising import shares were more likely to file LFV petitions. They concluded that their results are largely supportive of the hypothesized rent-seeking or rent-protecting model.

Good examples of studies focusing on the cyclical determinants of LFV cases are Takacs (1981), Grilli (1988), Coughlin, Terza and Khalifah (1989) and Feinberg (1989). Takacs (1981) focused on explaining the pattern of U.S. escape clause petitions over time. Using the number of petitions and the number of affirmative findings from 1949 to 1979 as indices of protectionism, Takacs used OLS regression analysis to estimate the importance of cyclical economic pressures and regulatory changes to the decision to file for and to award escape clause relief. This study found that number of petitions per year was positively related to lower cyclical economic activity, lower international competitiveness and a greater perceived likelihood of receiving protection. Furthermore, it was found that the Trade Act of 1974 discouraged fewer petitions and granted relief more often than the Trade Expansion Act of 1962.

Grilli (1988) also focused on the cyclical determinants of protectionism but used the total number of non-tariff measures (LFV plus escape clause or safeguard actions) in the U.S. and in the EEC as his independent variables. After presenting a theory of the demand for protection, this study used OLS regression analysis to identify the relative importance of factors theoretically linked to the frequency of petitions filed from 1969 to 1986. Grilli found that the number of petitions per year were positively related to real appreciations in exchange rates, higher unemployment, lower production levels and a trend towards a lower level of comparative advantage. Grilli concluded that if purely structural determinants of the new protectionism are difficult to identify, the cyclical macroeconomic ones are quite clear.

Coughlin et al. (1989) extended previous analyses of U.S. escape clause decisions. Based on cases filed from 1948 to 1984, this study formulates a model of a firm's decision to file a petition. Unlike previous studies, Coughlin et al. assumed that the number of escape clause petitions per year was Poisson distributed. Second, the authors divided the number of petitions by an estimate of the number of potential petitioners to transform the cases per year into a continuous variable. The authors empirical estimation of a Poisson reduced form regression model indicated that the frequency of petitions was inversely related to economic activity (measured in terms of capacity utilization or profit levels) and the merchandise trade balance. Like previous work, the Trade Act of 1974 was found to have discouraged fewer petitions than the Trade Expansion Act of 1962. Finally, the authors found a post-war trend toward more protectionist pressure.

Feinberg (1989) examined the targeted country pattern of U.S. LFV petitions filed quarterly from 1982 to 1987. Using pooled tobit analysis, this study focuses on the response to the absolute and relative frequency of country specific cases to exchange rate changes. Feinberg found that real bilateral exchange rates had a significant effect on the country-targeting of LFV cases. He concluded that the observed inverse relationship between the number of petitions and the real external value of the U.S. dollar was consistent with technical interpretations of LFV cases and with the view that cases were promoted by rent-seeking activities of lawyers and economists representing petitioners. Furthermore, it was concluded that the bulk of the exchange rate effect was due to cases targeted at Japanese industries.

This review of the primary literature shows that most of the empirical investigations of the determinants of protection are based on U.S. conditions. The research reported here is unique in that it analyses the frequency of LFV cases per year in Canada as well as in the United States. Second, with the exception of Grilli (1988) and Coughlin et al. (1989), the selection of independent variables has not followed from an orderly specification of a structural model and has thus been quite ad hoc. This study presents a separate structural model for the U.S. and Canada that specifies the demand and supply factors to be tested in reduced form models. Furthermore, the time period used in this study allows for the comparison of the U.S. Trade Act of 1974, the Trade Agreements Act of 1979 and the Trade and Tariff Act of 1984 with respect to their effect on the incidence of U.S. LFV petitions. Finally, this study is the first to empirically test the significance of election years on the supply of LFV protection.

2.3 Review of the Macroeconomic Environment

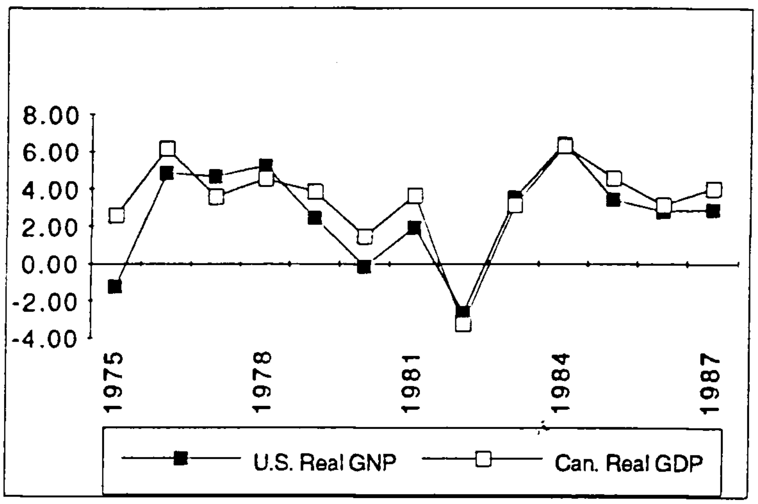
This section briefly reviews the macroeconomic environments in Canada and the U.S. and is included to develop a better feeling for the relationship between cyclical macroeconomic activity and the frequency of LFV petitions in the United States and Canada

Figures 2.1 to 2.3 illustrate how similar the U.S. and Canadian economies have performed over the 1975 to 1987 period. The economic impacts of the business cycle and the oil price shocks in 1974 and 1980 can be clearly seen in these three figures.

Figure 2.1 shows the annual percentage change in real U.S. GNP and Canadian GDP, and like most of the world's economies, it illustrates how the U.S. and Canada were still suffering the effects of the 1974-1975 oil price shock. However, by the end of 1975, the U.S. and Canadian economies had started to improve.

Figure 2.1

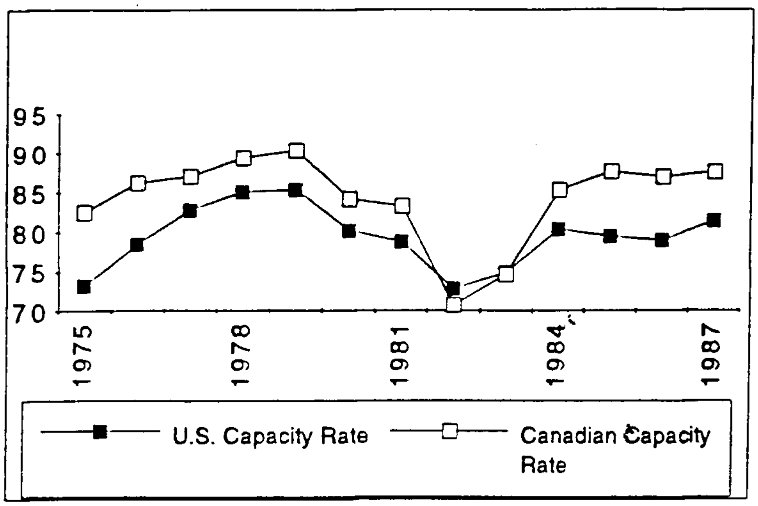
Annual Change in U.S. GNP and Canadian GDP (%)



As illustrated in Figure 2.2, the post recession expansion period lasted until 1979. However, although economic growth was relatively strong and capacity utilization high, unemployment remained high due to a growing work force. Figure 2.3 illustrates how the rate of unemployment in the U.S. and Canadian stayed high through out the 1975 to 1979 period.

Figure 2.2

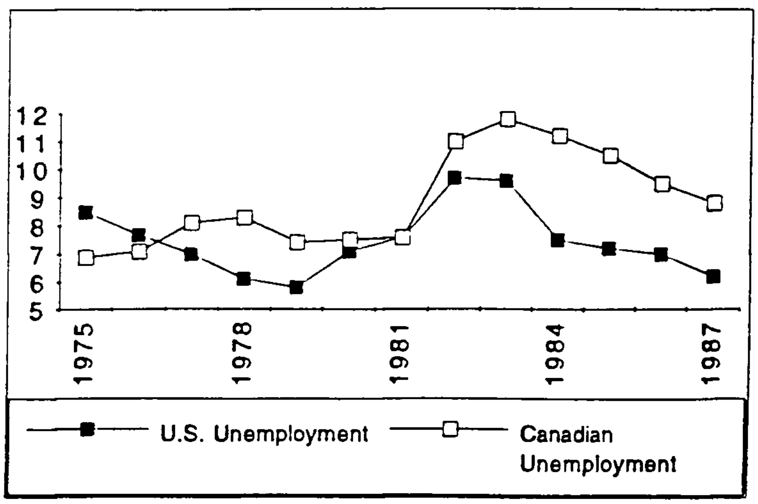
U.S. and Canadian Capacity Utilization Rate (%)



Figures 2.1 and 2.2 show the impact of the second oil shock on the U.S. and Canadian economies. The weak growth in 1980 was due to declines in various components of domestic demand, and as a result, capacity utilization in manufacturing fell by about four percent. Occurring simultaneously with this weak economic growth, the number of LFV cases in the U.S. rose in 1980 to 103 from 24 the previous year.

Figure 2.3

U.S. and Canadian Unemployment Rate (%)



The devastating impacts of the 1981-1982 recession can be seen in Figures 2.1 to 2.3. High inflation and interest rates as well as other factors combined and resulted in the worst recession since the second world war. In the

U.S., for example, unemployment reached a post war high, and capacity utilization reached a post war low. In 1982, there was a record number of LFV disputes in the U.S. and Canada. In the U.S., seven domestic steel companies simultaneously filed 93 countervailing duty and antidumping petitions (ITC 1983). In Canada, the number of LFV petitions rose to 73 in 1982, topping the previous record of 60 in 1977.

Finally, the economic environment began to recover in 1983. Figures 2.1 to 2.3 show the results of the post 1982 expansion period. Healthy economic growth rates and relatively high capacity utilization rates helped to push the rates of unemployment down to nearly six percent in the U.S. and to about nine percent in Canada. However, despite the expansion, protectionist sentiment remained high due to concern over government deficits and rising imports. In the U.S., there was also substantial concern over the rapidly growing trade deficit. In 1984, protectionist sentiment was high in the U.S. and domestic manufacturing industries that had previously not felt the pressure from foreign competition, suddenly found themselves turning to LFV procedures for relief from rising imports (ITC 1985).

The U.S. and Canadian economies performed similarly over the 1975 to 1987 period. The apparent relationship between the business cycle and various macroeconomic shocks, on the one hand, and the frequency of LFV cases on the other, suggests that pressure for LFV protection is counter cyclical. As shown in Figures 2.4 and 2.5, the number of LFV petitions appear to rise during economic down-turns and fall when the economy is expanding[2]. The next section develops a framework for assessing the strength of this relationship and addresses the question of what motivates firms to file LFV petitions.

2 Note that the number of LFV cases in the U.S. and Canada are not proportional to the size of their economies since the number of petitions depends more on other factors such as the number of firms and industries, and on the proportion of tradeable goods and services in each economy.

2.4 Theory Development

The starting point in this analysis of U.S. and Canadian determinants of the annual number of LFV petitions is the specification of reduced form models. This paper adopts a simple rent-seeking-public choice framework for developing a structural model of the factors that affect the supply and demand for protection.

Among the factors affecting the demand for LFV protection are the size of the industry, its concentration and its labour intensity (Feinberg and Hirsch 1989, Kaempfer and Willett 1989 and Grilli 1988). Thus, the larger and the more visible an industry is, the greater its ability to minimize the free rider problem and thus, to organize and petition for protection. It is also reasonable to hypothesize that industries will demand and receive more protection when they have fallen on hard times than when they are prosperous, even though they have more resources available for lobbying in the latter case.

There are at least three reasons to expect a greater frequency of LFV petitions during hard times than when times are prosperous. The first reason, mentioned previously, is that an economy can more easily absorb increasing imports and sustain foreign competitive pressure when it is expanding.

Second, it is important to distinguish between average and marginal changes when considering the decision to file a petition. Although it may be possible that average rent-secking benefits are high during boom times (due perhaps to previous policy decisions), it seems more likely that marginal revenue changes will be higher during economic downturns.

Third, the distribution of LFV cases suggests an inverse relationship between the number of petitions and the profitability of an industry. Most LFV cases in the U.S. and Canada involve dumping complaints[3]. Dumping is price discrimination in the sense that foreign firms charge lower prices in their export markets than in their home market. Therefore the price gap or dumping margin should rise with increasing competition among import competing firms. One should expect to find an inverse relationship between the profitability of import competing industries and the number of LFV complaints.

The supply of LFV protection is discussed by Grilli (1988). Factors affecting supply include the education level and political sophistication of the general public, the quality of information systems available to special interests and regulators, the level of organization and effectiveness of lobby groups, the extent of interventionist tradi-

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3 Between the years 1975 and 1987, 457 of 764 LFV petitions filed in the U.S. involved dumping complaints. The comparable figures for Canada were 420 of 432 LFV petitions.

tions, regulatory changes and discretionary political factors. Although it is quite easy to see how each of these factors can affect the supply of LFV protection, many of these factors are difficult to measure. Abstracting from reality, this study assumes that the regulatory changes affecting the LFV processes and the tendency for politicians to enhance their own self interest by appealing to strong visible special interests during elections represent the most important shifters affecting the supply of LFV protection.

2.4.1 U.S. Structural Model

The number of LFV petitions filed in the U.S. each year (USLFV) is assumed to be a function of factors affecting the demand (USDLFV) and the supply (USSLFV) for LFV protection and thus, can be represented by the following expression.

$$\text{USLFV} = f(\text{USDLFV, USSLFV}) \tag{1}$$

Abstracting for simplicity, it is assumed that the number of LFV petitions demanded each year in the U.S. can be represented by the following expression.

$$\text{USDLFV} = f(\text{Economic Activity, Relative Competitiveness}), \tag{2}$$

where economic activity in the U.S. economy is assumed to be cyclical in nature and related to the general ups and downs in the economy (i.e., to the business cycle). At the macroeconomic level, manufacturing profits can be used as a measure of the state of the domestic manufacturing sector (USPROFIT).

The relative international competitiveness of U.S. import competing industries is assumed to be reflected by the level of import penetration and, thus, is also cyclical in nature, but not in the same sense as the general business cycle. A rise in import penetration represents a relative decline in U.S. international competitiveness. At a broad level, the penetration of imports over time in the U.S. (USIMPEN) can be represented as follows:

$$\text{USIMPEN} = f(\text{RUSEXCH, USRELCOST, TREND}), \tag{3}$$

where RUSEXCH is the real U.S. effective exchange rate, USRELCOST is the relative unit cost of production and TREND is a time trend.

Changes in the real U.S. exchange rate (i.e., deviations from purchasing power parity), represent real shifts in comparative advantage and, thus, in the relative competitiveness of U.S. foreign manufacturers. The relative cost of production has been used as an index of the relative competitiveness (Roberts 1988; Adams, McCarl and Homayounfarrokh 1986). An increase in U.S. unit production cost relative to foreign competitors represents a decrease in the competitiveness of U.S. producers relative to foreign exporters. Over time, there can be changes in the overall technological capability of a country; the trend variable measures the residual shifts in relative U.S. comparative advantage.

Substituting the relationships discussed above for the factors triggering the demand for LFV protection, Expression 2 can be rewritten as follows:

$$USDLFV = f(USPROFIT, RUSEXCH, USRELCOST, TREND), \quad (4)$$

where USPROFIT is the real value of U.S. manufacturing profit and RUSEXCH, USRELCOST and TREND are defined as above.

The supply of LFV protection is a function of several complex factors, many of which are difficult to measure. Abstracting from reality, this study assumes that the supply of LFV protection can be represented as follows:

$$USSLFV = f(\text{Injury, Regulatory Environment, Political Environment}) \quad (5)$$

The supply of LFV protection is assumed to increase with the level of domestic material injury[4]. Injury investigations involving LFV complaints must take into account all relevant factors that have a bearing on the state of the domestic industry and find that the impact of imports (in terms of volume and price) is significant. Furthermore Feinberg (1989) maintains that in recent years, the ITC has taken a bifurcated approach to injury determinations; first a finding of absolute injury is required, and then they determine if LFV imports have caused the injury. Although imports are the result of many interacting factors, there is a tendency in the U.S. and elsewhere to associate higher absolute levels of imports with increased injury. Consequently, this study adopts the premise that the import level is a reasonably index of material injury and thus, higher imports lead to a greater supply of protection.

Changes in the U.S. regulatory environment shift the supply of LFV protection. The regulatory environment has changed over the years. Briefly, the the Trade Act of 1974 imposed strict time limits on investigations and allowed for private petitioners to challenge LFV rulings. The Trade Agreements Act of 1979 combined dumping with countervailing duty complaints to create what are now known as Title VII cases. This act also shifted the responsibility for Treasury Department procedures to the Commerce Department and shortened the time allowed for making Commerce and ITC determinations. The Trade and Tariff Act of 1984 addressed the notion of upstream subsidies and directed the ITC to aggregate the effects of imports from all countries in its injury determinations. These

4 Material injury is defined by the U.S. Trade Agreements Act of 1979 as harm which is not inconsequential, immaterial or unimportant.

regulatory changes are generally thought to have simplified and streamlined LFV procedures, and as such, to lead to more positive determinations by the ITC and Commerce.

The political environment pertains to those factors that can have an impact on the discretionary decision making powers of the Executive and Legislative Branches of the U.S. government. The political economy of decision-making by the U.S. government is beyond the scope of this study; however, the importance of electoral politics to the supply of LFV protection can be tested in the same manner as in Hibbs (1987). In his study of the relationship between political parties, elections and the supply of policies and outcomes, Hibbs (1987) found statistically significant relationships between election years and the supply of changes to inflation and unemployment policies. In the same vein, this study postulates that presidential elections may also shift the supply of LFV protection.

Substituting the relationships discussed above for the factors affecting the supply of LFV protection, Expression 5 can be rewritten as follows:

$$\text{USSLFV} = f(\text{RUSIMP, TA74, TAA79, TTA84, U76, U80, U84}), \qquad (6)$$

where RUSIMP is the real value of U.S. imports, TA74 is an indicator variable for the Trade Act of 1974, TAA79 is an indicator variable for the Trade Agreements Act of 1979, TTA84 is an indicator variable for the Trade and Tariff Act of 1984, and U76, U80 and U84 are indicator variables for the 1976, 1980 and 1984 U.S. presidential elections respectively.[5]

Substituting Expressions 4 and 6 into Expression 1 leads to the following general expression for the number of U.S. LFV cases per year (USLFV).

$$\text{USLFV} = f(\text{USPROFIT, RUSEXCH, USRELCOST, TREND, RUSIMP,}$$
$$\text{TA74, TAA79, TTA84, E76, E80, E84}) \qquad (7)$$

Expression 7 is a reduced form model of the number of U.S. LFV cases per year. Various specifications of this general expression were estimated using annual observations for the years 1975 to 1987.

2.4.2 Canadian Structural Model

The model of the number of U.S. LFV cases per year may not be appropriate for Canada due to the openness of the Canadian economy and the greater importance of exports to the Canadian economy than in the United

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5 The indicator variables TA74, TAA79, TTA84 are equal to 0 up to the year before enactment, and equal to one otherwise; the indicator variables U76, U80 and U84 are equal to 1 in the year of the election and 0 otherwise.

States. However, the development of the Canadian structural model starts from the same equilibrium condition as for the U.S. model. That is, the number of LFV petitions filed in Canada each year (CLFV) is assumed to be a function of the factors affecting the demand (CDLFV) for and the supply (CSLFV) of LFV protection and, thus, can be represented by the following equilibrium condition.

$$CLFV = f(CDLFV, CSLFV) \tag{8}$$

The factors affecting the number of LFV petitions demanded in Canada each year are much the same as those in the U.S.; however, the degree of interaction between economic activity and relative competitiveness in Canada is much greater than in the United States. In Canada, changes in the international competitiveness via real changes in the exchange rate will have an immediate and much larger effect on manufacturing activity than in the United States. Thus, the specification of the the Canadian demand for LFV protection cannot include both manufacturing profit and the exchange rate.

This study assumes that Canadian real manufacturing profit (CPROFIT) can be represented by the following expression.

$$CPROFIT = f(RCEXCH, CLPROD, CDEMAND), \tag{9}$$

where RCEXCH is the Canadian real effective exchange rate, CLPROP is the average productivity of labour in Canadian manufacturing and CDEMAND is the level of Canadian domestic demand.

Canadian import penetration is assumed to be a function of the same variables as in the U.S. and thus, can be represented by the following expression.

$$CIMPEN = f(RCEXCH, CRELCOST, TREND), \tag{10}$$

where RCEXCH is defined as above, CRELCOST is the relative unit production cost of Canadian manufacturing and TREND is a time trend.

Aggregating these relationships results in the following expression for the demand for LFV protection in Canada:

$$CDLFV = f(RCEXCH, CLPROD, CDEMAND, CRELCOST, TREND), \tag{11}$$

where RCEXCH, CLPROD, CDEMAND, CRELCOST, TREND are defined as above.

The Canadian supply of LFV protection is assumed to be a function of the same factors as in the United States. Also, like the U.S., imports are assumed to be a reasonable index of material injury; higher imports represent greater injury and, thus, lead to a greater supply of LFV protection. The regulatory environment has been quite stable in Canada. However, in 1984, the Special Import Measures Act was enacted and replaced the Antidumping Act. The regulatory changes in the Special Import Measures Act were not substantial, but are generally thought to have simplified the LFV procedures for petitioners while retaining the discretionary powers of the government. Thus, it is assumed that the Special Import Measures Act had a positive effect on the number of Canadian LFV petitions per year. Finally, as in the U.S., this study postulates that federal elections may shift the supply of LFV protection. That is, this study tests if Canadian federal elections in 1974, 1979, 1980 and 1984 correspond to shifts in the supply of Canadian LFV protection.

By aggregating these relationships, the Canadian supply for LFV protection can be represented as follows:

$$\text{CSLFV} = f(\text{RCIMP, SIMA, C74, C79, C80, C84}), \qquad (12)$$

where RCIMP is the real value of Canadian imports, SIMA is an indicator variable for the Special Import Measures Act and C74, C79, C80, C84 are indicator variables for the federal elections held in 1974, 1979, 1980 and 1984 respectively.[6]

Substituting Expressions 11 and 12 into Expression 8 results in the following general expression for the number of Canadian LFV petitions per year (CLFV).

$$\text{CLFV} = f(\text{RCEXCH, CLPROD, CDEMAND, CRELCOST, TREND,}$$
$$\text{RCIMP, SIMA, C74, C79, C80, C84}) \qquad (13)$$

Expression 13 is a reduced form model of the number of Canadian LFV cases per year. Various specifications of this general expression were estimated using annual observations for the years 1975 to 1987. The next section reviews the statutes governing LFV procedures in the U.S. and Canada. Following this, the time horizon and the data used in the estimation of Expressions 7 and 13 are presented.

2.5 Review U.S. and Canadian Trade Statutes

The dependant variable used in this analyses of protectionist pressure in the U.S. and Canada is the total number of initiated countervailing duty and antidumping cases. These two types of actions against unfair trading practices were combined because they both involve less-than-fair value complaints. Briefly, this is because "the trade practices they are intended to control involve, in legal terms, the sale of products at less than their 'fair' value"

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6 The value of the indicator variables are as follows: the SIMA variable is equal to 0 before the Act and 1 after; the election year indicators are equal to 1 in the year of the election and 0 otherwise.

(Finger Hall and Nelson 1982). There have been several changes to antidumping and countervailing duty laws in the U.S. and Canada over the years. This section reviews the major changes to the statutes governing these laws.

2.5.1 United States Trade Statutes

As signatories to the GATT and the GATT subsidies code[7], the U.S. and Canada have similar trade statutes. Regarding the U.S., the relevant statutes governing the rules and regulations concerning antidumping and countervailing duty cases are the Antidumping Act of 1921, the Tariff Act of 1930, the Trade Expansion Act of 1962, the Trade Act of 1974, the Trade Agreements Act of 1979 and the Trade and Tariff Act of 1984 and the Omnibus Trade Act of 1988[8]. Although some of the rules and procedures in the U.S. governing countervailing duty and antidumping cases have changed over the years, the essence of what constitutes dumping and an unfair foreign subsidy has not. This section first explains the notion of dumping and then briefly reviews some of the more substantive changes to the antidumping investigation procedures. Following this, major changes to U.S. countervailing procedures are reviewed.

Dumping occurs when an imported good's fair market value exceeds the purchase price paid by a U.S. importer (or an exporters sales price if the exporter markets a good in the U.S. market)[9]. Section 201(a) of the Antidumping Act of 1921 provided that whenever foreign goods were being, or were likely to be sold in the U.S. domestic market or elsewhere at less than fair value, the Tariff Commission[10] shall determine if a U.S. industry was being injured, or was likely to be injured, or was being prevented from being established by the importation of dumped goods (U.S. Tariff Commission 1975). In addition, this act stipulated that the dumping margin and, thus, the antidumping duty, must be equal to the difference between a good's foreign market value and its U.S. purchase price or exporter's sales price (taking account of various conditions and terms of sale), which ever is the most rele-

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7 The full name of the 1979 GATT subsidies code is "Agreement on Interpretation and Application of Articles VI, XVI, and XXIII of the General Agreement on Tariffs and Trade. However, for convenience, this agreement will be referred to as the subsidy code.

8 In 1988, the U.S. passed the Omnibus Trade Act; however, the time series of U.S. import protection cases was only available until 1987, thus the Omnibus Trade Act of 1988 is not pertinent to this study and will not be reviewed.

9 Economic theory defines dumping as price discrimination in international trade. There is price discrimination when like goods sell for different prices in two or more national markets. The term dumping is most often used to describe price discrimination between home and foreign markets when the lower price is charged in the foreign market. For a discussion of dumping as price discrimination see Wares (1977).

10 Renamed the International Trade Commission by the Trade Act of 1974.

vant. However, within limits, the Secretary of the Treasury could decide both how intensively to investigate a particular dumping complaint and whether or not dumping had or was occurring (Wares 1977).

The criteria for arriving at affirmative injury findings in dumping cases has changed somewhat over the years. In the early 1960s, the Trade Expansion Act of 1962 raised the standard for obtaining protection. However, the Trade Act of 1974 (the first major revision of the Trade Expansion Act of 1962) once again made the test for finding injury less stringent (U.S. Tariff Commission, 1975). Antidumping procedures were once again substantially modified by the Trade Agreements Act of 1979. The GATT multilateral trade negotiations in general, and the GATT antidumping code in particular, provided the primary motivation for this act. The Trade Agreements Act of 1979 repealed the Antidumping Act of 1921 and amended the Tariff Act of 1930 by including antidumping and countervailing duty investigations under Title VII. This is why dumping and countervailing duty complaints are now referred to as Title VII cases. This act also shifted responsibility for administration of antidumping procedures from the Treasury to the Department of Commerce.

The Trade and Tariff Act of 1984 made several modifications to the antidumping laws; however, these changes were mainly technical in nature, and were meant to clarify and simplify investigation proceedings. The new provisions included in this act pertained more to countervailing duty investigations than to antidumping investigations. The major revisions to U.S. countervailing duty procedures are discussed below.

U.S. countervailing duty legislation was originally enacted in 1897 and was later embodied in section 303 of the Tariff Act of 1930. This section provided for countervailing tariffs without regard to a determination of injury only when subsidized, dutiable goods were being imported. In other words, if a good was imported duty free, then countervailing duties could only be imposed if there were affirmative determinations regarding the simultaneous presence of a subsidy and injury. The absence of an injury test for dutiable goods predates the GATT, and the U.S. relied on its grandfathering rights to protect itself from violating the GATT requirement (contained in Article VI) to prove material injury. The Trade Act of 1974 represents the first time that countervailing duty law dealt specifically with nondutiable imports.

The Trade Act of 1974, also for the first time, allowed private petitioners to mount court challenges to actions taken by the Department of the Treasury. Furthermore, this act imposed time limits on each of the steps[11] in

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[11] For example, under the Trade Act of 1974, the Department of the Treasury was required to issue a preliminary determination as to the presence of an unfair subsidy within six months of the receipt of a complaint. An

the countervailing duty decision-making process. Hufbaur and Erb (1984) claim that "the right of court review, reinforced by strict time limits, led to a surge of petitions". Furthermore, section 331 of this act required that a public notice be issued upon the receipt of each complaint alleging that goods benefiting from bounties or grants in the country of origin were being exported to the U.S. Finally, this act also gave authority to the Secretary of the Treasury (until January 3, 1979) to waive imposition of a countervailing duty if, in his judgement, adequate steps had been taken to remove the subsidy or substantially reduce its injurious affects. Hufbaur and Erb (1984) state that this waiver authority was used quite liberally.

The Trade Agreements Act of 1979 modified countervailing duty law in a number of ways, and was also a major step toward implementing GATT multilateral trade agreements. First, in order to make GATT conforming changes in domestic trade law, section 701 was added to the Tariff Act of 1930. This section provides for the requirement of a positive material injury determination before a countervailing duty can be applied to imports from countries who are signatories of the GATT subsidies code. Section 303 was still applicable to countries that were not signatories. In addition, this law expanded the authority to suspend investigations when or if early action taken by a foreign government eliminated the unfair subsidy or its injurious effect. Finally, the act shortened the time granted to the Department of Commerce and the ITC for making their preliminary and final determinations.

Section VI of the Trade and Tariff Act of 1984 also modified countervailing duty procedures. This statute revised the authority to reach a settlement agreement by introducing a verification requirement for settlements that involved the use of off-set taxes. In addition, this statute required that the public interest be considered in settlements that involved the use of quantitative restrictions. The notion of upstream subsidies was also addressed in this act. Subject to certain conditions, countervailable subsidies were extended to include certain payments to producers of inputs that were used in a subsequent production process. This act stipulated that these upstream subsidies were to be counted as part of the total benefit to be countervailed if the upstream subsidy resulted in an input factor price that was lower than would be paid in an arm's-length transaction. Another major revision introduced by this statute affected injury investigations. Prior to 1984, the ITC was not given explicit direction regarding the question of whether the injury from a subsidized import should be considered from each country separately or from all countries

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additional six month period was also provided to determine whether the the imposition of a final countervailing duty was warranted.

combined. This statute required the ITC to consider the cumulative effect from all countries in its determination of injury.

Two publications were used as sources of information concerning U.S. LFV cases. The titles of the two publications, both issued by the ITC, are as follows: Operation of the Trade Agreements Program, Annual Report (various years) and United States International Trade Commission Annual Report (various years). The time series for the number of initiated antidumping and countervailing duty cases were constructed by recording the sequential ITC case numbers and dates that the injury investigation request was received by the ITC. I assumed that this investigation request date was a reasonable proxy for the date the petition was initiated. Regarding countervailing duty petitions, both 303 cases involving injury determinations and 701 cases were recorded[12].

2.5.2 Canadian Trade Statutes

In simple terms, dumping in Canada refers to "the sale for export at prices ('export price') lower than those charged to domestic buyers ('normal value'), taking into account the conditions and terms of sale" (Slayton 1979). The Canadian statutes governing antidumping and countervailing duty investigations are the Antidumping Act, the Customs Tariff Act and the Special Import Measures Act.

The Antidumping Act of 1969 fulfilled Canada's obligations as a signatory to the GATT. This act gave investigative authority to the Departments of National Revenue (Customs and Excise Branch) and Finance (the Antidumping Tribunal). The Deputy Minister of National Revenue for Customs and Excise was authorized to initiate investigations into dumping, either on his own or as a result of a dumping complaint received from a Canadian producer. In addition, and on his behalf, Customs and Excise officials conducted preliminary and final investigations aimed at determining the margin of dumping. This act also provided for the creation of the Antidumping Tribunal which was authorized to "conduct inquiries as a quasi-judicial court of record to determine the impact of dumped imports on the production in Canada of like goods" (Canadian Anti-dumping Tribunal 1983). Thus, acting like a court, the Tribunal heard evidence to determine if dumped goods had caused, were causing or were likely to cause material injury to Canadian import competing producers, or if the dumped goods had materially retarded or were materially retarding or were likely to materially retard the establishment of a Canadian import competing producer.

12 303 cases refer to section 303 of the U.S. Tariff Act of 1930. 701 cases refer to section 701 of of the U.S. Tariff Act of 1930 as amended by the Trade Agreements Act of 1979.

In July, 1979 (and in response to the conclusion of the Tokyo Round of multilateral trade negotiations), Canada announced that it intended to adhere to the GATT conventions on subsidies and countervailing duties, and the revised antidumping code (released in June, 1967). To conform to these conventions the Canadian government resolved to amend or repeal all statutes that pertained to imposition of antidumping and countervailing duties. The result of this review process was the Special Import Measures Act (SIMA) which received Royal Assent on June 28, 1984.

The purpose of SIMA is to protect Canadian industry from unfair import competition (U.S. International Trade Tribunal 1987). SIMA repealed the Antidumping Act in order to streamline and modernize Canada's trade laws. With respect to antidumping investigations, SIMA retains the same division of responsibilities between the departments of Revenue and Finance, but provided for the creation of a new injury determining council which was named the Canadian Import Tribunal[13].

With respect to countervailing duty laws and procedures, Canada did not have any until March, 1977 when the Governor in Council proclaimed and published the Countervailing Duty Regulations[14] under section 7 of the Customs Tariff Act. The first Canadian countervailing duty investigation occurred in 1982. Preliminary and final investigations into the existence of unfair and injurious foreign subsidies were done by the Department of National Revenue, Customs and Excise. Although a material injury investigation by the Antidumping tribunal was required by section 16.1 of the Antidumping Act[15], the Tribunal's findings were only advisory.

A complete listing of all antidumping and countervailing duty cases was obtained from Revenue Canada, Customs and Excise. However, these data had to be adjusted to ensure comparability with U.S. data. Canada numbers its LFV cases differently than in the U.S. For example, in 1982, both Canada and the U.S. investigated dumping complaints concerning imported steel products originating from several different countries. In the U.S., the ITC considered each of the countries named in these complaints as a separate investigation. Consequently, in the U.S., if

[13] In effect, SIMA simply provided for the renaming of the Antidumping Tribunal to the Canadian Import Tribunal. On July 18, 1988, the Canadian Import Tribunal was renamed the Canadian International Trade Tribunal as a result of the passing of Bill C-110 "An Act to Establish Canadian International Trade Tribunal and to Amend or Repeal Other Acts in Consequence Thereof".

[14] Order in Council PC 1977-838 of March 24,1977. The the Countervailing Duty Regulations were superseded by SIMA in 1979.

[15] This section stipulated that the Antidumping Tribunal had to "inquire into and report to the Governor in Council on any other matter or thing in relation to the importation of goods into Canada that may cause or threaten injury to the production of like goods in Canada" (Antidumping Tribunal p. 9, 1983)

a petition is filed that accuses companies located in five different countries of dumping, then the ITC carries out five different investigations and numbers then sequentially. In Canada, the Canadian Import Tribunal considered each petition as a separate case. Consequently, in Canada, if a petition is filed that accuses companies located in five different countries of dumping, then the Canadian Import Tribunal (now the Canadian International Trade Tribunal) carries out only one investigation. These numbering conventions are the same for countervailing duty investigations.

In order to insure comparability, the Canadian time series for antidumping and countervailing duty cases were adjusted to conform with the ITC's case numbering convention. This adjustment comprised a simple renumbering or expansion to reflect the number of countries cited in each Canadian investigation.

2.6 Choice of Study Time Period and Data Sources

The time period for the U.S. and Canadian data bases is from 1975 to 1987. The timing of trade law revisions was the primary reason for choosing 1975 as the beginning of the time horizon for the U.S. study. As mentioned above, the Trade Act of 1974 brought about several changes in U.S. trade policy. For example, this act allowed private petitioners to challenge the determinations of the U.S. Treasury, imposed time limits on each step of the dumping and unfair subsidy determination processes, and gave the Secretary of the Treasury new authority to waive countervailing duty determinations. These changes led to the expectation of a bulge in the number of LFV petitions in general, and in countervailing duty petitions in particular. This is because this act appeared to favour potential petitioners by reducing the discretionary powers of the law's administrators. To avoid the potential problem of a change in the size of the potential pool of LFV petitioners, the study period starts at the time when the Trade Act of 1974 came into effect (i.e., January, 1975).

Table 2.1
Listing of Independent Variables Used in LFV Analysis

Variable Name	Units
U.S. Gross National Product Implicit Price Deflator	1980=100
Canadian Gross Domestic Product Implicit Price Deflator	1980=100
U.S. Real Effective Exchange Rate Index	1980=100
Canadian Real Effective Exchange Rate Index	1980=100
Japanese Real Effective Exchange Rate Index	1980=100
German Real Effective Exchange Rate Index	1980=100
U.K. Real Effective Exchange Rate Index	1980=100
U.S. Manufacturing Profits: Durable	Billions of 1980 $U.S.
Canadian Real Corporate Profits Before Taxes: Manufacturing	Millions 1980 $Can.
U.S. Real Value of Imports: fob	Billions of 1980 $U.S.
Canadian Real Value of Imports: fob	Millions 1980 $Can.
Canadian Index of Industrial Production	1980=100
Canadian Manufacturing Employment	1985=100
Canadian Growth in Real Private Consumption	%

Even though Canadian antidumping laws have changed very little from their enactment in 1969 of the Antidumping Act, the 1975 to 1987 time period was also used for the Canadian analysis. The rationale for this decision was two fold. First, using the same time period would improve comparability of the U.S. and Canadian results and second, Canadian real effective exchange rate data was not available before 1975.

Table 2.1 lists the variables that were collected for this study. Except were noted below, all data was obtained from the publication entitled International Financial Statistics (IMF 1988). Where necessary, conversion of nominal values to real terms was done using the appropriate country GNP/GDP implicit price deflator.

U.S. annual corporate profits for manufactured durable products was collected from the Economic Report of the President Transmitted to Congress in February 1991. For Canada, before tax corporate profits from manufacturers was obtained from Statistics Canada Catalogue No. 13-201. The index of Canadian annual manufacturing employment was obtained from the OECD publication entitled Main Economic Indicators: Historical Statistics 1969-1988. Finally the growth of real Canadian private consumption was obtained from OECD Economic Outlook: 1990. Appendices 2.1 and 2.2 list the U.S. and Canadian data used in this study.

2.7 Estimation and Results

Several versions of Expressions 7 and 13 were estimated to test the validity of the two structural model specifications and to assess the relative importance of U.S. and Canadian macroeconomic conditions to the number of LFV petitions filed each year. All estimation was done using Version 6.2 of SHAZAM (White et al. 1990). Unless specified otherwise, significant means statistically significant at the 95 percent level of confidence.

2.7.1 Factors Affecting the Number of U.S. LFV Petitions per Year

With only 12 years of data, the specification of the U.S. structural model was kept simple. In the abstract, the number of U.S. LFV petitions per year was assumed to be a function of corporate manufacturing profits, the U.S. real effective exchange rate, U.S. relative manufacturing costs, a linear trend, real U.S. imports, regulatory changes to U.S. trade statutes and presidential elections.

For the development of Expression 7, I assumed that lower profits would increase the demand for LFV protection. However, corporate manufacturing profits represent a broad array of industry sectors, many of which do not compete with imports. Consequently, I assumed that durable manufacturing sectors were the most sensitive to foreign imports. This assumption is reasonable given the analysis in Finger (1981) which showed that, from 1975 to 1979, virtually all U.S. LFV petitions involved manufactured goods and that over half of the imports named in petitions were related to the auto industry. Finger (1981) also found that many of the complaints against developed countries centred on steel, steel products and electronic machinery.

Real corporate profits of durable product manufacturers have fluctuated dramatically over the period from 1975 to 1987. For example, from 1975 to 1978, profits trended upwards at 20.8 percent per year[16]. However, during the four years between 1978 and 1982, profits fell at a rate of 53.5 percent per year. Finally, from 1982 to 1987, profits from manufacturers of durable products rose at a rate of 29.0 percent per year. There was a minus 72.2 percent linear correlation between the number of U.S. LFV petitions per year and the level of real U.S. profits for manufacturers of durable products.

The U.S. real effective exchange rate and U.S. relative real manufacturing costs are assumed to be important factors in the demand for LFV protection. A higher effective U.S. exchange rate or higher relative production costs should increase the number of LFV complaints. In order to reduce the number of variables and because of the difficulty of developing consistent country specific estimates of production costs, the ratio of U.S. to Japanese real effective exchange rates based on normalized unit labour costs was used as a competitive index of factors affecting U.S. import penetration and, thus, the number of petitions filed per year. Thus, the ratio of U.S. to Japanese real effective exchange rates based on normalized unit labour costs was used instead of RUSEXCH and USRELCOST. This ratio reflects changes in relative competitiveness between the U.S. and Japan due to real changes in exchange rates and wages. Japan was chosen for this relative competitive index because Feinberg (1989) found that, during the period from 1982 to 1987, the relationship between U.S. LFV complaints and exchange rates was particularly significant for complaints concerning Japanese companies. Of the 203 cases analyzed by Feinberg (1989), only 17 percent involved imports from Japan; however, this represented the largest single share of complaints.

The larger the ratio of U.S. to Japanese real effective exchange rates, the greater the import penetration and, thus, the greater the number of LFV complaints per year. The time series of the ratio of U.S. to Japanese real effective exchange rates can be divided into three periods. From 1975 to 1978, the ratio fell at an annual rate of 14.6 percent. From 1978 to 1985, the ratio rose at a rate of 9.2 percent per year. Finally, from 1985 to 1987, the ratio fell sharply at an annual rate of 26.2 percent. U.S. relative competitiveness appears to be cyclical, at least with respect to Japan, and is closely related to the frequency of LFV complaints. There was a 57.4 percent correlation between the number of U.S. LFV petitions per year and the ratio of U.S. to Japanese real effective exchange rates.

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16 Unless stated otherwise, all annual rates of growth are calculated as the compound rates of linear trend lines.

The real value of U.S. imports can be viewed as an index of potential material injury and, thus, higher imports should lead to a greater number of LFV complaints via a shift in the supply of LFV protection. The real f.o.b. value of U.S. imports trended steadily upward at a rate of 4.7 percent through out the study period. However, the post 1975 expansion, the recessionary trough in 1982 and the boom during the latter half of the 1980s can be clearly seen in the time series. There was a 33.2 percent correlation between the number of U.S. LFV petitions per year and the real value of U.S. imports.

Expression 3 suggests that a trend variable might be needed to account for relative technological changes that affect the level of import penetration. However, because of a 90.2 percent correlation with the real value of imports, a time trend variable was not considered in this analysis. Finally, indicator variables for U.S. legislative changes and presidential election years were incorporated into the analysis to test for supply shifts in LFV protection.

2.7.2 Model Results for the Number of U.S. LFV Petitions per Year

Table 2.2 presents the results of the reduced form model of the number of U.S. LFV petitions per year. All four versions of Expression 7 were estimated using the natural logarithms of the explanatory variables. This transformation was based on the results of a Box-Cox regression analysis.

The results for the first model in Table 2.2 are based on estimating a third order autocorrelation model. The choice of a third order autocorrelation model was based on the results of the standard least squares model and on the significance of the lagged autocorrelation rho estimates[17]. The coefficients for relative competitiveness (USJCI), durable profits (USRDPFT) and real imports (USRIMP) are all highly significant and have the expected sign. The coefficients for the regulatory and electoral indicator variables were not statistically significant but may have the correct signs. That is, it was expected that during election years there would be more pressure on the Department of Commerce and ITC to grant LFV protection. Furthermore, it was not unexpected that, relative to the Trade Act of 1974, the Trade Agreements Act of 1979 and the Trade and Tariff Act of 1984 would be associated with fewer LFV complaints.

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[17] The t-statistics from the third order autocorrelation model for the estimated rho values, lagged one, two and three periods, were -3.94, -1.71 and -1.16 respectively.

The second and third models in Table 2.2 test the significance of regulatory and electoral indicator variables separately. The results for these two specifications are based on first and third order autocorrelation models respectively. The second model indicates that elections do not significantly influence the administration of U.S. LFV procedures; also, the sign does not conform with theoretical expectations[18]. Like the first model, the third model in Table 2.2 indicates that regulatory changes over the study period have not had a significant impact on LFV petitions, even though they tend to be associated with fewer complaints[19].

The results for the fourth model in Table 2.2 are based on estimating a first order autocorrelation model[20]. As with the other three models, the coefficients for USJCI, USRDPFT and USRIMP are all highly significant and have the expected signs. This fourth model explains 93.9 percent of the variance in the number of U.S. LFV complaints, yet contains only three variables. Furthermore, the standard OLS assumptions appear to be reasonable and model specification concerns such as variable selection and functional form appear to be minor. The analysis of various Box-Cox transformations indicate that the choice of a linear functional form is reasonable. Even though most of the variance in the number of U.S. LFV complaints is explained by the fourth model, we cannot be sure that this represents the true model. Nonetheless, the results of the fourth specification in Table 2.2 are robust, plausible and significant. Figure 2.4 shows the relationship between the actual number of U.S. LFV cases and the predicted number of cases using the fourth model in Table 2.2.

In summary, the results indicate that the number of U.S. LFV petitions is negatively correlated with the business cycle and rises when firms are experiencing increasing competition from imports. Furthermore, it appears that the variability in the number of LFV cases is due to shifts in both supply and demand factors. On the demand side, the frequency of complaints rises with declines in profitability and relative competitiveness. On the supply side, the frequency of complaints rises with a real rise in imports. Combining these factors leads to the plausible argument that declines in profitability and competitiveness, that are coincident with a rise in imports, will give rise to an increase in the number of LFV petitions. That is, the results support the hypothesis that U.S. import competing industries seek to redistribute the benefits of trade via LFV protection during economic downturns, i.e., when profits and relative competitiveness are low. Add to this the fact that most LFV complaints originate from a relatively

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18 The t-statistics from the first order autocorrelation model for the estimated rho value was -144.9.

19 The t-statistics from the third order autocorrelation model for the estimated rho values, lagged one, two and three periods, were -3.61, -1.62 and -1.15 respectively.

20 The t-statistics from the first order autocorrelation model for the estimated rho value was -97.74.

Table 2.2

Regression Results:
U.S. LFV Cases per Year for the Years 1975 to 1987

Variable	Models 1	2	3	4
USJCI	71.463 (3.67), 0.466	73.917 (3.48), 0.335	59.153 (3.05), 0.424	72.223 (4.37), 0.237
USRDPFT	-37.426 (-2.46), 0.641	-29.512 (-6.10), 0.320	-30.976 (-4.60), 0.548	-29.880 (-7.788), 0.239
USRIMP	142.47 (3.29), 0.786	99.718 (4.49), 0.012	115.27 (4.32), 0.786	100.24 (7.17), 0.012
USELEC	8.5091 (0.42), 0.359	-1.7859 (-0.14), 0.153	* *	* *
TAA79	-19.480 (-0.59), 0.843	* *	-1.20 (-0.07), 0.833	* *
TTA84	-21.885 (-0.87), 0.837	* *	-5.90 (-0.31), 0.836	* *
Constant	-585.44 (-3.30), 0.000	-389.72 (-4.58), 0.000	-466.15 (-3.39), 0.000	-585.44 (-3.30), 0.000
R^2	0.9787	0.939	0.973	0.939
Durbin Watson	2.17	1.93	2.11	1.97
Het[1]	ok	ok	ok	ok
Degrees of Freedom	6	7	7	8

1 Six tests for heteroscedasticity were carried out. Three asterisks indicate rejection of the null hypothesis of homoscedasticity at the 0.01 significance level for at least one of the tests. White's heteroscedasticity-consistent estimates of the variance-covariance matrix were used to calculate t-statistics in these cases.

2 Values in brackets are t-statistics. The second value is the Aux R^2 for the corresponding variable

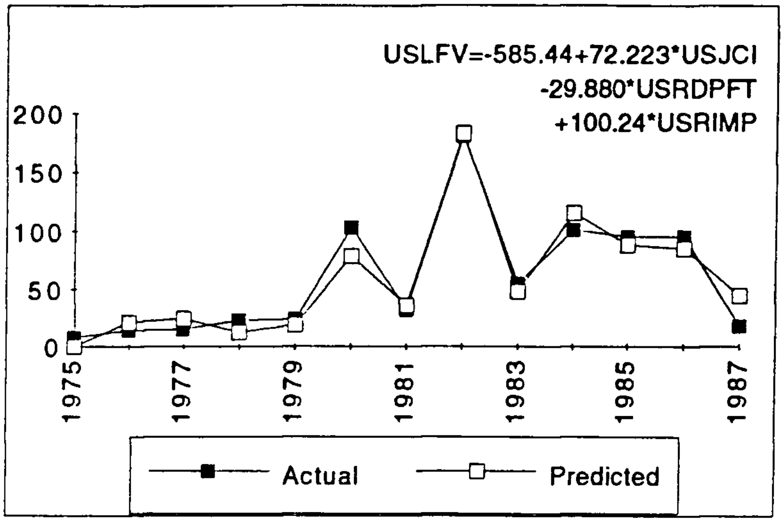
3 Aux R^2 is the R^2 for the regression of the *i* th independent variable on the remaining independent variables.

small number of large, concentrated, capital intensive and unionized import competing industries, and the rent-seeking model seems even more plausible.

Finally, business cycle variables have significant explanatory power in anticipating U.S. antidumping and countervailing duty actions. Although inconclusive, the close relationship between LFV cases and business cycle variables (that are broadly independent of imports), supports the hypothesis that rent-seeking is among the factors that motivate industries to initiate dumping and countervailing duty complaints. Also, assuming an underlying rent-seeking motivation to LFV cases, it appears that the relative attractiveness and the marginal benefit from rent-seeking activity is higher when general competitive pressures are high as compared to when they are low.

Figure 2.4

Number of U.S. LFV Petitions



2.7.3 Factors Affecting the Number of Canadian LFV Petitions per Year

The frequency of Canadian LFV complaints per year was assumed to be a function of the Canadian real effective exchange rate, Canadian relative manufacturing costs, Canadian labour productivity, Canadian consumption, a linear trend, the real value of Canadian imports, regulatory changes to Canadian trade statutes and federal elections.

Higher real effective exchange rates and relative production costs were assumed to increase the number of Canadian LFV cases via their effects on profits and import penetration. Like in the U.S. analysis, the ratio of real effective exchange rates was used to reduce the number of variables. However, because more of Canada's LFV complaints involve imports from Europe, the ratio of the Canadian to the West German real effective exchange rates based on relative normalized unit labour costs was used as a competitive index. Furthermore, plots of the exchange rate ratio and the number of LFV cases indicated a one year lag structure. Consequently, the ratio of the Canadian to the West German real effective exchange rates, lagged one year, was used in the analysis of Canadian LFV cases.

The larger the ratio of the Canadian to the West German real effective exchange rates, the greater the import penetration and the lower the manufacturing profit and, thus, the greater the number of LFV complaints per year. The time series of the ratio of Canadian to West German real effective exchange rates can be divided into three periods. From 1976 to 1979, the ratio fell at an annual rate of 10.5 percent. From 1979 to 1984, the ratio rose at a rate of 5.4 percent per year. Finally, from 1984 to 1987, the ratio fell at an annual rate of 8.9 percent. Canadian relative competitiveness appears to be cyclical, at least with respect to West Germany, and is positively related to the frequency of LFV complaints. There was a 43.4 percent correlation between the number of Canadian LFV petitions per year and the lagged ratio of Canadian to West German real effective exchange rates[21].

Average Canadian manufacturing labour productivity was assumed to be an important determinant of manufacturing profits. All other things being equal, lower labour productivity will reduce profits and, thus, lead to a higher number of LFV petitions per year. This study constructed a proxy for the Canadian average labour productivity by dividing the Canadian industrial production index by an index of the number of Canadian manufacturing employees. This analysis used the annual rate of change in average labour productivity in the empirical estimation of Expression 13 because it was thought that annual rates would have a stronger impact on profits than annual levels. The rationale for this assumption was that it should be the rate of productivity change (rather than the level) that affects manufacturing job turn-overs and, thus, net rates of job creation or loss. Given that job creation or loss rates are closely linked to the overall level of profitability then, it should be the rate of productivity change that affect profits and the frequency of LFV complaints.

The annual rate of change in the average productivity of Canadian manufacturing labour has fluctuated over the study period. From 1976 to 1982, the rate of improvement in labour productivity fell by 0.9 percent per year. From 1982 to 1984 the rate of productivity improvement improved quickly and grew at 6.7 percent per year. Finally, from 1984 to 1987, rate of improvement in labour productivity fell each year and dropped below a value of one in both 1986 and 1987. There was a minus 15.4 percent correlation between the number of Canadian LFV petitions per year and the rate of change in Canadian average labour productivity.

This study used the growth in real private consumption as a measure of domestic demand in Canada. High growth rates in real private consumption reflect real increases in private spending. In turn, real spending increases result in higher profits which provide higher incomes that promote a higher level of consumption. Thus, high growth rates in real private consumption are associated with economic expansion and improved profitability, while low growth rates in real private consumption are associated with economic contraction and declining profitability.

The percentage growth in real private consumption fell from 6.5 percent to 2.3 percent during the period from 1976 to 1981. From 1981 to 1982 growth in real private consumption fell dramatically from 2.3 percent to

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21 The correlation between the number of Canadian LFV petitions per year and the ratio of Canadian to West German real effective exchange rates was 31.7 percent.

minus 2.6 percent. Private consumption recovered after the recession and by 1985, the growth rate in private consumption had risen to 5.2 percent. During the 1985 to 1987 period, the growth in private consumption fell slightly to 4.5 percent. Over the study period, there was a minus 60.4 percent correlation between the number of Canadian LFV petitions per year and the percentage growth in real private consumption.

The real value of Canadian imports was assumed to be an index of potential material injury and, thus, higher imports should lead to a greater number of LFV complaints via a shift in the supply of LFV protection. The real f.o.b. value of Canadian imports trended upward at a rate of 3.5 percent through out the study period. Like the U.S., the post-1975 expansion, the recessionary trough in 1982 and the boom during the latter half of the 1980s can be clearly seen in the time series of Canadian imports. There was a minus 56.4 percent correlation between the number of Canadian LFV petitions and the real value of Canadian imports.

A trend variable was included in the analysis to account for relative technological changes that affect the level of import penetration. In addition, indicator variables representing the 1984 change in Canada's trade statutes and federal elections were incorporated into the analysis to test for supply shifts in LFV protection.

2.7.4 Model Results for the Number of Canadian LFV Petitions per Year

Table 2.3 presents the results of five different specifications of Expression 13. All models were estimated using OLS. The first model in Table 2.3 tests for the significance of the introduction of the Special Import Measures Act in 1984 and the impact of the federal elections in 1979, 1980 and 1984. Although the coefficients for the relative competitiveness, lagged one year (LCGCI), the growth in real private consumption (CGRPC) and the average productivity rate of change of Canadian manufacturing labour (RTCMLAP) are all individually significant and have the expected signs, the regulatory and election year indicator variables (i.e., SIMA and CANELEC) are not significant. Furthermore, the sign of SIMA is negative and, based on conversations with staff of the Canadian International Trade Tribunal, it should be positive.

The second model in Table 2.3 indicates that neither the real value of imports nor the time trend are strong determinants of the frequency of Canadian LFV complaints. Unlike the U.S., the coefficient of the real value of imports (CRIMP) is not significant, it also has the wrong sign. The time trend variable, included to test for the impacts of a long-run decline in manufacturing comparative advantage, is also insignificant; however, the sign agrees with expectations. The relatively high Aux R^2 statistics for this model reflect the 79.9 percent correlation between

Table 2.3

Regression Results:
Canadian LFV Cases per Year for the Years 1976 to 1987

	Models				
Variable	1	2	3	4	5
LCGCI	137.61 (3.63), 0.681	91.611 (3.07), 0.542	118.77 (3.27), 0.622	105.14 (3.79), 0.403	108.73 (4.38), 0.276
CGRPC	-3.9831 (-2.93), 0.324	-3.9929 (-2.97), 0.389	-4.8744 (-4.03), 0.075	-5.0835 (-3.09), 0.538	-4.9052 (-4.29), 0.071
RTCMLAP	-207.54 (-2.22), 0.707	-150.60 (-2.59), 0.330	-152.19 (-1.77), 0.625	-144.26 (-2.28), 0.361	-128.51 (-2.18), 0.284
CANELEC	7.5342 (0.85), 0.611	* *	3.4403 (0.40), 0.551	* *	* *
SIMA	-8.1305 (-1.26), 0.373	* *	* *	4.2577 (0.301), 0.863	* *
CTREND	* *	0.14381 (0.11), 0.758	* *	-1.4014 (-0.84), 0.826	* *
CRIMP	* *	-0.000498 (-0.95), 0.824	* *	* *	* *
Constant	103.14 (1.57), 0.000	130.25 (1.80), 0.000	69.314 (1.11), 0.000	86.037 (1.51), 0.000	57.520 (1.11), 0.000
R^2	0.8556	0.872	0.817	0.855	0.813
Durbin Watson	2.63	3.03	2.12	2.67	2.21
Het[1]	ok	ok	ok	ok	ok
Degrees of Freedom	6	6	7	6	8

1 Six tests for heteroscedasticity were carried out. Three asterisks indicate rejection of the null hypothesis of homoscedasticity at the 0.01 significance level for at least one of the tests. White's heteroscedasticity-consistent estimates of the variance-covariance matrix were used to calculate t-statistics in these cases.

2 Values in brackets are t-statistics. The second value is the Aux R^2 for the corresponding variable

3 Aux R^2 is the R^2 for the regression of the *i* th independent variable on the remaining independent variables.

CRIMP and CTREND. Furthermore, although inconclusive, the Durbin Watson statistic and a visual inspection of the residuals indicates that the parameters may be poorly estimated due to the presence of negative autocorrelation.

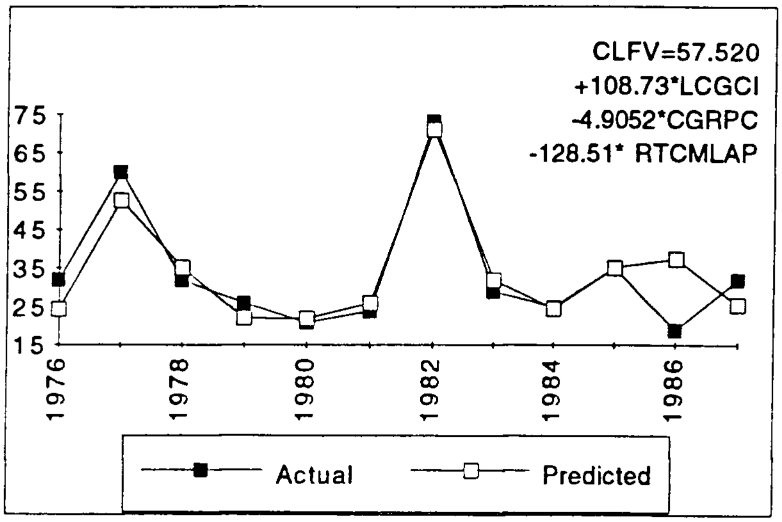
The third and fourth models in the table of Canadian results test two different combinations of the time trend and supply shifter variables. Once again, CANELEC, SIMA and CTREND are insignificant. Finally, the fifth model includes only the variables that were significant in the other four models. This fifth model explains 81.3 percent of the variability in the annual frequency of Canadian LFV complaints. Furthermore, the results for this model do not appear to violate the standard OLS assumptions. The results of Box-Cox regression analysis support the choice of a linear functional form.

Even though most of the variance in the number of Canadian LFV complaints is explained by the fifth model, we cannot be sure that this represents the true model. Nonetheless, these results are significant and plausible with respect to economic theory. Figure 2.5 shows the relationship between the actual number of Canadian LFV cases and the predicted number of cases using the fifth model in Table 2.3.

In summary, the results in Table 2.3 indicate that Canadian LFV petitions are negatively correlated with the growth in private consumption and, thus, with macroeconomic cycles. In addition, LFV complaints rise with a deterioration in Canada's relative competitiveness due to fluctuations in either the real effective exchange rate or normalized unit labour costs. Finally, high rates of improvement in the average productivity of labour tend to improve the

Figure 2.5

Number of Canadian LFV Petitions



profitability of Canadian manufacturers and thus, lower the demand for LFV protection. Combining these factors indicates that when manufacturers are faced with shrinking domestic markets and competitive pressures from exchange rates and declining labour productivity, they tend to increase their demand for LFV protection.

The insignificance of the three supply side shift variables (SIMA, CANELEC and CRIMP), suggests that the Canadian process for providing LFV protection was quite stable over the study period and that it may be less susceptible to the import competing manufacturer's lobby than in the United States. Although inconclusive, this premise seems reasonable given the nature of the differences between U.S. and Canadian LFV procedures. For example, in the U.S., a typical ITC hearing often limits the duration of presentations by affected parties to about thirty minutes, lasts only a few days and does not make submitted information public. In Canada, on the other hand, a typical hearing before the International Trade Tribunal does not impose strict time limits on positions, usually lasts weeks and makes all submitted information public[22].

As with the analysis of the U.S., business cycle variables have significant explanatory power in anticipating Canadian LFV actions. Consequently, the results support the hypothesis that rent-seeking is among the factors that motivate Canadian industries to initiate dumping and countervailing duty complaints and that rent-seeking activity in Canada is more vigorous during economic downturns than during economic upturns.

22 All submitted information is made available to affected parties and their representatives; however, only information that is not confidential with respect to specific firms is made available to the general public.

2.8 Discussion and Conclusions

This paper focused on the question of what motivates U.S. and Canadian firms to initiate LFV investigations. It was presumed that rent-seeking was among the motivating factors in the sense that firms make LFV complaints when it is in their interest to do so. However, it is not obvious what rent-seeking implies about the timing of complaints. This paper investigated the hypothesis that rent-seeking pressures are more acute at low points in the business cycle. Thus, business cycle variables were expected to have significant explanatory power in anticipating antidumping and countervailing duty actions.

Although the premise may sound reasonable, it is very difficult, from a practical perspective, to test if a firm's decision to invest in protectionism is affected by the level of activity in its markets. This is because, at the firm level, investments in protectionism are rare events. For a firm, or even an industry for that matter, a petition for import relief occurs only once every so often. That is, for a particular firm or industry, protectionism is the exception rather than the rule. Aggregation can solve this rare event problem.

Aggregating across many firms or industries, increases the chance that a rare event will occur in a given time-period. Thus, by grouping import competing firms together, there is a greater chance of assessing the relationship between petitioning for import protection and economic activity. On the other hand, by aggregating across firms or industries, much of the inherent variance among firms and industries in terms of, for example, production costs or the timing and frequency of market cycles is lost. Thus, aggregation presents a new set of potential problems, many of which can only be solved by adopting simplifying assumptions about the characteristics of the grouped firms.

This study used the total number of antidumping and countervailing duty petitions as a measure of protectionist pressure. This measure is an aggregate not only of LFV petitions, but also of all petitioning firms and industries. This is a powerful assumption. It implies that among the petitioners, there exists a common set of characteristics that are prominent enough to warrant the aggregation. Are there prominent characteristics that are common to all or practically all petitioning industries?

This question of the overall validity of aggregating across all petitioning industries can be assessed, in part, by addressing the assumptions implicit to any aggregation procedure. First, as alluded to above, an optimal aggregation or allocation procedure requires a set of characteristics that maximize the likelihood of differentiating among groups. In other words, from a spatial perspective, some set of characteristics must exist that maximizes the "distance" between groups.

There are several characteristics common to all petitioning firms. The most obvious common element is that they all initiated LFV investigations, thus they all were pressuring for special protection from imports. Second, they were all manufacturing firms that compete with imports. Third, many of the investigations were requested by primary producers or traditional smokestack industries. Fourth, a large proportion of the petitioning industries were large, capital intensive and well organized. Examples of this representative group are the steel industry, the lumber industry, the textile industry, the oil and gas industry, the mining industry, the automotive industry and the agricultural industry. Finally, most of the petitioning industries had similar business cycles, i.e., they were procyclical.

Notwithstanding these similarities, there are obviously substantial differences among the population of petitioning industries in the U.S. and Canada. However, there is value in considering petitioners as a whole and in investigating the plausibility of this assumption. If a strong positive relationship exists between protectionist pressure (as measured by the number of initiated LFV cases), and the level of economic activity, and the specification of the relationship is cogent at the firm or industry level, then the implicit assumption that petitioning firms or industries are similar in some sense is perhaps reasonable. That is, there is perhaps something to to learned from thinking of petitioners as a whole. Conversely, the lack of a strong relationship or a cogent specification may mean that aggregation across all petitioners was inappropriate.

Although this study aggregated LFV cases, future work could investigate the effects of industry characteristics and other factors that may significantly affect the supply and demand for LFV protection. For example, LFV cases could be disaggregated into those filed by industries producing intermediate goods versus those producing goods for final consumption. Another question that could be tested is whether industries dominated by multinational firms are more or less inclined to seek LFV protection than industries less dominated by multinational firms. There may also be a retaliatory component to the decision to seek protection; thus, future work could test the extent to which industries file petitions in response to previous "attacks" from other countries. Finally, another factor in the process of LFV protection that could be tested is the evolution of ITC appointments. That is, does the composition of the ITC in terms of such factors as the number of economists or the political disposition of the committee members affect the supply of LFV protection.

Ideally, the measures of cyclic economic activity should have corresponded to the pool of LFV petitioners. However, in some cases, indicators of the total economic activity in the U.S. and Canada were used instead. This substitution was made because I assumed that total economic activity was a reasonable proxy for the aggregate level of activity in the domestic markets of petitioning industries. This assumption is reasonable if these markets represent either a relatively fixed proportion or a very significant proportion of total economic activity. Although the manufacturing sectors of the U.S. and Canadian economies have been giving way to service sectors, they still account for a large share of total activity and thus the cyclic nature of total activity.

The results of this study are based on a general specification of a structural model and a somewhat systematic exploration of a database containing several aggregate macroeconomic variables. Consequently, the final models must be viewed as partially instigated by the data. Leamer (1978) presents both sides of the controversy regarding data dependant model selection processes. He starts with the basic question of whether or not there is value in data dependant specification searches. In other words, are specification searches productive? One view is that they merely identify relationships that exist in historical data. That is, searches simply describe the salient economic features of a historical dataset. On the other hand, Leamer (1978) suggests that specification searches can be viewed as "trying to lend some data dependant quantitative support to a broadly held qualitatively determined conjecture". He also suggests that judgement and purpose ultimately are essential ingredients in assessing the validity of data dependent models. In this study, the development of reduced form models represent an attempt to reveal empirically relevant and economically consistent relationships. This search for relevant specifications is legitimate in that it attempts to reveal "some of the truth that is buried in the data" (Leamer 1978)[23].

This study found that business cycle variables were significant in explaining the frequency of U.S. and Canadian LFV complaints. Thus, the results support the contention that there is a countercyclical relationship between protectionist pressure and macroeconomic variables. The significant explanatory power of business cycle variables in anticipating LFV complaints is consistent with an underlying rent-seeking model of some sort. The findings in Krueger (1980) also support a rent-seeking model. In her analysis of foreign trade competition Krueger (1980) argues that examination of the evidence does not support the contention that increased imports were a signifi-

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23 Another reason to treat these results cautiously is the small number of events. Because the study period covers only two business cycles, part of the reason for the good fit may be due the influential nature of a small number of observations. Techniques are available to address the small number of events problem (e.g., weighted regression techniques), however, they were not used in this study.

cant determinant of job losses in the United States. Dornbusch and Frankel (1987) also maintain that the adverse effects of imports have been overshadowed by economy-wide recoveries. That is, Dornbusch and Frankel (1987) found that although import penetration in the U.S. rose from 6.1 to 8.4 percent between 1972 and 1981, the fraction of shipments exported rose from 5.8 to 9.9 percent over the same period.

Bhagwati (1988) and Rugman and Anderson (1987) maintain that LFV trade disputes often represent a form of harassment aimed at shifting economic benefits toward import competing domestic industries. According to this rent-seeking model, the technical process of administering LFV statutes in the U.S. and Canada is sensitive to political and economic conditions. Rugman and Anderson (1987) argue that the tendency to down play economic principles in LFV investigations is an indication of an inability to depoliticize trade issues. When this tendency is added to the fact that trade issues tend to be dominated by a relatively small number of producer organizations (Lenway 1983, and Dornbusch and Frankel 1989) and that these producers face few risks when they initiate trade actions, it is easy to see why industries resort to lobbying for special restrictions as a way of improving their competitive position.

The analysis of Canadian LFV cases suggest that protectionist pressure in Canada is countercyclical. The rate at which private consumption changes is a measure of the overall level of economic activity. When the growth in Canadian private consumption is low or negative, as it was in 1982, the level of economic activity is low. Conversely, when private consumption is growing quickly, economic activity will be high. Thus, the growth in Canadian private consumption is positively correlated with the business cycle. The negative coefficients in Table 2.3 for CGRPC indicates that the frequency of LFV complaints rises significantly during the downside of business cycles. This finding supports the hypothesis that rent-seeking is a determinant of the incidence of LFV cases in Canada.

Labour productivity is also an important determinant of LFV cases in Canada. This is because beginning in the early 1970s, a fundamental imbalance between real wages and productivity appeared in Canada (Economic Council of Canada 1987). The lack of productivity gains to validate wage increases, coupled with a decline in international competitiveness (due to movements in real exchange rates for example), contributed to the unemployment rate and declining profitability in Canada's import competing manufacturing sector. The imbalance between wages and productivity and the insignificance of real imports in Table 2.3 suggests that an inability to compete in the domestic labour market is more important than the level of imports in explaining unemployment and lost profits. In summary, the results suggest that Canada's import competing industries seek import restricting policies during economic downturns and when competitive pressures are high (due to such factors as changes in exchange rates and an imbalance between wages and productivity). This is consistent with the notion that rent-seeking is an important determinant in the decision to seek LFV protection in Canada. If the rent-seeking model is correct, then at least under some circumstance, both the political and administrative environment surrounding Canadian trade policy favour private business interests over those of the public. I agree with Cass (1989) that there is no sound justification for interpretations of the law that result in penalties "when it can be shown that causes wholly extraneous to imports ... caused all but de minimis injury to domestic industry. By raising the requirements and the role of economic analysis in the disposition of LFV cases there may be a greater chance of settling trade disputes in ways that promote the public interest. Methods to depoliticize trade disputes need to be developed so that the social costs of rent-seeking in the administration of Canadian trade policy can be removed or reduced.

Finally, this study did not test for the presence of rent-seeking directly. However, the significant explanatory power of business cycle variables in anticipating LFV complaints can be interpreted as supporting a rent-seeking model of some sort. That is, business cycle variables indicate rent-seeking given certain auxiliary assumptions. For example, if it is assumed that during downturns, the opportunity cost of executives and lawyers etc. is low in the sense that they are not engaged in building new plants and doing things that they do during expansions, then the frequency of LFV complaints will tend to rise during recessions because the cost of initiating complaints will be less than during expansions. Or perhaps the marginal benefit of using scarce resources in marketing and other activities aimed at expanding sales falls during a recession compared to the marginal benefit obtained from seeking LFV protection. Another possibility is to assume that the timing of petitions has something to do with the satisficing theory of the firm. That is, maybe as long as firms are making a certain amount of revenue or executives and workers are getting paid and firms are not going bankrupt, then firms and unions satisfice, they just go along with things and do not worry about things. However, if their minimum aspiration level is threatened, as might be the case during a recession, then they take vigorous action.

These various timing assumptions were not explicitly incorporated into the reduced form models estimated in this study. Consequently, nothing can be said about the appropriateness of different rent-seeking models for explaining the incidence of LFV petitions. A lack of data precluded the testing of possible reasons for the apparent timing of LFV complaints found in this study. However, the data required for to tests several plausible timing hypotheses are available so the question of what type of rent-seek motivates industries to seek LFV protection can be the focus of future research. The results of this research would be interesting because it would help to explain why rent-seeking seems to be more vigorous during economic downturns than during economic upturns.

3. IMPORTS AS A CAUSE OF INJURY

3.1 Introduction

In 1986, a negotiated settlement to the Canada-U.S. softwood lumber dispute, known as the memorandum of understanding, was signed before the U.S. International Trade Commission (ITC) completed its final injury determination. The question of whether the injury being suffered by American lumber producers at that time was caused by higher Canadian softwood lumber exports resulting from less than fair value timber pricing policies has never been answered. This paper addresses the issue of injury in the Canada-U.S. softwood lumber dispute. That is, it tries to assess the extent to which the alleged timber subsidy in British Columbia contributed to the injury suffered by American softwood lumber producers.

This question of injury causality in the softwood lumber dispute is reasonably well suited to econometric analysis. Using six different notions of injury, and using the best available data, I undertake a statistical analysis of the relationship between various potential causal factors, including stumpage prices, and "injury" to U.S. producers. My basic finding is that stumpage prices appear to have had little effect on injury to the U.S. industry. The effects of the "business cycle" and the exchange rate appear to be the most important determinants of the performance of the U.S. industry. Before discussing the six measures of injury used in this econometric analysis, I briefly discuss several general but important aspects of injury.

According to U.S. and international law, injury to domestic producers, either by itself or in conjunction with an unfair subsidy, is a necessary condition for U.S. import protection. Petitions requesting relief from imports involving Escape Clause procedures require a positive ITC injury determination and presidential support for protection to be awarded. American softwood shingle and shake producers received "Escape Clause" protection from Canadian exports in June, 1986.

The softwood lumber dispute involved the U.S. countervailing duty process. Unlike Escape Clause protection, this is a two track system. First, the Department of Commerce, through its International Trade

Administration, must find that an unfair subsidy exists[1] and second, like Escape Clause petitions, the ITC must find that the petitioning industry has been injured or is faced with a threat of being injured.

More specifically, in countervailing duty cases, the ITC must determine if the allegedly unfair imports are causing material injury to domestic producers. This reference to material injury arises from the Subsidies and Countervailing Duties Code signed in 1979 as a result of the Tokyo Round of the multilateral GATT negotiations. However, although the GATT and the Subsidies Code (Article 6:3) refer to material injury, neither defines precisely what it is. Rather, material injury is described in terms of a series of criteria that must be linked to the alleged subsidy under investigation[2]. The ITC must consider material injury to be "harm which is not inconsequential, immaterial or unimportant" (U.S. Tariff Act of 1930 as amended by the Trade Agreements Act of 1979) and include actual or potential declines in such factors as output, sales, market share, profits, and prices in its injury determinations. Furthermore, the ITC is required to take into account all the relevant factors that have a bearing on the state of a domestic industry and find that the impact of imports (in terms of volume and price) is significant.

From this list of factors, it would seem that injury has something to do with danger or potential danger to domestic claimants (i.e., share holders or wage earners). But a listing of factors does not address the concern over which is the most appropriate measure of injury. A lack of a clear consensus on what the most appropriate measure of injury should be is a concern for several reasons. Trade laws that define or measure injury in such a way that benefits are conferred on one group while imposing a greater tax on another group will not serve the public interest. The meaning of injury should relate to a set of well understood and consistent principles for there to be injury determinations that will stand up to objective scrutiny. Also, from a more practical perspective, industries monitor trade disputes, and a definition or measure of injury that does not properly balance the interests of domestic groups with those of foreign exporters may distort trade flows. Thus, a likely result of a biased definition of injury is a reduction in the profitability of foreign exporters. This idea is at the heart of the argument that claims that injury determinations can be (and often are) used as a form of harassment that discourages foreign exporters from entering or expanding into a domestic market[3].

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1 For descriptions of the notion of fairness as it relates to U.S. trade statutes see Rugman and Porteous (1989), Percy and Yoder (1987) and Haufbauer and Erb (1984).

2 For a list of these criteria see Balassa (1989), Kennedy (1989) and Haufbauer and Erb (1984).

3 See for example Bhagwati (1988)

Notions of injury can be found in more than just trade law. For example, competition law views injury and compensation in a way that is analogous to trade law. Competition laws define acceptable methods of competition and award the right to seek redress in cases where injury can be linked to unacceptable methods of competition. Thus, firm's that have suffered from unfair competition (e.g., predatory pricing) have the right to seek compensation for financial losses. This idea that a firm has a right to some form of compensation and protection from an unfair competitive practice is central to trade disputes. Domestic firms in most countries have the right to petition their regulatory institutions for protection from foreign imports, and protection will be given when it can be shown that foreign firms are taking unfair advantage of open markets and that the imports are causing unacceptable losses among domestic producers.

Measurement of injury requires a comparison of the injured state with the state before the injury occurred, everything else being equal. Although this comparison may sound simple and straight forward, in practice it usually is not. For example, in a trade context, it may take several years for the full effects of an allegedly unfair trade practice to work their way through the various domestic factor markets to the end product markets. In addition, there may be multiple injuries that complicate the process of identifying the healthy state. Thus, it may be difficult to identify and specify the timing of a particular cause and effect relationship.

Another difficulty relating to the causality problem is that the best measure of injury may be unobservable. If an industry is being injured, it is possible to assess injury in terms of lost production, employment or market share. However, from a strictly economic point of view, the best measure of the injury is the change in the level of social welfare. From a practical point of view though, the loss of social welfare is very difficult to estimate.

Even though social welfare remains hard to observe, the countervailing duty statutes of some countries (e.g., Canada) include a reference to the public interest[4]. Thus, it would seem that there are different opinions about who's interests should be considered in an injury analysis. Who counts is an important consideration in an injury investigation. This is because, from a social perspective and excluding strategic concerns, it is hard to see why retaliation against foreign subsidies is warranted when subsidies result in net economic benefits. This was an issue in the Canada U.S. softwood lumber dispute. Because U.S. trade statutes do not attempt to balance the interests of both

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4 In the Case of Canada the statute is known as the Special Import Measures Act. Section 45 of this statute specifically calls for the consideration of the public interest into the unfair trade law process (see Rugman and Porteous (1989) and Giese (1986)).

consumers and producers, the ITC must focus only on the concerns of American producers in their injury determinations. According to Kalt (1987), "taking the sum of consumers' and producers' surplus as our yardstick of aggregate national welfare, the ITC might have been instructed to send a note of gratitude to the Canadians, rather than impose a tariff against them".

This question of who counts is most likely a moot point for any particular U.S. trade dispute because procedures are largely fixed by existing laws. However, a focus on existing trade laws begs the question of which of the several measures of injury used by the ITC is the most appropriate for assessing trade impacts to producers? As mentioned above, the ITC must assess impacts on prices, output, market share and profits (among other things) as part of its injury determinations. In addition to these measures, the petition in the softwood lumber dispute included lost employment in its injury claims. Are all of these measures equally capable of measuring the impacts of unfair imports? Also, what is the relationship among these measures?

The next section reviews the literature pertaining to the analysis of causality and the primary literature pertaining to the econometric analysis of the Canada-U.S. softwood lumber dispute. This paper next algebraically defines six measures of injury and then shows how these measures respond to various static changes (i.e., shocks) in their component terms. Following this, an empirical overview of the injury measures is presented. In the following two sections, this paper first presents the theoretical development of a general reduced form injury model and then presents the actual specifications that are empirically estimated. Next, the data collected for this study and their sources are presented. The next section reports the results from empirically estimating the reduced form models for the six injury measures. Following this, the final injury models are used to assess the economic importance of several key variables. Finally, the results and conclusions of this study are discussed.

3.2 Literature Review

This review looks first at the literature pertaining to the analysis of causality and then at the primary literature pertaining to econometric analyses of the Canada-U.S. softwood lumber market. In antidumping and countervailing duty cases, the ITC is responsible for determining if a domestic industry has been materially injured. Morkre and Kruth (1989) review what they regard as the traditional or dominant approach used by the ITC in their assessments of the causal relationship between allegedly unfair imports and material injury to a domestic industry. In their paper, Morkre and Kruth (1989) divided injury investigations into four steps. First the ITC state what are perceived to be the controlling statutory standards. Second, a traditional analysis reviews data on trends of the imports under investigation and often of the domestic industry's performance. Morkre and Kruth (1989) contend that a negative correlation between these trends points in the direction of a positive determination. Third, the ITC review data on nominal transaction prices for the imports under investigation and those for the domestic counterparts. Finally, individual transactions where domestic firms have allegedly lost sales or revenue are reviewed.

In their critique of this traditional causality analysis, Morkre and Kruth (1989) cite a point made by Commissioner Cass in the 1988 Microdisks dispute that the traditional ITC approach to causality analysis may not be fully faithful to the language and history of Title VII of the U.S. Tariff Act of 1930[5]. In his review of the ITC's requirement to prove causality between unfair imports and injury, Palmetre (1986) concluded that cause and effect do not play a particularly important role in the agency's determinations. With respect to causality, most economists feel that the approach should compare a domestic industry's actual performance with the estimated performance in the absence of the unfairly traded import during the time period of the investigation.

A number of studies have used this counterfactual approach in analyzing the injury suffered by U.S. industries. For example, Grossman (1986) looked at the question of imports as a cause of injury to the U.S. steel industry. In this study, a log-linear reduced form employment equation was estimated using monthly data from January 1973 to October 1983. Grossman's structural model starts with a Cobb-Douglas production function with labour, capital, energy, iron ore and scrap steel as inputs. After specifying supply and derived demand functions for the inputs, Grossman specifies that the demand for steel is a function of imported steel and, thus, the exchange rate

[5] Antidumping and countervailing duty disputes are collectively known and less than fair value disputes or Title VII disputes. The term Title VII disputes arose due to an amendment to the U.S. Tariff Act of 1930 combined antidumping with countervailing duty procedures in section seven of the statute.

(among other factors). His study showed that employment in the U.S. steel industry was sensitive to the business cycle and import prices. Employment in the steel industry also suffered because of a time trend effect interpreted as an economy wide shift in employment to high-technology sectors, an increase in the use of plastics and the adoption of labour saving technologies (among other things). Grossman conducted a series of counterfactual simulations to assess the relative importance of the explanatory variables in his reduced for model. This study concludes that imports were not the most important cause of employment loss to the steel industry and were only one fifth of the losses caused by the general secular shift toward other industries during the 1976 to 1983 period. Furthermore, during the 1979 to 1983 period, the real appreciation of the U.S, dollar was responsible for all of the job losses associated with import competition.

Pindyck and Rotemberg (1987) utilized a demand and supply framework in their development of a reduced form model of the U.S. copper industry. Unlike Grossman (1986), they used refinery production, smelter production, mine production and mining employment as indicia of injury. For each of these four measures, real GNP was used to account for demand shifts. Supply shifts were accounted for by a time trend and the ratio of wages in copper mining relative to average U.S. wages. Foreign competition was captured by including the imported quantity of the appropriate form of copper into each equation. The parameters of the four reduced form models were estimated using annual data for the years 1950 to 1983. Pindyck and Rotemberg found from their simulations that for each index of injury, low GNP and high wages had a greater impact on injury than did the level of imports. On the basis of these and other results, they concluded that imports "hardly seem to be a 'substantial cause' of injury to the domestic copper industry".

In a study more closely related to the softwood lumber dispute, Kelly (1988) analyzed the determinants of injury in the U.S. western red cedar shingles and shakes industry. Kelly used the level of production as the measure of injury. However, unlike the other studies of injury causality, which were based on estimation of reduced form models, Kelly worked out the algebra for decomposing the changes in domestic production into changes in domestic demand, changes in domestic supply and changes in import supply. This decomposition follows from the assumption that the demand, supply and import functions are linear. Kelly also showed that the decomposition can be expressed in terms of demand, domestic supply and import supply elasticities. Using estimates of elasticities obtained or estimated by the ITC to establish relevant ranges, this study found that imports from Canada were not a substantial cause of the decrease in domestic shingle and shake production over the period from 1978 to 1984. Furthermore, Kelly found that the observed changes in price, domestic production and imports showed that the decrease in domestic demand was the greatest cause of injury to the U.S. western red cedar shingles and shakes industry. When he focussed on just the 1983 to 1985 period, Kelly found that the greatest cause of injury was a shift in the domestic supply curve due to a decreasing supply of western red cedar logs suitable for making shingles and shakes. Kelly concluded that imports of shingles and shakes from Canada were not a cause of injury "but were rather a consequence of the true causes of injury".

There has been a considerable amount of research focusing on the North American forest industry and how it reacts to various policy changes. Adams and Blackwell (1973) developed one such model to forecast annual changes in the U.S. lumber and plywood markets. This model accounts for interactions between the U.S. markets for lumber, plywood, saw logs, veneer logs and stumpage and was estimated using annual data for the years 1949 to to 1969. Adams and Blackwell modelled lumber imports from Canada as a function of U.S lumber consumption, the relative price of lumber in Canada and the U.S. and a time trend. Because the motivation for this research pertained to the concern that the U.S. lumber industry might not be able to satisfy the requirements of U.S. housing programmes at reasonable prices, this paper focused on the sensitivity of the main U.S. endogenous variables (e.g., the price and consumption of lumber and plywood) to forecasts of housing demand and policies designed to curb lumber price increases. A simulated increase of one billion board feet per year (starting in 1970) in imported lumber from Canada caused the 1975 U.S. price of lumber to fall by less than two percent relative to the 1957 to 1959 average price. Based on this and other results, Adams and Blackwell concluded that the U.S. price of lumber was only moderately sensitive to residential construction and price curbing policies because of the apparent ability of the industry to adjust their production levels.

Various studies have focused on the nature of U.S. lumber demand. Buongiorno and Chou (1983) used monthly data from 1974 to 1980 to estimate the demand elasticities for U.S. forest products. Addressing concerns over the level of Canadian lumber imported into the U.S., this paper found that lumber imports were more sensitive to the U.S price of lumber than to either the import price, the level of residential housing or the U.S. price of all other commodities. Spelter (1985) also analyzed the nature of U.S. lumber demand. He estimated a logistic product diffusion model that allowed for a decline in the price elasticity of lumber over time. Spelter simulated the effect of a tariff on lumber imports and concluded that higher domestic prices for lumber would not dramatically affect consumption.

Adams and Haynes (1985) also addressed the increasing controversy in the U.S. over imports of Canadian lumber. For this study, Adams and Haynes used a regional multiple product partial equilibrium market model (known as the Timber Assessment Market Model) to study the importance of factors influencing lumber trade between the U.S. and Canada[6]. Not surprisingly, this study found that production costs, lumber recovery efficiency and a declining accessibility of timber in Canada were critical influences on level of future lumber trade. Adams and Haynes also found that even though lower wood costs in Canada accounted for some of the rise in Canada's market share, trends in other factors, such as interest rates, demand, Canadian improvements in processing and harvest levels, also played important roles.

Swanson and Jacques (1985) focussed exclusively on the factors that influence relative shares in the U.S. softwood lumber market. Using annual data for the years 1970 to 1983 the ratio of the Canadian to the U.S. share of the U.S. softwood lumber market was modelled as a function of the exchange rate, the ratio of Canadian to U.S. chip revenues, the ratio of Canadian to U.S. average variable costs and the number of U.S. single unit residential housing starts. Swanson and Jacques calculated the ratio of Canadian to U.S. average variable costs using own country currency values because they assumed that "competing foreign producers consider costs and revenues in their own respective currencies, and not in the currency of their foreign competitors, before any decisions concerning investment are made". This study concluded that the exchange rate was the most significant factor explaining the rise in Canada's market share.

Adams, McCarl and Homayounfarrokh (1986) estimated a regional econometric model to study the importance of the exchange rate on U.S.-Canadian lumber trade. This study of lumber and stumpage markets used data for the years 1950 to 1983 and divided the North American lumber market into a U.S. demand region and five supply regions: four in the U.S. and one in Canada. Capacity adjustments over time were also modelled. Based on various exchange rate simulations, the authors concluded that Canada-U.S. exchange rate played a definite role in the expansion of the Canada's market share, but a stable exchange rate would not have completely eliminated the rise in Canadian market share over the 1975 to 1979 period.

Using a partial equilibrium, regional model of the North American lumber market, Boyd and Krutilla (1987) estimated the production and welfare impacts of U.S. tariff and quota restrictions on imports of Canadian lumber. In

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[6] The regional and product breakdown of the the Timber Assessment Market Model is described in Adams and Haynes (1980).

this spatial market model, the North America lumber market was divided into 26 U.S and eight Canadian supply regions. The U.S. market was divided into 39 demand regions. The authors claim that the level of disaggregation was necessary because of the complex structure of inter regional trading patterns. Boyd and Krutilla found that the U.S. regions that experienced the biggest relative gains from a ten percent tariff (on imports of Canadian lumber) were those in the west that competed directly with British Columbian lumber producers. Furthermore, although a ten percent tariff benefited U.S. producers and the U.S. treasury, the net effect on the North American lumber market was negative, reflecting the efficiency costs associated with market distorting policy actions.

Kalt (1987) also studied the welfare impacts of a U.S. tariff on imported Canadian imports. Kalt divided the North American market into U.S. demand, U.S. supply and the supply of Canadian imports and assumed constant elasticity functional forms for these relationships. Based on elasticities cited in the literature, this study estimated the partial equilibrium impacts of a 15 percent tariff. The results in this study are similar to those in Boyd and Krutilla (1987), i.e., U.S. producers and the treasury gained more than U.S. consumers lost, but the North American market was found to be worse off (due to losses by Canadian producers).

Kalt (1987) also empirically estimated the relationship between the Canadian supply of logs and a measure of the stumpage subsidy using data from 1977 to 1984. Canadian log supply was estimated simultaneously with the total demand for logs in the U.S. and Canada. Kalt's results, based on constant elasticity functional forms, did not produce any evidence that Canada's system of stumpage subsidies resulted in an increase in Canada's supply of logs.

Chen, Ames and Hammett (1988) developed and estimated a model of the U.S. lumber market consisting of four simultaneous equations. The model was estimated, using annual data for the years 1965 to 1985, to assess the impacts of a tariff on imported lumber into the United States. The results of this study indicated that lumber imports from Canada were affected by the U.S. price of lumber, the Canadian price of lumber, and the square footage of U.S. residential construction. The U.S. supply of lumber was found to be inelastic (0.309). Thus, in the short-run, it was concluded that a tariff induced price increase would result in windfall gains to U.S. lumber producers.

Roberts (1988) is a departure from these econometric studies of the U.S. lumber market and the Canada-U.S. lumber dispute. This study looked at the broader question of the relationship between the competitiveness of the Canadian forest products sector and the exchange rate by assessing the impact on indices of international competitiveness to a ten percent appreciation in the U.S. value of the Canadian dollar[7]. The competitive index for softwood lumber was defined as the ratio of U.S. to Canadian average variable costs expressed in a common currency. In his review of the lumber sector, Roberts found that 1987 cost conditions, and an approximate ten percent appreciation of the Canadian dollar caused the effective cost of lumber production in Canada to change from being seven percent lower to three percent higher than in the United States. By separating changes in the lumber competitive index, it was found that changes in relative costs in the U.S. and Canada tend to be greater (in terms of variance) than changes in the exchange rate. Roberts concluded that this suggests that the exchange rate was not the most volatile factor determining the relative competitiveness of Canada's lumber industry. Based on this study, it would seem that changes in both the exchange rate and relative costs of production are important considerations to any competitiveness assessment of Canada's lumber sector.

Buongiorno and Chavis (1988) is another example of research that focuses on the importance of the exchange rate to U.S. imports of Canadian lumber. This study used time-series analysis of monthly data from January 1974 to January 1986. Feed-back measures and long-run multipliers between imports, the exchange rate and the U.S. price of lumber were also calculated. Buongiorno and Chavis found that 68 percent of the rise in imports (during the period studied) was due to a rise in the U.S. price of lumber, where as the exchange rate was not found to have a significant effect on imports. The authors also found that the observed increase in imports did not lead to a decrease in the price of lumber received by U.S. producers. The insignificance of the exchange rate with respect to its effect on imports was counterintuitive given the results of previous studies (discussed above). The long-run multiplier of the exchange rate on imports was reported to be 0.46. This is the same as the elasticity of imports with respect to the exchange rate reported in Adams McCarl and Homayounfarrokh (1986); however the standard error for Buongiorno and Chavis' multiplier was 0.70, hence the conclusion that changes in the exchange rate have not affected imports. Buongiorno and Chavis conclude that because the information in their study results from a "model equivalent to a reduced form", they cannot identify the mechanisms that cause the zero net effect of the exchange rate on the level of U.S. imports.

This review of the literature focusing on the North American lumber market is not complete. However, it does present a clear indication of the various econometric approaches that researchers have adopted to explain

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7 Roberts (1988) looked at the softwood lumber, newsprint and market pulp sectors.

Canadian and U.S. lumber production, prices and trade flows. Disputes between Canada and the U.S. over softwood lumber have motivated practically all of the research discussed above. However, these studies have tended to focus on welfare effects and partial equilibrium adjustment of lumber production and prices to trade restrictions. These studies have not attempted to address the broader question of injury and causality per se.

This is not to say that models like those developed by Adams and Haynes (1980) and by Boyd and Krutilla (1987) could not be used to quantify some of the measures of injury addressed in this study because they clearly could and they would help to provide insight. However, these sorts of models were developed to answer more strategic questions pertaining to changing technologies or forest regulatory policies for example. The question of injury in ITC investigations requires a framework that is less data intensive than partial equilibrium spatial market models. Furthermore, although this point may be arguable, injury investigations require a framework that imposes less structure on the production and consumption relationships. Approaches similar to those found in Grossman (1986) and in Pindyck and Rotemberg (1987) are more appropriate than market models for analyzing statutory notions of injury.

The reduced form econometric framework used in this study is similar to that used by Grossman (1986) and by Pindyck and Rotemberg (1987), but is unique in that it looks at a much broader array of injury measures. The six measures of injury assessed in this study are among the most often cited indicators of performance in the forest sector. A complete evaluation of the primary determinants of these measures will remove much of the ambiguity that has surrounded the sources of the injury cited by U.S. lumber producers in their petition for protection against allegedly unfair lumber imports from Canada.

3.3 Measures of Injury

In conducting its injury determinations, the ITC must evaluate all relevant economic factors that have a bearing on the state of a petitioning industry. Section 771 of the U.S. Tariff Act of 1930 specifies that the ITC must consider, but is not limited to, at least 15 different economic factors in their investigations[8]. Of these factors, this paper considers impacts on prices, output, market share, profits (defined as the return on sales and the stock price) and employment in its assessment of the injury suffered by U.S. sawmills during the period from 1951 to 1986.

A change in price is the first of the six measures of injury addressed in this paper. The price of a product in time t ($P_{x,t}$) is given by its inverse demand function and can be defined as follows:

$$P_{x,t} = P_t(X_t, I_t, P_{st}, P_{ct}, Z_t), \quad (1)$$

where X_t is the quantity of good X demanded in period t, I_t is the income of consumers in period t, P_{st} and P_{ct} are vectors of prices for substitutes and complements, respectively, and Z_t is a vector of other exogenous demand variables. Assuming that demand is downward sloping, anything that increases (decreases) the supply of X will decrease (increase) its price.

The second measure of injury considered in this paper is a change in the level of output. A firm's level of output (x_t) depends on its production function which can be defined as follows for the general case of N inputs.

$$x_t = \alpha_1 F_1 + \alpha_2 F_2 + ... + \alpha_N F_N \ , \quad (2)$$

Expression 2 shows that increases (decreases) in the use of factor F_i result in an increase (decrease) in the level of output. In addition, technological changes that increase (decrease) the value of α_i (the quantity of input i necessary per unit of the output x), also increase (decrease) the level of output. Also, assuming profit maximization, an increase (decrease) in the demand or a decrease (increase) in the marginal cost will increase (decrease) a firm's profit maximizing level of output.

The next measure of injury to be considered is a change in market share. Market share can be expressed in terms of quantity or value. For a traded good, the market share of domestic and foreign producers (SHR_i) is equal to

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8 Section 771, subparagraph (c), parts (ii) and (iii) of the U.S. Tariff Act of 1930 lists the following 15 economic factors: prices, output, sales, market share, profits, productivity, return on investment, capacity utilization, cash flow, inventories, employment, wages, growth, ability to raise capital and investment.

the quantity of their respective shipments (consumed in a particular market) divided by the total quantity of shipments (consumed in the market) and can be defined as follows:

$$SHR_i = \frac{x_{it}}{X_t} \text{ , where} \tag{3}$$

$$X_t = \sum_{i=1}^{M} x_{it} \text{ , } M = 1, 2 \text{ ,} \tag{4}$$

and where x_{it} is the quantity shipped to a particular market in time period t by country i. Anything that increases (decreases) the quantity of imports relative to the quantity of domestic shipments will decrease (increase) the share of the market held by domestic producers.

From an economic perspective, perhaps the most natural measure of injury is lost producer surplus or profits. The ITC can view a substantial decline in industry profits caused by unfair imports as an indication of material injury.

Although there are many measures of profitability, I consider return on sales (ROS) and stock prices (SP). ROS can be defined as follows:

$$ROS_t = \frac{\pi_t}{x_t P_t(X_t)} \text{ ,} \tag{5}$$

where π_t is a firm's profit in period t. A firm's profit in any particular time period is described by its profit function which can be defined as follows:

$$\pi_t = x_t P_t(X_t) - w_t L_t - r_t D_t - OC_t \text{ ,} \tag{6}$$

where x_t is the quantity of good x produced in period t, $P_t(X_t)$ is the inverse demand for good X, w_t is the wage rate in period t, L_t is the amount of labour used in period t, r_t is the interest rate in period t, D_t is the total debt in period t and OC_t represents other costs incurred in period t. ROS is a short-run performance measure for a particular time period (e.g., a year). Expression 5 shows that anything that increases (decreases) a firm's profits per unit of output will increase (decrease) its ROS.

The fifth measure of injury considered is a change to the economic value of a common stock. The economic value of a common stock is equal to its market trading price. Provided we define dividends sufficiently broadly, then by adopting a "fundamentalist" view we would expect that a firm's stock price (SP) to be equal to the present value of future returns as illustrated by Expression 7.

$$SP = \sum_{t=0}^{t=\infty} \frac{\pi_t/Nt}{(1+r)^t}, \tag{7}$$

where π_t is defined by Expression 6, N_t is the number of shares in period t and r is the discount rate. Expression 7 could be modified to allow for different discount rates in each time period. Expressions 6 and 7 indicate that factors which increase (decrease) a firm's expected profits will also increase (decrease) its stock price.

Lost employment or man-hours is another measure of injury. It can be shown that for a given level of output during a time period, a cost-minimizing firm should employ its factors of production up to the point where the ratios of the marginal factor productivities to their respective marginal outlays are equal. Thus, for a given level of output, an increase (decrease) in the marginal productivity of labour or a decrease (increase) in the marginal outlay for labour will result in an increase (decrease) in the use of labour. Also, changes in the level of output will also affect the demand for labour. A decrease (increase) in the level of output will decrease (increase) the demand for labour. Thus, changes in the use of labour need to be factored into output effects and substitution effects (i.e., movements along the expansion path versus shifts in the expansion path).

From this listing and brief discussion, it would appear that the various measures of injury are related to one another. For example, a change in the output decision affects the value of the profit function, the return on sales and the distribution of market shares. However, even though these measures are related, they are not perfectly correlated. Consequently, depending on the nature of the underlying economic shock, the various measures of injury may or may not move together (i.e., in the same direction). The next section explores the relationship between the six measures of injury listed above.

3.4 Relationship Between Measures of Injury

This section shows how the six measures of injury listed above respond to various economic shocks. This analysis is done from the perspective of the U.S. and Canadian softwood lumber market. The response of the injury measures are determined for two demand shocks (higher U.S. income and higher U.S. housing starts) and two supply shocks (higher Canadian stumpage prices and a higher Canada-U.S. exchange rate). For each of the four cases, the effects of the shock are illustrated algebraically and diagrammatically.

Assume for simplicity that the U.S. and Canada produce softwood lumber and that the U.S. imports lumber from Canada. Furthermore, assume that Canada does not import lumber from the United States. Under these conditions, the U.S. will have excess demand (filled by Canada) and Canada will have excess supply (shipped to the U.S.). Let the U.S. excess demand (XD_{US}) be defined as follows:

$$XD_{US} = XD(P_L; Y, H, X) \ , \qquad (8)$$

where P_L is the price of lumber in U.S. dollars, Y is the level of U.S. income in U.S. dollars, H is the square footage of new U.S. residential construction and X is a vector of other shift variables. The Canadian excess supply (XS_C) can be defined as in Expression 9.

$$XS_C = XS(P_L; SP, E, Z) \ , \qquad (9)$$

where P_L is defined as above, SP is the Canadian stumpage price in Canadian dollars, E is the exchange rate in terms of the number of Canadian dollars per U.S. dollar and Z is a vector of other shift variables.

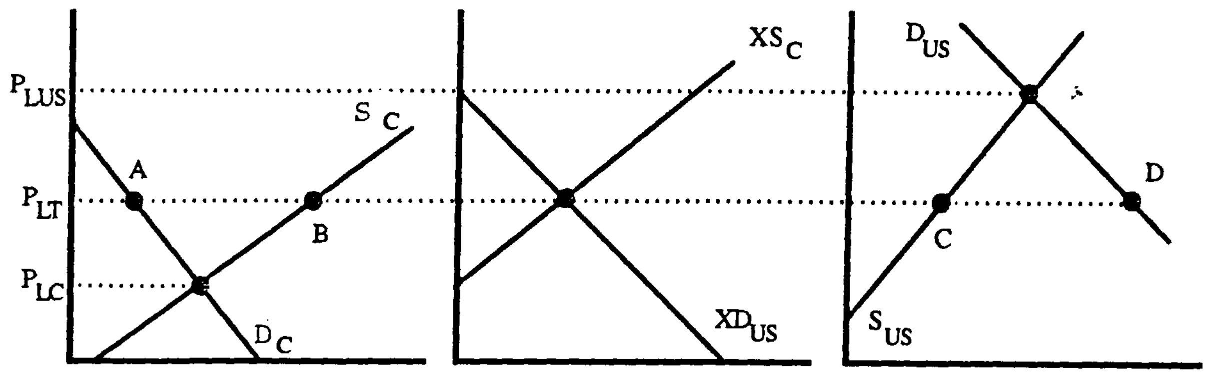
Assuming that in any period the market clears and there are no inventories, then Canadian excess supply will equal U.S. excess demand. Furthermore, changes in Canadian excess supply must be balanced by corresponding changes in U.S. excess demand, and visa versa. Thus, the total derivative of the Canadian excess supply function must equal the total derivative of the U.S. excess demand function. This condition is shown by Expression 10.

$$\frac{\partial XS}{\partial P_L} dP_L + \frac{\partial XS}{\partial SP} dSP + \frac{\partial XS}{\partial E} dE = \frac{\partial XD}{\partial P_L} dP_L + \frac{\partial XD}{\partial Y} dY + \frac{\partial XD}{\partial H} dH \ , \qquad (10)$$

The Canadian and U.S. markets, as well as the excess supply and demand curves are illustrated in Figures 3.1.1 to 3.1.3.

In Figure 3.1.1, S_C is the supply of lumber and D_C is the demand for lumber in Canada. Without trade, the price and quantity of lumber in Canada would be P_{LC} and Q_{LC}. Similarly, in Figure 3.1.3, S_{US} is the supply of lumber and D_{US} is the demand for lumber in the United States. Without trade, the price and quantity of lumber in the U.S. would be P_{LUS} and Q_{LUS}. Figure 3.1.2 shows the Canadian excess supply curve (XS_C) and the U.S. excess demand curve (XD_{US}) which correspond to Figures 3.1.1 and 3.1.3. With trade, the price of lumber rises in Canada and falls in the Unites States to P_{LT}. Furthermore, with trade, Canadian exports equal AB, and U.S. imports equal CD.

Figure 3.1.1 Canadian Lumber Market | Figure 3.1.2 Equilibrium Condition | Figure 3.1.3 U.S. Lumber Market



From the equilibrium condition in Figure 3.1.2, I will now review the effects of a series of economic shocks on the injury measures considered in this study. For each case, I allow only one of the exogenous variable to change. The results of this analysis are summarized in Table 3.1. For the first shock, I assume a one time increase in U.S. income. From Expression 10, this scenario is characterized algebraically as follows.

$$\frac{\partial XS}{\partial P_L} dP_L = \frac{\partial XD}{\partial P_L} dP_L + \frac{\partial XD}{\partial Y} dY ,$$

Collecting like terms and factoring yields,

$$dP_L\left[\frac{\partial XS}{\partial P_L} - \frac{\partial XD}{\partial P_L}\right] = \frac{\partial XD}{\partial Y} dY ,$$

Dividing both sides by dY results in,

$$\frac{dP_L}{dY} = \frac{\frac{\partial XD}{\partial Y}}{\frac{\partial XS}{\partial P_L} - \frac{\partial XD}{\partial P_L}} . \tag{11}$$

Expression 11 shows that the effect of an increase in Y on P_L depends on the relative slopes of the excess supply and demand curves with respect to P_L and Y. What can be said about the sign of Expression 11? Focusing on the right hand side, we know that the numerator must be positive because demand rises with an increase in income. Also, the first term in the denominator must be positive because supply rises with an increase in price.

Finally, the second term in the denominator must be negative because demand falls with a rise in price. Thus, it would seem that an increase in income produces a rise in the U.S. price of lumber.

This result can also illustrated in Figures 3.2.1 and 3.2.2. The rise in Y shifts D_{US} to D'_{US}. This causes an upward shift in XD_{US} to XD'_{US} and a rise in the lumber price from P_L to P'_L. Figure 3.2.2 also shows that the increase in Y causes U.S. lumber imports to rise from AB to CD and U.S. lumber production to rise from OE to OF. Because the rise in imports is greater than the rise in U.S. production, Canada's market share rises.

Figure 3.2.1
Equilibrium Condition: Rise in U.S. Income

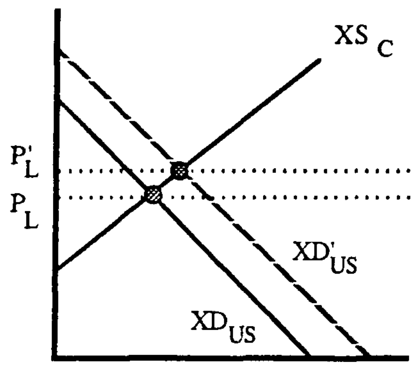
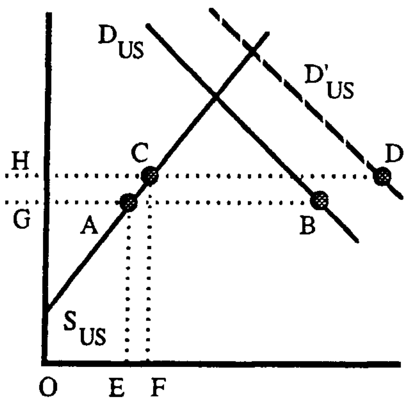


Figure 3.2.2
U.S. Lumber Market: Rise in U.S. Income



The increase in U.S. production will require more labour thus, the increase in Y also increases the number of production hours. Increases in U.S. price and production raise profits by AGHC thus, according to Expressions 2 and 3, the average stock price of the U.S. lumber industry will rise. Finally, the effect of the rise in Y on the return on sales depends on the form of the U.S. supply function respect to price because functional form affects relative profit and quantity responses to an income induced price changes. Thus, the effect of a rise in Y on the return on sales is indeterminate.

For the second shock, assume that there is a one time increase in the number of U.S. housing starts due to a low income mortgage subsidy programme for example. An increase in housing starts will increase H, the square footage of U.S. new residential construction. This scenario is depicted by the following expression.

$$\frac{\partial XS}{\partial P_L} dP_L = \frac{\partial XD}{\partial P_L} dP_L + \frac{\partial XD}{\partial H} dH \ ,$$

Collecting like terms, factoring and then dividing both sides by dH yields,

$$\frac{dP_L}{dH} = \frac{\frac{\partial XD}{\partial H}}{\frac{\partial XS}{\partial P_L} - \frac{\partial XD}{\partial P_L}} \quad . \qquad (12)$$

Thus, the effect of an increase in H on P_L depends on the relative slopes of the excess supply and demand curves with respect to P_L and H. The denominator of the right hand side of Expression 12 is the same as in Expression 11 thus, it must be positive, as before. The numerator must also be positive because the demand for lumber is derived from its end uses and residential construction utilizes the largest proportion of U.S. lumber consumption. Consequently, it would seem that an increase in the square footage of new residential construction raises the U.S. price of lumber.

Graphically, this scenario is the same as an increase in per capita income. Consequently, the impacts on the other measures of injury are the same. The directions of these effects are listed in Table 3.1.

To see the importance of the exchange rate on the performance of the U.S. lumber industry assume there is an appreciation of the U.S. dollar relative to the Canadian dollar. From the perspective of U.S. lumber producers, an increase in the number of Canadian dollars per U.S. dollar can be symbolized by the following expression.

$$\frac{\partial XS}{\partial P_L} dP_L + \frac{\partial XD}{\partial E} dE = \frac{\partial XD}{\partial P_L} dP_L \; ,$$

Collecting like terms, factoring and then dividing both sides by dE yields,

$$\frac{dP_L}{dE} = \frac{-\frac{\partial XD}{\partial E}}{\frac{\partial XS}{\partial P_L} - \frac{\partial XD}{\partial P_L}} \quad . \qquad (13)$$

As before, Expression 13 states that the effect of the rise in the relative value of the U.S. dollar on the price of lumber depend on the slopes of the excess supply and demand curves. The denominator of the right hand side of Expression 13 is positive; however, in this scenario, the numerator is negative. This is because the appreciation of the U.S. dollar lowers the U.S. dollar value of Canadian production costs.

This result is illustrated in Figures 3.3.1 and 3.3.2. The rise in E shifts XS_C to XS'_C. This causes an fall in the lumber price from P_L to P'_L. Figure 3.3.2 also shows that the increase in E causes U.S. lumber imports to rise from AB to CD and U.S. lumber production to fall from OE to OF. Because imports rise and U.S. production falls, Canada's market share rises.

Lower U.S. production lowers the demand for labour and, thus, the number of production hours will fall. Lower prices and production translate into a drop in profits equal to AGHC thus, according to Expressions 2 and 3, the average stock price of the U.S. lumber industry will fall. Finally, the effect of the rise in E on the return on sales depends on the form of the U.S. supply function. Thus, without additional information on nature of U.S. lumber supply, the effect a rise in E on the return on sales is indeterminate.

Figure 3.3.1
Equilibrium Conditions: Rise U.S. $

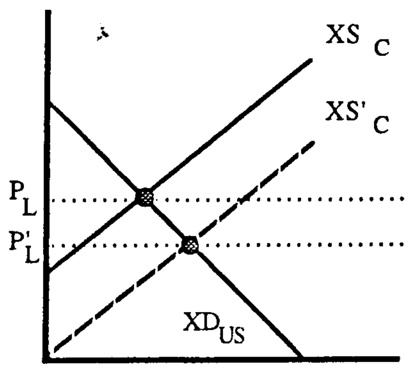
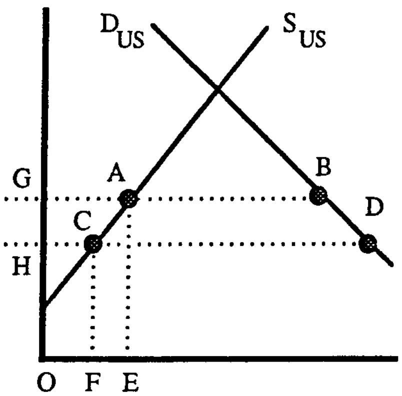


Figure 3.3.2
U.S. Lumber Market: Rise U.S. $



For the final economic shock, consider what would happed as the result of a one time increase in the Canadian stumpage price (SP). Algebraically, this economic shock can be characterizes as follows.

$$\frac{\partial XS}{\partial P_L} dP_L + \frac{\partial XD}{\partial SP} dSP = \frac{\partial XD}{\partial P_L} dP_L ,$$

Collecting like terms, factoring and then dividing both sides by dSP yields,

$$\frac{dP_L}{dSP} = \frac{-\frac{\partial XD}{\partial SP}}{\frac{\partial XS}{\partial P_L} - \frac{\partial XD}{\partial P_L}} . \qquad (14)$$

The effect of a rise in SP on the price of lumber in the U.S. is positive because both the numerator and denominator on the right hand side of Expression 14 are positive. The numerator is positive because higher stumpage prices raise Canadian production costs and this lowers Canadian excess supply. The price of lumber must rises to ration this decrease in Canadian supply.

Figures 3.4.1 and 3.4.2 illustrate this result. The rise in SP shifts XS_C up to XS'_C and this causes the lumber price to rise from P_L to P'_L. Figure 3.4.2 also shows that U.S. lumber imports to fall from AB to CD.

U.S. lumber production also rises in this scenario from OE to OF. Because imports fall and U.S. production rises, Canada's market share falls.

Figure 3.4.1
Equilibrium Conditions: Rise Can. SP

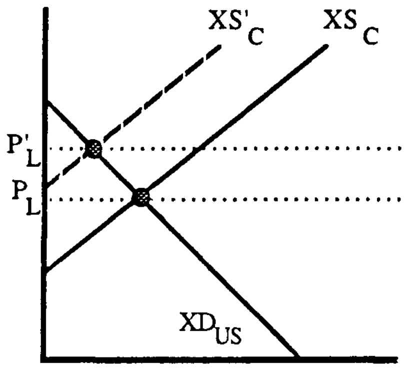
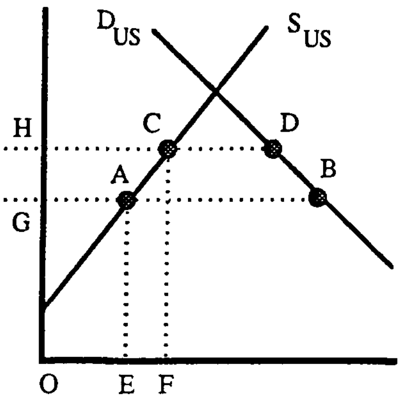


Figure 3.4.2
U.S. Lumber Market: Rise Can. SP



An increase in U.S. production increases the demand for labour and, thus, the number of production hours will rises. U.S. profits rise by AGHC because if higher prices and production. Consequently, the average stock price of the U.S. lumber industry will rise. Finally, as before, the effect of a rise in SP on the return on sales is in-determinate.

Table 3.1 indicates that the impact on the return on sales was inconclusive for each of the four economic shocks discussed. As mentioned above, this is because the direction of change in the return on sales depends on the functional form of the cost function. To see this, consider the following special case of a linear supply function.

$$Q_S = \alpha P_L$$

It can be easily shown that the profit (π) for a given lumber price implied by this simple supply function is defined by the following expression.

$$\pi = \frac{\alpha P_L^2}{2}$$

Substituting lumber output into Expression 3 yields the following expression for the return on sales.

$$ROS = \frac{\alpha P_L^2}{2\alpha P_L^2}$$

Simplifying yields,

$$ROS = \frac{1}{2}.$$

Thus, in this example of a linear supply function with no intercept, the return on sales is 50 percent for all prices.

Table 3.1

Review of Impacts on U.S. Lumber Industry Injury Measures

	Scenario			
Injury Measure	Increase in U.S. Per Capita Income	Increase in U.S. Residential Housing Starts	Increase in the Can-U.S. Exchange Rate	Increase in the Canadian Stumpage Price
U.S. Lumber Price	+	+	-	+
U.S. Lumber Production	+	+	-	+
Can. Market Share	+	+	+	-
U.S. Employment	+	+	-	+
U.S. Return on Sales	?	?	?	?
U.S. Avg. Stock Price	+	+	-	+

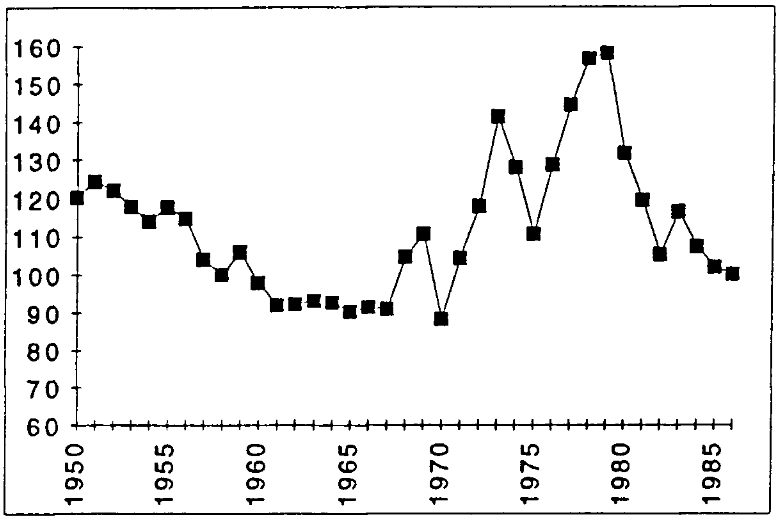
If the example is changed to a linear supply function with a positive intercept, it can be shown that price increases will result in an increase in the return on sales, but at a decreasing rate. That is, the larger the intercept the lower the return on sales for the initial output, but as output increases, the return on sales rises toward 50 percent. If the intercept is negative (an unlikely condition), then price increases will result in a decrease in the return on sales.

The impacts of the four economic shocks indicate that while the measures of injury are related, they are not perfectly correlated. Thus, depending on the nature of an economic shock, theory shows that the measures may or may not move in the same direction. The question of how these measures move and whether they actually move together in practice is an empirical question. This study analyzes these six measures of injury for the U.S. softwood lumber industry and attempts to empirically determine the relative importance of factors that have affected them over time. The next section briefly discusses how these U.S. softwood lumber industry performance measures have changed over time.

3.5 Empirical Overview

This section presents a brief historical overview of the six performance measures used to assess the performance of the U.S. softwood lumber industry. Figure 3.5 shows the U.S. softwood lumber price index. Most of the major U.S. recessions are reflected in this plot of the U.S. lumber price index, most notably the recessions in 1970, 1975, and 1982. As one would expect, the lumber price index is related to U.S. lumber production and saw log prices.

Figure 3.5
Plot of the U.S. Softwood Lumber Price Index



For the 1950 to 1986 period, there was a 0.61 simple linear correlation coefficients between the U.S. softwood lumber price index and U.S. lumber production. The simple linear correlation coefficients between the U.S. softwood lumber price index and the real Douglas-fir saw log price in Washington and Oregon was 0.85 for the years 1950 to 1985. This high correlation illustrates the strong linkage between the lumber and stumpage markets in the U.S. and the effect of U.S. saw timber shortages in the U.S. Pacific Northwest on the U.S. lumber market.

Figure 3.6 shows the level of U.S. softwood lumber production and the number of U.S. residential housing starts for the years 1950 to 1986. Figure 3.6 shows that lumber production is strongly correlated (76 percent) with the number of housing starts, and housing starts is an important indicator of aggregate economic activity. Consequently, lumber production is also procyclical.

Figure 3.6
Plot of U.S. Softwood Lumber Production

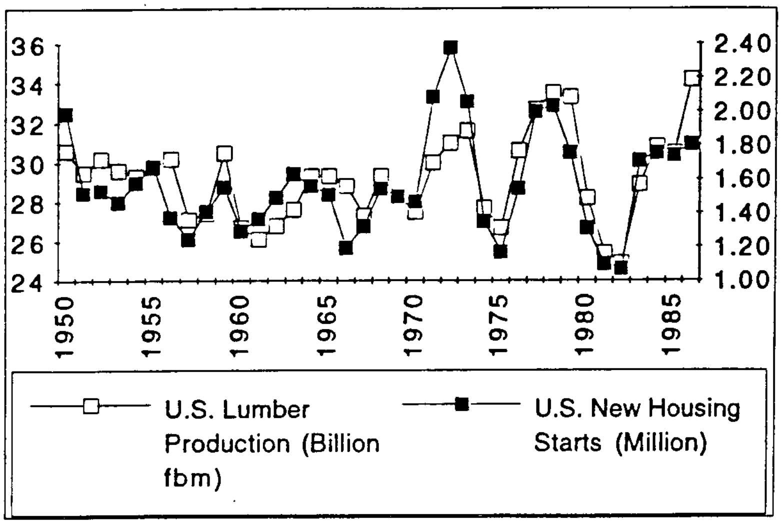


Figure 3.7
Plot of Canada's Share of U.S. Softwood Lumber Consumption

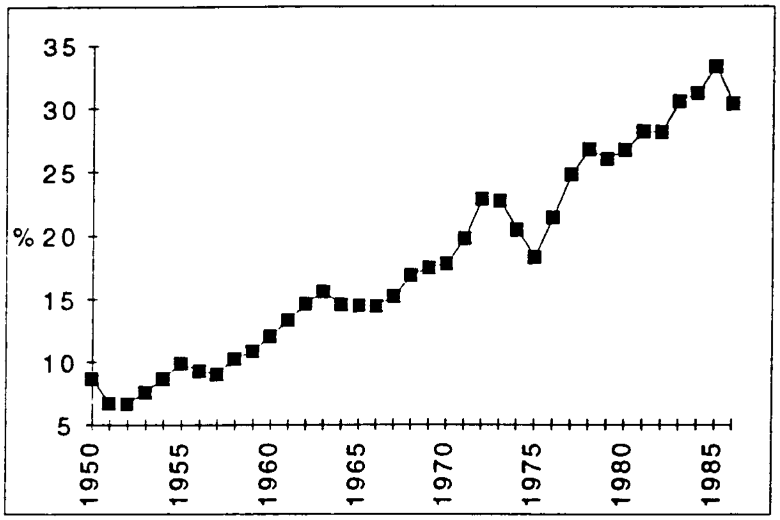


Figure 3.7 shows the Canadian share of the U.S. softwood lumber market for the years 1950 to 1986. Canadian market share has been trending upward at a compound rate of 5.1 percent per year throughout the 37 year time period. A comparison of Figures 3.5 through 3.10 does not suggest a strong positive business cycle relationship between Canada's market share and aggregate measures of U.S. economic activity. However, if the period after the Canadian dollar was allowed to float in 1970 is considered, then there is a strong relationship between Canadian

market share and the U.S./Canadian exchange rate. If only the period between 1972 and 1986 is considered, then the correlation coefficient between the Canadian market share and the nominal U.S./Canadian exchange rate is 0.93[9].

Figure 3.8
Plot of the Weighted Average Return on Sales for U.S. Sawmills

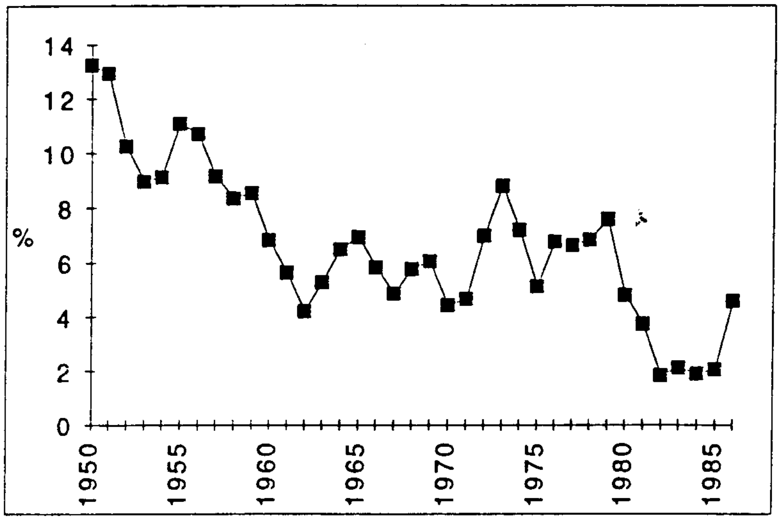


Figure 3.8 shows the weighted average return on sales for the companies comprising the Standard and Poor's Forest Products Index. A comparison of Figures 3.8 and 3.9 indicates that stock prices and ROS do not always move in unison with one another. For example, even though the stock prices of forest products companies were falling during the years from 1970 to 1975, the average ROS peaked in 1973 due to a rise in softwood lumber prices relative to costs.

The ROS of the U.S. forest products industry shows considerable fluctuation during the period 1950 to 1986. All of these fluctuations correspond with periods of growth and set backs in the economy as a whole. There were eight main recessionary periods in the U.S. during the 37 years starting in 1950. The post Korean War recession in 1954 was due, in part, to reduced defense spending. The recessions of 1959, 1961, and 1967 reflect periods of tight money and rising interest rates. The 1970 recession has been attributed to a strike at General motors and a decline in defense spending. The relatively severe recession of 1975 was due to a sharp increase in OPEC oil prices due to an embargo on Arab oil destined for the U.S. The brief recession in 1980 was due to a second oil shock caused by the Iranian revolution in 1979. Finally, the 1981-82 recession is generally attributed to a period of restric-

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9 The correlation coefficient between the Canadian market share and the real (1980) U.S./Canadian exchange rate is 0.91.

tive, anti-inflationary monetary policies adopted in the U.S. and elsewhere. Figure 3.8 shows that the ROS of the U.S. forest products industry declined in all but the 1980 recession. Consequently, the ROS measure of profitability is also very procyclical.

For an industry, the stock price is an aggregate concept and measures the present value of aggregate future dividends for an industry as a whole. Another way to assess industry profit is to aggregate the stock prices of a representative group of firms. This was the approach used in this study.

Figure 3.9
Plot of Standard and Poor's U.S. Stock Price Indexes:
Forest Products and the 400 Top Industrials

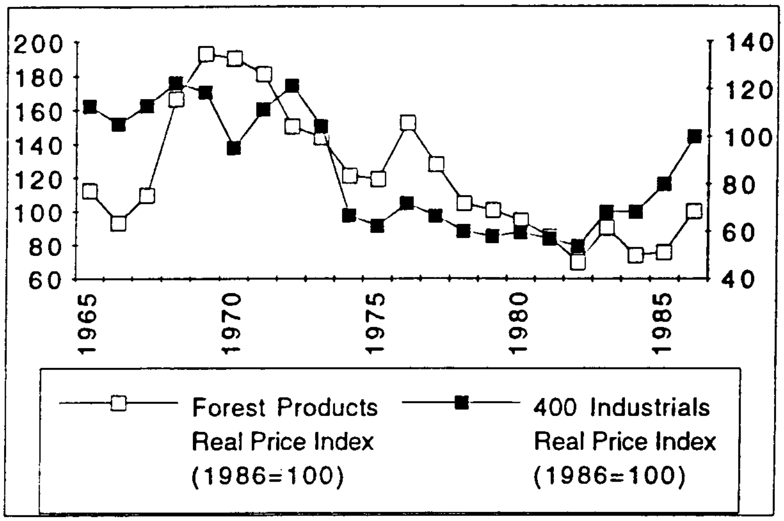

Figure 3.9 shows the value of Standard and Poor's Forest Products Stock Price Index and the 400 Industrials Stock Price Index for the years 1965 to 1986. The Forest Products Index is a composite of stock prices for the following companies: Boise Cascade, Champion International Corporation, Evans Products[10], Georgia Pacific, Louisianna-Pacific Corporation[11], Potlatch Corporation, and Weyerhaeuser Company. The forest products index and the industrials index tend to move together, but they are not perfectly correlated as indicated, for example, by the different performances during the 1970 business recession. From 1972 onwards, the two stock price indexes move together quite closely, although the forest products index shows more variability. The effects of the 1974 and 1982 recessions can be clearly seen in the forest products index. This is because the softwood lumber and other forest prod-

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[10] Evans Products is included in this index only up to April 11, 1984.

[11] Louisianna-Pacific Corporation was formed and included in the Standard and Poor's Forest Products Index in 1973.

ucts sectors are widely regarded as being procyclical industries, i.e., their performance is positively correlated to the business cycle.

Figure 3.10
Plot of U.S. Sawmill Production Hours

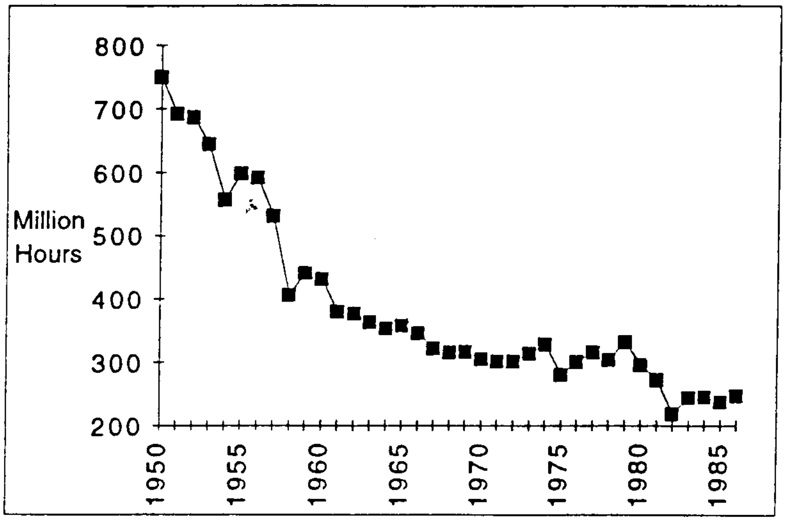

Figure 3.10 shows the number of hours worked by U.S. sawmill production workers[12]. Over the 37 years starting in 1950, the number of workers has fallen by about 73 percent. This decline in the use of labour is coincident with a steady rise in the real hourly wage of sawmill workers. In fact, over the 1950 to 1986 time period there is a - 0.77 simple linear correlation between the number of workers and their wage level. The trend in the number of hours worked is not closely related to the level of activity in the U.S. economy. However, small dips in sawmill employment can be seen for the years 1975 and 1982.

12 Sawmill production workers includes hourly production workers in both hardwood and softwood lumber mills. Salaried staff are not included.

3.6 Theory Development

The starting point for a causal analysis of injury suffered by American softwood lumber producers is a specification of a reduced form model. In turn, the derivation of a reduced form model requires a structural model. For convenience, unless specified otherwise, lumber will mean softwood lumber.

Due to the nature of the trade dispute, two products need to be considered. In the petition filed with the ITC by the American Coalition for Fair Lumber Imports, it was claimed that Canadian softwood lumber was entering the U.S. at less than its fair value because (among other things) it was manufactured using timber that was being sold at subsidized prices. Consequently, both softwood lumber and softwood logs must be considered in the analysis[13].

If it is assumed that logging is conducted by market loggers or by vertically integrated lumber producing firms that transfer logs between their logging and milling divisions at market prices, then Canada's aggregate logging profit functions can be defined as follows[14]:

$$\pi_{LG} = X\, P_{LG}(X_{LG}) - wL - rD - OC_{LG} + s_{LG}X_{LG}\text{, where} \qquad (15)$$

π_{LG} is the profit from producing X_{LG} m^3 of logs, $P_{LG}(X_{LG})$ is the inverse derived demand for saw logs priced in Canadian dollars, w is the logging wage per hour, L is the quantity of labour used to produce X_{LG} m^3 of logs, r is the interest rate, D is the total logging debt, OC_{LG} represents other logging cost (e.g., materials, fuel, electricity etc.) and s_{LG} is the alleged Canadian subsidy per m^3 of log.

The Canadian derived demand for saw logs will be a function of the price of saw logs, the prices of other factors related to the production of lumber, the price of lumber and the exchange rate. Thus, the demand for logs will have the following general form:

$$X_{LG} = f\,(P_{LG}, l_{LM}, P_{LM}, E)\text{, where} \qquad (16)$$

P_{LG} is the saw log price, l_{LM} are factor prices (for factors other than logs) used in the production of lumber, P_{LM} is the price of lumber and E is the Canada-U.S. exchange rate[15].

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[13] Timber and logs are not the same commodity. The term timber refers to the uncut trees (i.e., tree volume on the stump), whereas logs are the manufactured product that result from the harvesting of timber. Thus, logs are the input (not timber) in the production of lumber.

[14] The time period subscript has been omitted for convenience.

[15] This specification assumes that lumber is priced in U.S. dollars.

A subsidy per m^3 of harvested and scaled timber is equal to the difference between the true economic value of the right to harvest timber (EVRT) and the appraised value (i.e., the stumpage price SP). Thus, a timber subsidy can be represented generally as follows:

$$s_{LG} = EVRT - SP , \qquad (17)$$

where s_{LG} is defined as above and SP is the appraised stumpage price per m^3 of harvested and scaled timber. However, in practice, the variable EVRT cannot be observed. An observable proxy variable that is a function of s_{LG} must be specified.

The total rent per m^3 of log delivered to a sawmill equals the market price of logs minus the appraised stumpage price and costs. Thus, the rent per m^3 of log can be illustrated as follows:

$$R_{LG} = P_{LG} - HC - TC - OC_{LG} - SP , \text{ where} \qquad (18)$$

R_{LG} is the rent per m^3 of log, P_{LG} and SP are defined as above, HC is the harvest cost per m^3, TC is the transportation cost m^3 and OC_{LG} are other costs (e.g., the return to capital) per m^3. Expression 17 can be rewritten in terms of the stumpage price as follows:

$$SP = EVRT - s_{LG} \qquad (19)$$

Substituting Expression 19 into Expression 18 yields the following relationship:

$$R_{LG} = P_{LG} - HC - TC - OC_{LG} - EVRT + s_{LG} . \qquad (20)$$

Letting the variable C equal the sum (HC + TC + OC_{LG}), Expression 20 can be rewritten as follows:

$$R_{LG} = P_{LG} - C - EVRT + s_{LG} . \qquad (21)$$

Thus, the rent per m^3 of log delivered to a sawmill is correlated with the timber subsidy. That is, everything else being equal, an increase (decrease) in the subsidy will result in an increase (decrease) in the rent per m^3 of log. This idea of using leaked rents as a proxy for the timber subsidy is based on Kalt (1987) who used a similar definition for the alleged subsidy in his evaluation of the lumber dispute.

Substituting leaked rent for the subsidy in Expression 15 yields Canadian regional logging profit functions of the following form:

$$\pi_{LG} = X_{LG} P_{LG}(X_{LG}) - wL - rD - OC_{LG} + R_{LG}X_{LG} . \qquad (22)$$

Consequently, logging profits in Canadian regions will increase (decrease) with an increase in the level of leaked rents.

With respect to lumber markets, Canadian lumber profit can be defined as follows:

$$\pi_{CLM} = x_{CLM} P_{LM}(X_{LM}) E - w_{CLM} L_{CLM} - rD_{CLM} - OC_{CLM} \ , \qquad (23)$$

where π_{CLM} is the profit from producing x_{CLM} m^3 of lumber, X_{LM} is the total quantity of lumber consumed in the U.S. and Canada, $P_{LM}(X_{LM})$ is the inverse derived demand for lumber priced in U.S. dollars, E is the exchange rate (as above), w_{CLM} is the average hourly wage in Canadian saw mills, L_{CLM} is the quantity of labour used in Canadian saw mills, r is the discount rate, D_{CLM} is the total saw mill debt and OC_{CLM} represents other Canadian lumber manufacturing costs (e.g., the cost of logs, fuel, electricity and other materials).

Similarly, the U.S. lumber profit function can be defined as follows:

$$\pi_{ULM} = x_{ULM} P_{LM}(X_{LM}) - w_{ULM} L_{ULM} - rD_{ULM} - OC_{ULM} \ , \qquad (24)$$

where the variables π_{ULM} , x_{ULM}, $P_{LM}(X_{LM})$, w_{ULM}, L_{ULM}, r, D_{ULM} and OC_{ULM} are defined as above.

The derived demand for lumber will be a function of the price of lumber and demand shifters (e.g., U.S. and Canadian income, the interest rate, prices of substitutes and complements etc.). Thus, the demand for lumber will have the following general form:

$$X_{LM} = f\,(P_{LM}, I_C, I_U, r, E, d_m) \ , \qquad (25)$$

where P_{LM} is the price of lumber, I_C and I_U are the incomes in Canada and the U.S. respectively, r is the interest rate, E is the exchange rate and d_m are other demand shift variables.

In summary, Expressions 15 through 25 imply that the alleged injury to American lumber producers can be modelled as a function of exogenous variables pertaining to Canadian regional log markets, the Canadian lumber market, the U.S. lumber market and the U.S. economy[16].

In general, an index of the injury to American lumber produces can be represented as follows:

$$INJ_i = f\,(P_{LG}, R_{LG}, P_{LM}, E, D_{LG}, D_{CLM}, D_{ULM}, w_{LG}, w_{CLM}, w_{ULM} ,$$
$$OC_{LG}, OC_{CLM}, OC_{CLM}, I_C, I_U, d_m) \ , \qquad (26)$$

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16 Note that the structural model in this study excludes international effects. Softwood lumber is traded internationally; consequently, the price of lumber in the U.S. is a function of the world price of lumber. Similarly, the other U.S. sawmill performance measures are also functions of international conditions. However, including international variables in the structural model would not add significantly to the analysis because of the small fraction of U.S. and Canadian softwood lumber consumption supplied from outside of the U.S. and Canada. Furthermore, from a statistical perspective, because of collinearity between North American and international variables, it would be hard to separate the effects of conditions in the U.S. and Canada from those in international markets.

where INJ_i are the various measures of injury (described by Expressions 1 through 7) and all the independent variables are defined as above. These reduced form equations do not contain the volume of Canadian lumber imported into the U.S. explicitly. This is because the volume of U.S. lumber imports from Canada is an endogenous variable, influenced by developments in the lumber sectors in the U.S. and elsewhere.

A possible interpretation of the U.S. ITC mandate to determine the presence of material injury is that there be a statistically significant shift in a foreign excess supply function due to an alleged unfair trading practice. That is, determinations of material injury should be limited to cases where a significant quantitative link to an unfair practice can be shown. Injury caused by the changes in U.S. markets (e.g., changing preferences or relative increases in factor prices) or by increased "fair" competition should not be included in material injury determinations.

Expression 26 is a reduced form equation for the six measures of injury. These six equations were estimated using annual data for the years 1951 to 1986. The next section describes the choice of exogenous variables included in the specifications for the reduced form models of the six injury measures.

3.7 Model Specification

Specification of Expression 26 depends on the factors influencing supply and demand for lumber in the U.S. and Canada. Lumber is an intermediate good; consequently, the demand for lumber in the U.S. and Canada is derived from the end uses of lumber. The main end uses for lumber are residential housing, home repair and remodelling, and other construction. Historically, residential construction alone has accounted for about 40 percent of U.S. and Canadian lumber consumption. In 1989, U.S. residential construction and the activity in residential repair and re-modelling accounted for 35 percent and 31 percent, respectively, of U.S. lumber consumption. Other end uses for lumber in 1989 were nonresidential construction at 14 percent, materials handling at ten percent and all other uses at ten percent (Paper Tree Letter, October 1989 and Western Wood Products Association 1985)[17].

The derived demand for lumber can be determined from the cost functions of the primary end uses. Using this approach, the demand for lumber will be a function of its price, the prices of other inputs and the level of the outputs. Focussing on all end uses would lead to an appropriate specification of the total demand for lumber. However, for simplicity, I focus on residential housing construction, although the same estimation structure would arise from considering all end uses. Consequently, the demand for lumber is derived from aggregating the production functions of individual house builders. By utilizing the duality between production and cost function (see Varian 1984), lumber demand can be obtained from the total cost function of residential construction. The determinants of the cost of residential housing construction are labour, capital, lumber, wood panel products (e.g., plywood), other materials (steel, bricks and cement etc.) and the number of residential housing starts. Thus, the cost of residential construction (C_R) is given by the following expression.

$$C_R = f\,(w, k, P_L, P_p, M, USFOOT)\ ,$$

where w is the price of labour, k is the price of capital, P_L is the price of lumber, P_p is the price of wood panel products, M is the price of other materials, and USFOOT is the square footage of residential construction. The square footage of residential construction or the number of residential housing starts can be used as measures of the output product. The square footage of residential construction is a better indicator of lumber demand than housing starts because it weights the various kinds of residential housing (e.g., single family, multi-family and mobile homes etc.) differently whereas the number of housing starts gives these housing types equal weight.

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17 Materials handling includes such uses as boxes, crates, pallets and dunnage etc. and all other uses includes the use of wood by railroads, mining and in furniture.

The derived demand for lumber (QD_L) using Shephard's lemma is given by the following expression.

$$QD_L = \frac{\partial C_R}{\partial P_L}$$

Thus, the demand for lumber derived from residential construction is given as follows:

$$QD_L = f(\text{USFOOT}, P_L, w, k, P_p, M).$$

The square footage of residential housing (USFOOT) is an end product and is determined by aggregating the demands of individuals. The demand for housing is a function of income, the price of housing and the prices of other consumer goods. The decision to invest in a home is also quite sensitive to the interest rate. The total demand for housing will rise with an increase in aggregate income and an expansion of the economy. Furthermore, total demand for housing will fall with an increase in the relative price of housing. Because the interest rate is an important determinant of the price of a house, the demand for housing will rise with a decrease in the interest rate. To test the importance of these factors as determinants of housing demand, they were regressed against the square footage of U.S. housing starts.

Table 3.2

Summary of Regression Results

Dependent Variable: Square Footage of U.S. Residential Construction (Million Square Feet)

$$\underset{}{\text{USFOOT}} = \underset{(-2.04)}{-\,4.0414} + \underset{(4.78)}{0.92523\text{E-}03}*\text{USGNP} + \underset{(2.44)}{4.5691}*\text{CUSGNP} - \underset{(-3.54)}{0.11819}*\text{USINT}$$

$R^2 = 0.746$ DW = 1.79 DF = 32

Note: Values in parentheses are t-statistics

The results of this regression are summarized in Table 3.2 and demonstrate the importance of aggregate income, the business cycle and the interest rate to the demand for residential housing. Using annual data for the years 1951 to 1986, and a first-order autocorrelation model, about 75 percent of the variance in the annual square footage of U.S. residential construction was explained by total real U.S. income (USGNP), the business cycle (CUSGNP), and the interest rate (USINT)[18]. The business cycle effect is represented by the annual rate of change in real U.S. GNP. Substituting USGNP, CUSGNP and USINT for USFOOT means that the derived demand for lumber in the U.S. (QD_{LU}) can be specified as follows.

$QD_{LU} = f$(USGNP, CUSGNP, USINT, P_L, w, P_p, M)

Assuming that lumber demand in Canada is sensitive to the same factors as in the United States, the derived demand for lumber in Canada (QD_{LC}) can be specified as follows.

$QD_{LC} = f$(CANGNP, CCGNP, CANINT, P_L, w, P_p, M)

For reasons of parsimony, I assumed that the U.S. and Canadian demand could be reasonably specified as functions of the price of lumber, the level of income and the business cycle. Relative prices of other inputs in residential construction were not explicitly included so their effect will be part of the "error" term of the estimated models. Thus, the demand for lumber in the U.S. and Canada is given by the following two expressions:

$QD_{LU} = f(P_L$, USGNP, CUSGNP), and

$QD_{LC} = f(P_L$, CANGNP, CCGNP).

Although the performance of the U.S. lumber industry is affected by changes in both U.S. and Canadian demand, these two effects are hard to separate due to their collinearity. For the years 1951 to 1986, there was a 99.6 percent correlation between real U.S. GNP and real Canadian GDP, and a 67.2 percent correlation between the annual rate of change in real U.S. GNP and in real Canadian GDP. Because of this high level of multicollinearity and because of this study's focus on the U.S. lumber industry, I used only U.S. measures to account for changes in demand. Consequently, changes in real U.S. GNP and the business cycle in the U.S. account for shifts in both U.S. and Canadian demand.

The quantity of lumber supplied is determined by summing the output decisions of individual sawmills. A firm's lumber output is a function of demand conditions and production costs. The cost of manufacturing lumber is a function of labour, capital, logs, other materials (fuel, electricity, etc.) and the quantity of lumber produced. Thus, the total cost of producing lumber (C_L) is given by the following expression.

$C_L = f\ (w, k, P_G, M, QS_L)$,

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18 The nominal U.S. prime interest rate was used in this regression. The choice between real and nominal interest rates is not obvious. Using the nominal interest rate is appropriate if new housing purchases are more responsive to nominal than real interest rates.

where w is the price of labour, k is the price of capital, P_G is the price of logs, M is the price of other materials and QS_L is the quantity of lumber produced.

The marginal cost of producing lumber (MC_L) is equal to the derivative of the total cost function with respect to lumber output and is given by the following expression:

$$MC_L = \frac{\partial C_L}{\partial QS_L} .$$

The specification of the marginal cost function depends on the form of the total cost function. However, in the absence of strict global constant returns to scale, the marginal cost of producing lumber is a function of the level of production and the prices of the inputs.

$$MC_L = f\ (QS_L, w, k, P_G, M)$$

Increases in factor prices raise the marginal cost of producing lumber. Thus, the total supply of lumber will fall with a rise in factor prices. However, because complete factor price data was unavailable, this study used the average variable cost of production instead to account for aggregate changes in lumber factor prices. For this reason, lumber supply will rise (fall) with a fall (rise) in the average variable cost of producing lumber.

An industry's international competitiveness rises when its production costs (measured in a common currency) fall relative to its foreign competitor's costs. Accordingly, Canadian lumber producers will have improved their competitive position relative to U.S. producers if their average variable cost of production, measured in U.S. dollars, fall relative to those of U.S. producers (Roberts 1988 and Adams et al. 1986). Thus, Canada's competitiveness improves relative to the U.S. if the following condition holds:

$$\frac{[CAVC_t * REXCHRT_t]}{[CAVC_{t-1} * REXCHRT_{t-1}]} < \frac{[UAVC_t]}{[UAVC_{t-1}]} ,$$

where $CAVC_t$ is the real average variable cost of production in Canada, REXCHRT is the real Canadian-U.S. exchange rate (in terms of Canadian dollars per U.S. dollar) and $UAVC_t$ is the real average variable cost of production in the United States. The real Canadian-U.S. exchange rate is defined as

$$NEXCHRT * (UDEF/CDEF) ,$$

where NEXCHRT is the nominal Canada-U.S. exchange rate, UDEF is the U.S. GNP implicit price index and CDEF is the Canadian GDP implicit price index. Thus, Canada's excess supply of lumber to the U.S. should rise (fall) with a fall (rise) in the U.S. dollar value of Canadian real average variable costs relative to those in the United

States. Similarly, U.S. lumber supply should rise (fall) with a fall (rise) in U.S. real average variable costs relative to those in Canada when expressed in U.S. dollars.

In this study, Canadian real average variable costs were kept in terms of Canadian dollars so that changes in relative competitiveness could be decomposed into changes in average variable costs and changes in the exchange rate. Separating these two effects is important; for example, Roberts (1988) found that over the period from 1971 to 1987, changes in the relative costs of lumber production in Canada and the U.S. were 2.5 times greater than changes in the real Canada-U.S. exchange rate. Thus, the exchange rate was not the only factor determining the relative competitiveness between the U.S. and Canada. Furthermore, there is not a clear understanding of the effect that real exchange rate changes have had on the performance of the U.S. lumber industry. In summary, assuming everything else stays the same, Canada's excess supply of lumber to the U.S. will rise (fall) with a fall (rise) in real average variable costs denominated in Canadian dollars or a rise (fall) in the real Canada-U.S. exchange rate. From the perspective of the U.S. producers, their supply of lumber will rise (fall) given a fall (rise) in their real average variable costs or a fall (rise) in the real Canada-U.S. exchange rate.

Finally, Canada's excess supply of lumber to the U.S. was assumed to be a function of the price of timber and a "timber subsidy" in British Columbia. The situation in British Columbia was used, versus that in Canada, because British Columbia has consistently supplied about 80 percent of Canada's softwood lumber exports to the United States and because much of the 1986 debate focussed on the price of timber in British Columbia.

U.S. lumber producers alleged that the price of timber in British Columbia was injuring them because the method used to calculate the price of timber allowed rents to be leaked to British Columbia's lumber producers and because of this, the price of timber was "too low" relative to U.S. timber prices. Even though the relationship between the price of timber and Canada's excess lumber supply is straight forward in that an increase in the price of timber should decrease supply due to a lower timber harvest, the U.S. concern over leaked rent is not.

The term "leaked" rent means rent that flows through to firms. In economic terms, the rent per m^3 of log delivered to a sawmill is equal to the residual value after subtracting harvesting, transportation and other costs (including a normal rate of return) from the price of logs at the mill gate[19]. Stumpage fees are the administered

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[19] In general, economic rent is the payment to the fixed factor of production required to keep it in a particular end-use. Hence, there is a particular rent associated with each end-use. In this study, rent pertains to the use of timber for producing lumber.

charge for the right to harvest timber and equal a portion of the total rent per m^3 of log. The portion of the rent that flows to the users of timber (i.e., sawmills) is said to be leaked.

Two aspects of this issue of leaked rent are important with respect to injury. First, the question of who gets the economic benefit of timber is a distributional question. As long as the rent on the last log harvested is zero, redistributing rent from timber owners to timber users does not distort the efficiency of harvest decisions. This is because the rent that is being redistributed is infra marginal. Second, as demonstrated by Expression 14, leaked rent is not equal to the timber subsidy, it is only correlated with the subsidy. The leaked rent in British Columbia was estimated by subtracting the sum of the weighted average B.C. stumpage price and the weighted average variable logging cost in B.C. from the weighted average B.C. delivered wood cost[20]. Because of the relationship between leaked rent and the timber subsidy, it was assumed that leaked rent was a reasonable proxy for the timber subsidy. If everything else is held constant, a rise in the timber subsidy will result in a rise in leaked rents. In summary, Canada's excess supply of lumber to the U.S. should rise with an increase in British Columbia's leaked rents and fall with an increase in its stumpage price.

These demand and supply assumptions mean that the six indices of injury (INJ_i) given by Expression 26 can be rewritten as follows.

$$INJ_i = f\,(USGNP, CUSGNP, REXCHRT, CAVC, BCSP, BCLRENT, UAVC)\,, \qquad (27)$$

where BCSP is the British Columbian stumpage price and BCLRENT is the level of infra marginal leaked rent in British Columbia. Accordingly, I am assuming that changes in the six measures of injury considered in this study can be traced to changes in factors affecting the excess demand and excess supply of lumber in the United States. Demand shifts are traced to changes in aggregate income and the business cycles in the U.S. and Canada. Supply shifts, are traced to adjustments in the real exchange rate, modifications in U.S. and Canadian production costs, and changes in the level of British Columbia's stumpage prices and leaked rent. The next section reports the results of empirically estimating these six reduced form models using data for the years 1951 to 1986.

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20 Weighting was done in terms of Coastal and Interior harvest levels.

3.8 Data Description

Tables 3.3 and 3.4 list the variable names for the data that were collected for this study of the alleged injury to American lumber producers caused by unfair Canadian timber pricing policies and the sources of the data. The Canadian data was compiled on a regional basis and then aggregated for the estimation of the models specified above. The data used to estimate the reduced form equations for the six measures of injury are listed in Appendix 3.1

Table 3.3 lists the regional variables in the Canadian data base. Canadian log producing sectors were divided into the B.C. Coast (BCC), the B.C. Interior (BCI) and the rest of Canada east of the Rockies (EOR). For each of these three regions, time-series for the annual softwood harvest, the average stumpage price, the average wage and the average variable cost of production were constructed for the years 1950 to 1986. Canadian weighted averages were constructed from regional variables.

Although only British Columbia's logging sector data were used in the estimation of the injury models, logging sector data for all the Canadian regions were collected. All logging sector data were obtained from Statistics Canada catalogues, except for stumpage prices. British Columbia average softwood stumpage prices were obtained by aggregating up from regional, administrative data obtained from B.C. Ministry of Forests annual reports. Average stumpage prices (weighted by the total harvest volumes) for EOR were derived from total harvest and royalty data obtained from annual forestry reports for Alberta, Ontario, Quebec and New Brunswick. Consequently, EOR stumpage prices can only be considered as proxies for softwood sawlog prices because the aggregate harvest and royalty data contain some hardwood and pulpwood values and because the definition of royalties varies across these provinces.

Canadian regional logging sector wages for the years 1967 to 1986 were constructed from Statistics Canada Catalogue 25-201 by dividing estimates of the total payroll by the total number of hours worked[21]. Regional logging wages for the years 1950 to 1986 were estimated using regression analysis.

For the BCC, logging wages were estimated as a function of the average price of softwood sawlogs purchased by B.C. Coast sawmills and Canadian GNP. For the BCI, logging wages were estimated as a function of the average price of softwood sawlogs purchased by B.C. Interior sawmills and Canadian GNP. Finally, EOR logging wages were estimated as a function of the Canadian GNP. The results of these models are presented in Table 3.5.

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21 Logging payroll and hours worked were for production workers only.

Table 3.3

Canadian Regional Data and Sources Collected for Injury Investigation

Variable Name	Variable Label	Source*
B.C. Coast Delivered Wood Cost ($\$/m^3$)	BCCDWC	SC 35-204
B.C. Coast Harvest Level (m^3)	BCCHARV	SC 25-201
B.C. Coast Logging Average Variable Cost ($\$/M^3$)	BCCLGAVC	SC 25-201
B.C. Coast Logging Wage ($/hr)	BCCLGWG	SC 25-201
B.C. Coast Sawmill Average Variable Cost ($\$/m^3$)	BCCSMAVC	SC 35-204
B.C. Coast Sawmill Wage ($/hr)	BCCSMWG	SC 35-204
B.C. Coast Sawmill Production (m^3)	BCCSMPROD	SC 35-204
B.C. Coast Stumpage Price ($\$/m^3$)	BCCSTUMP	B.C. MOF
B.C. Interior Delivered Wood Cost ($\$/m^3$)	BCIDWC	SC 35-204
B.C. Interior Harvest Level (m^3)	BCIHARV	SC 25-201
B.C. Interior Logging Average Variable Cost ($\$/M^3$)	BCILGAVC	SC 25-201
B.C. Interior Logging Wage ($/hr)	BCILGWG	SC 25-201
B.C. Interior Sawmill Average Variable Cost ($\$/m^3$)	BCISMAVC	SC 35-204
B.C. Interior Sawmill Wage ($/hr)	BCISMWG	SC 35-204
B.C. Interior Sawmill Production (m^3)	BCISMPROD	SC 35-204
B.C. Interior Stumpage Price ($\$/m^3$)	BCISTUMP	B.C. MOF
East of the Rockies Delivered Wood Cost ($\$/m^3$)	EORDWC	SC 35-204
East of the Rockies Harvest Level (m^3)	EORHARV	SC 25-201
East of the Rockies Logging Average Variable Cost ($\$/M^3$)	EORLGAVC	SC 25-201
East of the Rockies Logging Wage ($/hr)	EORLGWG	SC 25-201
East of the Rockies Sawmill Average Variable Cost ($\$/m^3$)	EORSMAVC	SC 35-204
East of the Rockies Sawmill Wage ($/hr)	EORSMWG	SC 35-204
East of the Rockies Sawmill Production (m^3)	EORSMPROD	SC 35-204
East of the Rockies Stumpage Price ($\$/m^3$)	EORSTUMP	Alberta, Ontario, Quebec, & New Brunswick MOF Annual Reports
B.C. Forestry Strike Days	BCSTRIKE	B.C. FIR
Canadian GNP	CANGNP	IMF-IFS
Canadian GNP Annual Percentage Change	CGNPGR	Transformation
Can. Implicit Price Deflator	CANDEF	IMF-IFS
Canadian Population	CANPOP	IMF-IFS
Can. Share of U.S. Lumber Market (%)	CANMSHR	USFS

* SC refers to Statistics Canada, B.C. MOF refers to B.C. Ministry of Forests Annual Reports, B.C. FIR refers to the B.C. Forest Industrial Relations Limited, IMF-IFS refers to IMF International Financial Statistics and USFS refers to the U.S. Forest Service Publication "U.S. Timber Production, Trade Consumption and Price Statistics 1950-1986".

Table 3.4

U.S. Data and Sources Collected for Injury Investigation

Variable Name	Variable Label	Source*
Exchange Rate ($Can/$U.S.)	EXCHRT	IMF-IFS
Real Exchange Rate (Constant 1986 $Can/$U.S.)	REXCHRT	Transformation**
U.S. Implicit Price Deflator (1986=100)	USDEF	IMF-IFS
Producer Price Index (All Commodities, 1967=100)	USPPI	USDL
U.S. GNP (Constant 1985 $U.S.)	USGNP	IMF-IFS
U.S. Prime Interest Rate (%)	USINT	Bank of Canada
U.S. Population	USPOP	IMF-IFS
U.S. Manufacturing Wage ($U.S./hr)	USMANWG	USDL
U.S. Construction Expenditure (Billion $U.S.)	USCONEXP	USFS1
U.S. New Construction Square Footage (Million ft^2)	USFOOT	USFS1
U.S. Housing Starts (Thousands)	USHSTART	USFS1
U.S. Plywood Price Index (1976=100)	USPWPI	USFS1
Forest Products Return on Sales (%)	USFPROS	MIM
U.S. Forest Products Stock Price Index (1986=100)	SPFPI	S&P
Stock Price Index of 400 U.S. Industrials (1986=100)	SP400	S&P
U.S. North West Saw Log Price ($U.S./MBF)	USSLOGPR	USFS1
U.S. North West Veneer Log Price($U.S./MBF)	USVLOGPR	USFS1
U.S. Douglas Fir Stumpage Price ($U.S./MBF)	USDFSTUMP	USFS1
U.S. Southern Pine Stumpage Price ($U.S./MBF)	USSPSTUMP	USFS1
U.S. Logging and Hauling Cost ($U.S./MBF)	USDWC	USFS1
U.S. Softwood Timber Harvest (Million ft^3)	USHARV	USFS1
U.S. Softwood Lumber Price Index (1986=100)	USSLPI	USFS1
U.S. Softwood Lumber Production (Billion BF)	USLMPROD	USFS2
U.S. Softwood Lumber Capacity (Billion BF)	USLMCAP	USFS2
U.S. Sawmill Wage ($U.S./hr)	USSMWG	USFS1
U.S. Sawmill Person Hours (Million Hours)	USSMHRS	USASM
U.S. Logging Average Variable Cost ($U.S./$ft^3$)	USLGAVC	USASM
U.S. Sawmill Average Variable Cost ($U.S./MBF)	USSMAVC	USASM

* IMF-IFS refers to IMF International Financial Statistics, USDL refers to U.S. Department of Labour Publication "Producer Prices and price Indexes", USFS1 refers to the U.S. Forest Service Publication "U.S. Timber Production, Trade, Consumption and Price Statistics 1950-1986", MIM refers to "Moody's Industrial Manual: American and Foreign", S&P refers to "Standard and Poor's Analyst's Handbook Official Series", USFS2 refers to the U.S. Forest Service Publication "Production Consumption and Prices of Softwood Products in North America: Regional Time Series Data 1950 to 1985", USASM refers to the Bureau of the Census Publication "U.S. Annual Survey of Manufacturers".

** For a discussion of real exchange rates see page 123 in R. I. McKinnon's book entitled "Money in International Exchange: The Convertible Currency System".

Table 3.5

Regression Results: Canadian Regional Logging Wages Per Hour

Dependent Variable: Regional Logging Wages per Hour ($C/hr)

	B.C. Coast Model		B.C. Interior Model		East of the Rockies Model	
Variable	Coeff	(t-stat)	Coeff	(t-stat)	Coeff	(t-stat)
Const.	1.8444	4.7206	1.3431	2.4873	0.8955	3.5158
BCCDWC	0.0618	2.1335	•	•	•	•
BCIDWC	•	•	0.1374	1.8876	•	•
CANGNP	0.0264	8.6457	0.0195	5.2840	0.0273	29.0000
R^2	0.982		0.966		0.979	
Durbin Watson	1.358		1.071		0.446	
F-stat	458.1723		240.5146		837.9507	
Observations	20		20		20	

Estimates of Canadian regional average variable logging costs for the years 1967 to 1986 were constructed by first summing the regional costs for logging sector payrolls, purchased materials, and fuel and electricity. These estimates of total regional variable costs were then divided by the corresponding regional harvest levels to obtain logging costs per harvested cubic meter.

As was the case for logging wages, complete time series for average variable logging costs were unavailable. Consequently, Canadian regional average variable logging costs for the years 1950 to 1966 were estimated using regression analysis. For the BCC, average variable logging cost was estimated as a function of the Canadian implicit price index, the BCC delivered wood cost and the BCC harvest level. For the BCI, average variable logging cost was estimated as a function of the BCI delivered wood cost and the BCI harvest level. Finally, EOR average variable logging cost was estimated as a function of the EOR delivered wood cost and the EOR harvest level. The results of these models are presented in Table 3.6.

Canadian regional delivered wood costs represent the average mill-gate prices (per m^3) of softwood sawlogs purchased by sawmills. Delivered wood cost includes harvesting, transportation, stumpage and other logging costs. Time series for delivered wood cost were constructed for each of the three Canadian regions by dividing the value of softwood sawlogs purchased by sawmills by the corresponding quantity.

Table 3.6

Regression Results: Canadian Regional Average Variable Logging Cost Per Cubic Meter

Dependent Variable: Regional Average Variable Logging Cost Per Cubic Meter ($\$C/m^3$)

Variable	B.C. Coast Model Coeff	(t-stat)	B.C. Interior Model Coeff	(t-stat)	East of the Rockies Model Coeff	(t-stat)
Const.	6.4898	1.8954	0.7158	0.6495	10.1674	2.3482
CANDEF	0.0499	1.4787	•	•	•	•
BCCDWC	0.8654	11.0000	•	•	•	•
BCIDWC	•	•	0.6657	8.5691	•	•
EORDWC	•	•	•	•	0.8628	8.9278
BCCHARV	-0.000361	-3.2032	•	•	•	•
BCIHARV	•	•	0.0000534	0.9228	•	•
EORHARV	•	•	•	•	-0.000141	-1.8205
R^2	0.991		0.964		0.940	
Durbin Watson	2.259		0.810		1.061	
F-stat	593.8035		230.0614		133.7801	
Observations	20		20		20	

Canadian regional timber harvests were obtained from Statistics Canada[22]; however, a breakdown of the British Columbian harvest into the Coast and Interior regions was only available for years after 1965. For the years 1950 to 1965, the total British Columbian harvest was divided into the Coast and Interior regions by using adjusted[23] British Columbian regional softwood lumber production as weights.

As with logging sector data, Canadian sawmill data were collected on a regional basis and then aggregated. Canadian sawmill data originated from Statistics Canada catalogues. Information for the years 1950 to 1986 was available for all variables except the number of sawmill production hours. Regression analysis was used to estimate the total number of sawmill production hours for the three Canadian regions. For the BCC, production hours were estimated as a function of a time trend, Coastal softwood lumber production, the number of production hours in U.S.

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22 Regional harvest levels were converted from board feet (log tally) to cubic meters using the following conversion factors: 5.8 fbm/ft^3 for the B.C. Coast, 5.5 fbm/ft^3 for elsewhere and 2.83168 m^3/cunit.

23 The adjustment to the weights was equal to the 1966 difference between the Coastal share of the B.C. harvest and the Coastal share of B.C.'s softwood lumber production. This adjustment (6.52 percent) was added to the Coastal share of the total B.C. softwood lumber production and subtracted from the Interior share.

Table 3.7

Regression Results: Canadian Regional Sawmill Production Hours

Dependent Variable: Canadian Regional Sawmill Production Hours (Thousands of Hours)

Variable	B.C. Coast Model Coeff	(t-stat)	B.C. Interior Model Coeff	(t-stat)	East of the Rockies Model Coeff	(t-stat)
Const.	940223.254	5.0859	590944.338	1.2715	-29758.816	-1.7715
YEAR	-481.0726	-5.0957	-298.4443	-1.2702	•	•
BCCSMPROD	4.9770	15.2576	•	•	•	•
BCISMPROD	•	•	3.4443	6.2766	•	•
EORSMPROD	•	•	•	•	1.0473	2.1333
USSMHRS	4.2215	0.4302	11.7137	0.6080	•	•
EXCHRT	236.5962	0.0971	-16292.160	-4.4374	•	•
BCCSMAVC	77.9856	7.4208	•	•	•	•
BCISMAVC	•	•	205.9413	7.0633	•	•
CANGNPGR	•	•	•	•	976.2060	3.7928
REXCHRT	•	•	•	•	43877.0888	3.3796
USSLPI	•	•	•	•	92.0491	2.3732
R^2	0.967		0.956		0.826	
Durbin Watson	2.307		1.186		1.150	
F-stat	119.0027		87.6034		24.8483	
Observations	26		26		26	

sawmills, the nominal exchange rate and the average variable cost of producing lumber on the B.C. Coast. For the BCI, production hours were estimated as a function of a time trend, Interior softwood lumber production, the number of production hours in U.S. sawmills, the nominal exchange rate and the average variable cost of producing lumber in the B.C. Interior. The results of these models are presented in Table 3.7.

Canadian regional sawmill sector hourly wages and average variable manufacturing costs for the years 1950 to 1966 were constructed in the same manner as for the logging sector. The hourly sawmill wage for production workers was constructed by dividing the annual total payroll by the total number of hours worked[24]. Average variable sawmill costs were constructed by summing the regional costs for sawmill payrolls, purchased materials[25] and

24 Sawmill payroll and hours worked were for production workers only.

25 The cost of purchased materials includes stumpage payments.

Table 3.8

Representative U.S. Forest Products Companies

U.S. Ranking	Company	Number of Lumber Mills	Head-quarters	% of '85 Softwood Lumber Production	Hardwood Lumber Production MBF	Softwood Lumber Production MBF
1	Weyerhaeuser Co.	30	Wash	8.16%	105,000	2,504,000
2	Louisiana-Pacific Corp.	64	Ore	6.42%	26,000	1,971,000
3	Champion International Corp.	30	Conn	5.92%	20,750	1,816,670
4	Georgia-Pacific Corp.	37	Ga	4.86%	192,000	1,492,000
5	Boise Cascade Corp.	17	Idaho	2.52%	29,373	772,619
8	Pope & Talbot Inc.[1]	5	Ore	2.00%	0	613,575
30	Potlatch Ltd.	3	Calif	0.71%	0	217,044
31	Evans	3	B.C.	0.70%	0	216,155
TOTAL				31.29%	373,123	9,603,063
U.S. TOTAL				100.00%	6,474,000	30,690,000

[1] Not included in Standard and Poor's Forest Products Stock Price Index.

fuel and electricity usage. These estimates of the total regional variable cost were then divided by the corresponding regional lumber production to obtain average variable manufacturing cost per cubic meter of lumber.

Regional lumber production for the years 1950 to 1986 were obtained from Statistics Canada Catalogues 35-204 and 35-250. When necessary, lumber production in board feet (lumber tally) was converted to cubic meters using a board foot to cubic meter conversion factor of 2.3597. This factor assumes full-sawn lumber[26] (i.e., the lumber's actual dimensions are equal to its nominal dimensions).

Table 3.4 lists the variables in the U.S. data base. Most of the data were obtained from a U.S. Forest Service Publication entitled "U.S. Timber Production, Trade, Consumption and Price Statistics 1950 to 1986". The data from this publication are updated annually from various sources, but chiefly from annual survey data published by the U.S. Departments of Commerce and Labor.

[26] Only full-sawn lumber has actual dimensions equal to its nominal dimensions. In North America, actual dimensions do not equal nominal dimensions. For example, a 2 x 4 has actual dimensions of 1.5 inches by 3.5 inches. The conversion factor from Hartman et al (1981) of 2.3597 m^3/MBF assumes full-sawn lumber.

Table 3.9

Years of Inclusion in the Computation of the Annual Average Return on Sales

Company	Data Range
Weyerhaeuser Co.	1950 to 1986
Louisiana-Pacific Corp.	1972 to 1986
Champion International Corp.	1950 to 1986
Georgia-Pacific Corp.	1950 to 1986
Boise Cascade Corp.	1953 to 1986
Pope & Talbot Inc.	1950 to 1986
Potlatch Ltd.	1951 to 1986
Evans	1950 to 1982

U.S. average variable costs were constructed using the same method that was used for constructing the Canadian data base. U.S. average variable logging costs for the years 1950 to 1986 were constructed by first summing the values of logging payrolls and purchased materials, and then dividing this total by the U.S. softwood timber harvest. U.S. average variable sawmill costs for the same time period were constructed in a similar manner, except that the annual estimates of total variable sawmill cost were divided by the total U.S. production of softwood lumber.

The annual return on sales of U.S. forest products firms was constructed as a weighted average based on firm level net income and gross revenue data obtained from Moody's "Industrial Manual: American and Foreign". Income and revenue data, where available, was collected for the eight U.S. forest products companies listed in Table 3.8. The choice of these eight companies was based on their lumber production and on their inclusion in the Standard and Poor's Forest Products Stock Price Index. The Forest Products Stock Price Index does not include Pope & Talbot; however, this company was included because of its national and regional importance. As can be seen in Table 3.8, the Forest Products Stock Price Index includes the top five U.S. softwood lumber producers and seven of the top 31 producers. Taken together, these eight companies used to estimate the annual return on sales of U.S. forest products firms accounted for 31 percent of softwood lumber production and six percent of hardwood lumber production in 1985.

Income and revenue data for the years 1950 to 1986 were available only for four of the eight companies listed in Table 3.8. Consequently, the number of firms included in the average return on sales varies by year. Table 3.9 lists the years in which each of the eight firms listed in Table 3.8 were included in the computation of the annual return on sales.

U.S. average annual logging and hauling costs per thousand board feet (MBF) log tally (i.e., the average U.S. delivered wood cost) represent the average unit cost of harvesting and transporting felled and bucked sawlogs to a saw mill. The estimate of the U.S. logging and hauling cost for the years 1950 to 1985 was computed from data representing six different U.S. logging regions. A weighted average of these costs was calculated using regional softwood harvests as weights. The U.S. logging and hauling cost does not include stumpage payments.

All prices in Tables 3.2 and 3.3 were converted into real terms. In the case of Canadian prices, the Canadian GNP Implicit Price Deflator was used to convert prices into constant 1986 dollars terms. U.S. prices were converted into real terms using the U.S. GNP Implicit Price Deflator. The Canada-U.S. exchange rate was converted into real terms using the Canadian and U.S. GNP Implicit Price Deflators.

3.9 Estimation and Results

The six measures of injury were estimated in an effort to establish the relative importance of changes in Canadian and U.S. economic conditions to the performance of American softwood lumber producers. The ordering of the results in this section is based on the order of the industry injury impacts listed in section 771 (C) of the U.S. Tariff Act of 1930. All estimation was done using Version 6.2 of SHAZAM (White et al. 1990).

Unless stated otherwise, the data used in this section were for the years 1951 to 1986. Each model was estimated first using ordinary least squares (OLS). In most instances the OLS results indicated the presence of autocorrelation among the residuals and an autocorrelation routine based on the standard Cochrane-Orcutt iterative procedure (AUTO) was used to estimate the models. In each of the tables that summarize the results of estimating the six reduced form models, the use of OLS as a column title means that the model was estimated using ordinary least squares. The use of AUTO as a column title means that the model was estimated using an autocorrelation routine.

Most of the tables in this section list results from estimating a model using both OLS and AUTO procedures. When this is the case, the column titles will have the same number. In Table 3.10, for example, the columns labelled "1 OLS" and "1 AUTO" report the results of estimating the same model using OLS and AUTO procedures.

Throughout this section, the term "full model" means a reduced form model containing all of the hypothesized explanatory variables. For each of the six measures of injury there are two full model specifications. That is, there is a full model that tests for the significance of BCLRENT and one that tests for the significance of BCSTUMP. When discussing the results, the term "rent model" means the model that tests for the significance of BCLRENT. Similarly, the term "stumpage model" means the model that tests for the significance of BCSTUMP.

Unless stated otherwise, significance means statistical significance at the 95 percent level of confidence. Although significance tests of variables assume an underlying random sampling process, random sampling was not part of the process used to develop the reduced form models. That is, variables were removed and, in some cases, new variables were added to improve the explanatory power of a model. Consequently, the strength of the statistical inferences based on the magnitude of t-statistics is diminished. An alternate way of viewing the results reported in this section is to consider them as plausible explanations of what happened in the real world based on an analysis of the best available data.

The results summarized in this section are listed in Tables 3.9 to 3.15. For each model, six tests for heteroscedasticity were carried out. Three asterisks in the tables indicate rejection of the null hypothesis of homoscedasticity at the 0.01 significance level for at least one of the six tests. In these cases and for OLS models, White's heteroscedasticity-consistent estimates of the variance-covariance matrix were used to calculate t-statistics. In each table, the row labelled RESET shows the results of performing the three Ramsey Reset specification tests[27]. Three asterisks indicate rejection of the null hypothesis of no misspecification at the 0.01 significance level for at least one of the tests. Because the Ramsey Reset tests are only defined for OLS regressions, these tests were not available (na) to assess the presence of specification error in the models estimated by the AUTO routine. The Aux R^2 statistics reported in this section represent the R^2 value for the regression of the i th independent variable on the remaining independent variables. The Aux R^2 statistics is included as a measure of multicollinearity.

3.9.1.0 U.S. Softwood Lumber Price Index

Changes in the U.S. real softwood lumber price index (1986=100) was the first measure of injury evaluated in this study. The real price index of United States softwood lumber (USLMPI) is an aggregate index of all softwood lumber prices. The time series for USLMPI can be divided into three periods. During the first period from 1950 to 1967, USLMPI trended downward slowly. However, between 1968 and 1979, USLMPI became quite volatile and trended upward at a rate of 3.0 percent per year. From 1980 to 1986, USLMPI trended downward at a brisk 2.0 percent per year.

Given the theoretical development of Expression 27, the USLMPI was assumed to be a function of the various shift variables accounting for changes in demand and supply conditions in the U.S. and Canada. Total income and the business cycle were specified as demand shifters. With respect to income, USLMPI should rise with a rise in the level of U.S. GNP (USGNP). During the years 1951 to 1986, there was a 31.2 percent correlation between the USLMPI and USGNP. Lumber demand rises during periods of economic expansion. USLMPI should also rise with

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27 These tests involve running three OLS regressions of a dependent variable on the independent variables and on different powers (i.e., second, third and fourth) of the predicted dependent variable. The RESET tests are F-tests that test if the coefficients for the powers of the predicted dependent variable are significantly different from zero (White et. al. 1990).

a rise in annual rate of change in U.S. GNP (CUSGNP). Over the study period, there was only a 0.1 percent correlation between the USLMPI and CUSGNP.

Increases in U.S. production costs will cause an increase in the excess demand for lumber in the United States. The real variable cost of producing lumber in the U.S. (RUSAVC), measured in U.S. dollars per thousand board feet, was specified as the aggregate measure accounting for shifts in the U.S. supply of lumber. Consequently, USLMPI should rise with a rise in RUSAVC. There was a 80.5 percent correlation between the USLMPI and RUSAVC.

With respect to the Canadian supply of lumber, increases in Canadian production costs will cause a decrease in the Canadian excess supply of lumber and, thus, a rise in USLMPI. Given the specification in Expression 27, shifts in Canadian production costs are attributed to changes in Canadian average variable costs (RCAVC), changes in the real Canada-U.S. exchange rate (REXCHRT), changes in the level of rent that flows through to British Columbian lumber producers (BCLRENT) and changes in the British Columbian stumpage price (BCSTUMP). Thus, USLMPI should rise with a rise in RCAVC (measured in Canadian dollars per thousand board feet), a fall in REXCHRT (measured in terms of Canadian dollars per U.S. dollar), a fall in BCLRENT (measured in real Canadian dollars per cubic metre) and a rise in BCSTUMP (measured in real Canadian dollars per cubic metre). The correlation between USLMPI and the Canadian supply shifter variables were as follows: RCAVC 77.9 percent, REXCHRT -22.0 percent, BCLRENT -10.2 percent and BCSTUMP 45.1 percent.

Finally, it was assumed that there has been a decline in USLMPI over the study period due to a trend away from using lumber in its traditional end-use markets. Changes in building codes, construction techniques and a rise in the use of substitute products (e.g., plastics, plywood, aluminium) have lowered the demand for lumber in both residential and nonresidential construction markets. Thus, there should be a negative trend in USLPI over time.

3.9.1.1 Model Results for the U.S. Softwood Lumber Price Index

Table 3.10 lists the results of the reduced form model of the real (1986=100) U.S. softwood lumber price index. The models in columns one and two of Table 3.10 represent the initial OLS estimation of the full models and test the significance of BCLRENT and BCSTUMP as Canadian supply shifters. The pattern of significance and the signs and magnitudes of the coefficients were encouraging, but the low Durbin-Watson statistics indicated that there was autocorrelation in the error term. Consequently, the two full variable models were estimated using the

AUTO routine. The choice of the second-order autocorrelation model was based on the significance tests of the first and second-order autocorrelation parameters[28].

The results of estimating the two full models using AUTO are reported in columns three and four of Table 3.10. The Durbin-Watson statistics indicate that there is no reason to reject the assumption of no first-order autocorrelation among the residuals. A review of the t-statistics indicates that RCAVC and TREND do not add significantly to the results. In addition, the collinearity between RUSAVC and RUSAVC suggest that the parameter estimates of these two variables may be unstable.

Columns five and six in Table 3.10 show the impact of removing RUSAVC and TREND from the rent and stumpage models. The t-statistic for the BCLRENT parameter estimate implies that rents which flowed through to British Columbian lumber producers did not significantly affect the U.S. price of lumber.

The model in column six is the preferred specification for explaining the changes in USLMPI. The tests for heteroscedasticity and Durbin Watson statistics for this model imply that the assumption of normally distributed and uncorrelated residuals is reasonable. The Aux R^2 statistics indicate that multicollinearity among the regressors has inflated the parameter error estimates. However, with the possible exception of the parameter for USGNP, the estimation and inference problems due to multicollinearity are acceptable. The results of various Box-Cox transformations (e.g., log-log) did not indicate the presence of model misspecification. A review of plots of USLMPI versus the explanatory variable did not indicate substantial structural changes in the data.

The signs of the coefficients in column six agree with economic theory. Higher lumber prices are associated with higher income, the upside of business cycles, a stronger Canadian dollar (relative to the U.S. dollar), higher Canadian average variable lumber production costs and higher British Columbian stumpage fees. Generally, the preferred model indicates that USLMPI is primarily a function of the business cycle and the exchange rate. The relative significance of RUSAVC and the Canadian supply shifters suggests that USLMPI is more sensitive to changes affecting Canadian supply than to changes affecting U.S. supply. The insignificance of the trend variable means there was no unexplained downward trend in prices over time.

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[28] The t-statistics for the first and second order autocorrelation parameters for the model in column three of Table 3.9 were 4.44 and -2.22 respectively. The corresponding t-statistics for the model in column four of Table 3.9 were 5.30 and -1.84.

Table 3.10
Regression Results: U.S. Lumber Price Index

Dependent Variable: U.S. Softwood Lumber Real Price Index (1986=100)
Time Series: 1951 to 1986
Estimation: OLS and Second-order Autocorrelation Models

		1 OLS	2 OLS	1 AUTO	2 AUTO	3 AUTO	4 AUTO
USGNP	Beta	2.23E-02	2.15E-2	1.31E-02	1.93E-02	1.30E-02	1.11E-02
	t-stat	1.63	1.81	0.424	0.64	3.23	2.39
	Aux R^2	0.994	0.994	0.994	0.994	0.749	0.638
	Elasticity	0.522	0.503	0.307	0.451	0.303	0.259
CUSGNP	Beta	166.92	161.21	135.29	117.07	151.82	140.06
	t-stat	3.12	3.05	2.35	2.34	3.56	3.85
	Aux R^2	0.281	0.261	0.281	0.261	0.110	0.114
	Elasticity	1.536	1.484	1.245	1.077	1.397	1.289
REXCHRT	Beta	-73.694	-86.178	-71.477	-56.563	-80.580	-59.035
	t-stat	-2.66	-4.01	-1.98	-1.63	-2.55	-1.95
	Aux R^2	0.662	0.667	0.662	0.667	0.570	0.584
	Elasticity	-0.740	-0.866	-0.718	-0.568	-0.809	-0.593
RUSAVC	Beta	0.21380	0.20842	6.39E-02	6.02E-02		
	t-stat	3.18	4.18	1.05	1.03		
	Aux R^2	0.729	0.650	0.729	0.65		
	Elasticity	0.551	0.537	0.165	0.155		
RCAVC	Beta	0.19675	0.073977	0.37060	0.20774	0.41991	0.22572
	t-stat	2.09	0.99	2.97	1.60	4.14	1.96
	Aux R	0.722	0.771	0.722	0.771	0.424	0.549
	Elasticity	0.380	0.143	0.716	0.401	0.811	0.436
BCLRENT	Beta	0.20418		-0.77556		-0.83438	
	t-stat	0.31		-1.07		-1.25	
	Aux R^2	0.729		0.729		0.594	
	Elasticity	-0.003		0.010		0.010	
BCSTUMP	Beta		1.4736		1.8165		1.8479
	t-stat		2.81		2.98		3.30
	Aux R^2		0.451		0.451		0.450
	Elasticity		0.079		0.097		0.099
TREND	Beta	-1.0635	-0.734	-0.10942	-0.67824		
	t-stat	-0.97	-0.82	-0.05	-0.29		
	Aux R^2	0.994	0.993	0.994	0.993		
Constant	Beta	-120.01	-85.010	-79.131	-56.292	-79.859	-55.029
	t-stat	-1.80	-1.41	-1.26	-1.01	-1.43	-1.06
	R^2	0.810	0.840	0.855	0.884	0.851	0.880
	DF	28	28	28	28	30	30
	DW	1.45	1.41	2.09	2.00	2.04	1.98
	HET	***	***	ok	ok	ok	ok
	RESET	ok	ok	na	na	na	na

The results in Table 3.10 indicate that lumber prices are more sensitive to real exchange rate changes than to changes in U.S. or Canadian production costs. This is plausible, especially if one considers the period between 1975 and 1986 when the real value of the Canadian dollar (relative to a U.S. dollar) was trending upward at 2.2 percent per year, while the ratio of U.S. to Canadian average variable costs was trending upward at only 0.1 percent per year.

Table 3.10 also shows that the Canadian excess supply of lumber is more elastic than the U.S. supply of lumber. This is indicated by the coefficient of Canadian average variable cost which is greater than the coefficient of

U.S. average variable cost (see column four). In turn, this means that a unit increase in the Canadian average variable cost will cause the price of lumber to rise by more than a unit increase in the U.S. average variable cost. For this to be true, the slope of the Canadian excess supply function must be less than the slope of the U.S. supply function.

In summary, the results show that the variation in the U.S. price of lumber can be explained, to a very large extent, by the level of economic activity in lumber's end-use markets. Furthermore, shifts in the factors affecting the Canadian excess supply of lumber are also significant determinants of the U.S. price of lumber. There is no statistical evidence to support the contention that rents, which may have flowed through to British Columbian sawmills, were responsible for lower U.S. lumber prices due to a positive shift in the supply of Canadian lumber exported to the U.S. market.

3.9.2.0 U.S. Softwood Lumber Production

U.S. softwood lumber production (USLMPROD) was assumed to be a function of the same explanatory variables as U.S. softwood lumber price. Consequently, on the demand side, USLMPROD should rise with an increase in USGNP and CUSGNP. The correlations between USLMPROD and these two demand shifters were 29.3 percent and 45.9 percent, respectively. On the supply side, USLMPROD should rise with a fall in RUSAVC or a rise in RCAVC. USLMPROD should also increase with a decrease in REXCHRT, a decrease in BCLRENT or an increase in BCSTUMP. Finally, USLMPROD should decline over the study period due to falling demand in traditional end-use lumber markets. The correlation between USLMPROD and RUSAVC was 15.3 percent. The correlations between USLMPROD and the Canadian supply shifters were as follows: RCAVC 25.2 percent, REXCHRT 15.9 percent, BCLRENT -2.1 percent and BCSTUMP 30.1 percent.

Among the primary reasons for the declining trend in lumber demand are changes in the composition of housing starts, floor space, construction techniques and the use of substitute products. Residential construction accounts for between 40 and 50 percent of U.S. lumber consumption. From 1950 to 1986, there was an 18 percent shift in floor area away from single family houses toward multi-family buildings and mobile homes. In 1970, single family homes required about three times more lumber as multi-family buildings (Rinfret Boston Associates, 1974). Thus, the change in the composition of housing starts away from single family dwellings lowered the U.S. demand for lumber.

Although the square footage of one and two family houses has tended to increase over the years, the total use of lumber in these housing starts has fallen. From 1962 to 1982, the total amount of lumber (including hardwood) used in one and two family houses dropped 12.5 percent from 11.2 MBF to 9.8 MBF. Changing construction techniques and a wider use of non-lumber substitutes are responsible for this decline. With respect to changing construction techniques, the increased use of slab construction (building on a concrete floor), a trend toward the use of masonry versus wood frame construction in exterior walls and prefabrication have lowered consumption and reduced waste on construction sites. Furthermore, relaxation of U.S. structural building codes has led to lower lumber utilization. Lumber utilization in residential construction has also fallen because of the increased use of non-wood and non-lumber substitute products. The greater use of non-wood products in roofs, interior walls, windows and doors and of panel products (e.g., plywood) for sheathing has caused lumber's traditional end-use markets to shrink.

3.9.2.1 Model Results for U.S. Softwood Lumber Production

The estimation results for the reduced form models of USLMPROD are listed in Table 3.11. The first two columns of Table 3.11 show the OLS results of estimating the full rent and stumpage models. As with lumber price, the signs and significance of the parameter estimates were encouraging, but the low Durbin-Watson statistics indicated that the presence of autocorrelation. The full models were estimated again using the second-order AUTO routine. As before, the choice of the second-order Cochrane-Orcutt iterative procedure was based on the significance tests of the first and second-order autocorrelation parameters[29].

The Durbin-Watson statistics in columns three and four indicate the assumption of no first-order autocorrelation among the residuals from the AUTO models is reasonable. Except for RCAVC, all of the coefficients in columns three and four are significant and have the expected sign. Although we should expect the same variables to explain both price and quantity, it appears that USLMPROD is more sensitive to Canadian supply than USLMPI. The significance and negative sign of the trend variable supports the assumption that lumber has been losing ground to substitute products in its end-use markets. The Aux R^2 values indicate that the standard errors of the parameter estimates are inflated. This is especially true for USGNP and TREND which have values of 0.99. Even though this

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[29] The t-statistics for the first and second order autocorrelation parameters for the model in column three of Table 3.10 were 6.25 and -4.52 respectively. The corresponding t-statistics for the model in column four of Table 3.10 were 5.68 and -2.83.

Table 3.11
Regression Results: U.S. Lumber Production

Dependent Variable: U.S. Softwood Lumber Production (Billion Board Feet) Time Series: 1951 to 1986 Estimation: OLS and Second-order Autocorrelation Models							
		1 OLS	2 OLS	1 AUTO	2 AUTO	3 AUTO	4 AUTO
USGNP	Beta	1.56E-02	1.71E-02	1.37E-02	1.52E-02	1.45E-02	1.40E-02
	t-stat	3.77	4.51	2.92	3.01	3.89	3.01
	Aux R^2	0.994	0.994	0.994	0.994	0.992	0.992
	Elasticity	1.406	1.538	1.235	1.368	1.306	1.255
CUSGNP	Beta	30.014	25.551	20.561	16.755	19.595	18.757
	t-stat	2.66	2.44	2.51	1.98	2.65	2.44
	Aux R^2	0.281	0.261	0.281	0.201	0.270	0.251
	Elasticity	1.062	0.904	0.727	0.593	0.693	0.663
REXCHRT	Beta	-13.304	-14.572	-15.050	-14.023	-15.352	-14.041
	t-stat	-2.45	-2.83	-2.96	-2.46	-3.21	-2.48
	Aux R^2	0.662	0.667	0.662	0.667	0.629	0.619
	Elasticity	-0.514	-0.563	-0.581	-0.541	-0.593	-0.542
RUSAVC	Beta	1.65E-02	7.52E-03	-2.94E-02	-2.66E-02	-2.88E-02	-2.89E-02
	t-stat	-1.34	-0.74	-3.71	-2.83	-3.77	-3.25
	Aux R^2	0.729	0.650	0.729	0.650	0.617	0.535
	Elasticity	-0.163	-0.074	-0.291	-0.264	-0.285	-0.286
RCAVC	Beta	-1.67E-02	-4.46E-02	5.08E-03	-9.97E-03		
	t-stat	-0.78	-2.03	0.28	-0.48		
	Aux R	0.722	0.771	0.722	0.771		
	Elasticity	-0.124	-0.331	0.038	-0.074		
BCLRENT	Beta	-0.19994		-0.28067		-0.28094	
	t-stat	-1.43		-2.81		-2.85	
	Aux R^2	0.729		0.729		0.726	
	Elasticity	0.009		0.013		0.013	
BCSTUMP	Beta		0.27374		0.25858		0.24196
	t-stat		2.45		2.40		2.49
	Aux R^2		0.451		0.451		0.321
	Elasticity		0.056		0.053		0.050
TREND	Beta	-1.0125	-1.1443	-0.84030	-0.99584	-0.89805	-0.89917
	t-stat	-3.18	-4.09	-2.35	-2.61	-3.11	-2.55
	Aux R^2	0.994	-0.725	0.994	0.993	0.992	0.992
Constant	Beta	-0.99955	5.6944	11.471	14.565	12.736	12.600
	t-stat	-0.08	0.49	1.27	1.56	1.72	1.59
	R^2	0.629	0.672	0.789	0.777	0.788	0.776
	DF	28	28	28	28	29	29
	DW	1.18	1.31	1.77	1.77	1.79	1.75
	HET*	ok	ok	***	ok	***	***
	RESET**	ok	ok	na	na	na	na

degree of collinearity means that parameter estimates are unstable, this is unavoidable when theory and structural characteristics of the market suggest that these variables are necessary.

Columns five and six in Table 3.11 show the effects of removing RCAVC from the rent and stumpage models estimated with the second-order AUTO routine. The results in these last two columns indicate that these are the preferred models for explaining the changes in the level of U.S. softwood lumber production. Of the six heteroscedasticity tests performed, only the chi-squared goodness of fit test for normality was significant at the 0.01 level of confidence. These test statistics became insignificant, however, if 1986 is removed from the data set.

All of the signs of the coefficients in the preferred models agree with economic theory. Higher U.S. lumber production is associated with higher income, the upside of the business cycle, a stronger Canadian dollar, lower U.S. average variable manufacturing costs, a lower level of rent flowing through to British Columbian sawmills and higher British Columbian stumpage fees. The significance of BCLRENT and BCSTUMP is sensitive, however, to length of the study period[30].

A review of the elasticities in Table 3.11 suggests that most of the change in the level of U.S. lumber production is due to changes in income and the business cycle. The positive elasticity for BCLRENT (which has a negative coefficient), reflects the fact that BCLRENT has negative values for some of the years in the time series and, thus, that the elasticity is unstable with respect to sign[31]. The average elasticity for BCLRENT is -0.017 if only the 15 years when BCLRENT is positive are considered. For the years 1975 to 1986, the average elasticity for BCLRENT is -0.010. Thus, concerning Canadian supply shifters, the exchange rate effect appears to be the dominant factor explaining shifts in Canadian lumber supply. That is, the elasticity for REXCHRT is 12 times larger than the elasticity for BCSTUMP, and at least 30 times larger that the elasticity for BCLRENT. Finally, although USLMPROD is affected by changes in U.S. average variable costs, the results show that USLMPROD is inelastic with respect to aggregate changes in factor prices.

Broadly speaking, the results reported above are similar to those obtained from the analysis of U.S. lumber prices. Generally, most of the changes in the price and and the quantity of lumber produced in the U.S. are explained by factors affecting the demand for lumber in its end-use markets (e.g., residential and non-residential construction). That is, rising income and the general level of economic activity explain most of the annual variation in lumber prices and output levels. Shifts in Canadian excess supply appear to have the next most important role among the determinants of U.S. lumber prices and output levels. The real exchange rate was the most important Canadian sup-

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30 For example, during the period from 1960 to 1986, the parameter estimate for BCLRENT was insignificant.

31 Negative values mean that the flow through rents to British Columbian sawmills were negative. Given the assumption that BCLRENT is a proxy for the alleged subsidy, then negative values mean the alleged subsidy was negative, i.e., that British Columbian sawmills were being taxed. BCLRENT has a negative value in 22 of the 37 years between 1950 and 1986.

ply shifter in both the price and output models. Unlike the preferred model of U.S. lumber prices, the coefficient for BCLRENT was significant in the model of U.S. lumber production. A complete explanation of this asymmetry is unavailable without better information. Finally, although the coefficients for BCLRENT and BCSTUMP were significant, the elasticities for these variables are substantially smaller, by an order of magnitude, than the elasticities for the other regressor variables.

3.9.3.0 Canada's Share of the U.S. Softwood Lumber Market

Canada's share of the U.S. softwood lumber market (CMSHR) is the next of the six injury measures addressed in this study to be listed in the U.S. Tariff Act of 1930. Given the specification of Expression 27, CMSHR should rise with a rise in USGNP and CUSGNP. During the study period, the correlation between CMSHR and USGNP was 98.2 percent. This strong linear correlation mirrors the fact that CMSHR has trended upward at an annual compound rate of 5.1 percent. The correlation between CMSHR and CUSGNP was -10.6 percent. CMSHR should also rise with a rise in Canadian competitiveness relative to the United States. Consequently, CMSHR should rise with a rise in RUSAVC, a fall in RCAVC, a rise in REXCHRT, a rise in BCLRENT or a fall in BCSTUMP. The correlations between CMSHR and these supply variables were as follows: RUSAVC 18.4 percent, RCAVC 13.0 percent, REXCHRT 65.6 percent, BCLRENT 68.5 percent and BCSTUMP -28.0 percent. A trend variable was also included in the specification to test for unexplained linear patterns in the dependent variable.

3.9.3.1 Model Results for Canada's Share of the U.S. Softwood Lumber Market

Table 3.12 lists the results of estimating various specifications of the reduced form Canadian market share model. As before, the Durbin-Watson statistics for the full OLS rent and stumpage models (in columns one and two), indicate the presence of serial correlation in the error term, and so the models were reestimated using the AUTO routine. Even though a review of first and second-order autocorrelation parameters suggested that a first-order model would correct for this serial correlation, the Durbin-Watson statistics in columns three and four lie between the upper and lower significance points for the 0.05 level of confidence[32].

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[32] The t-statistic for the first order autocorrelation parameters for the models in columns three and four of Table X were 2.59 and 2.69, respectively.

Table 3.12
Regression Results: Canadian Market Share

Dependent Variable: Canadian Share of U.S. Lumber Consumption (%)
Time Series: 1951 to 1986
Estimation: OLS and First-order Autocorrelation Models

		1 OLS	2 OLS	1 AUTO	2 AUTO	3 AUTO	4 AUTO	5 AUTO
USGNP	Beta	7.09E-4	5.19E-04	6.08E-04	3.83E-04			
	t-stat	0.20	0.15	0.15	0.09			
	Aux R^2	0.994	0.994	0.994	0.994			
	Elasticity	0.102	0.075	0.087	0.055			
CUSGNP	Beta	15.415	15.769	12.711	12.602			
	t-stat	1.63	1.69	1.43	1.45			
	Aux R^2	0.281	0.261	0.281	0.261			
	Elasticity	0.871	0.891	0.718	0.712			
USFOOT	Beta					1.5578	1.6409	1.5485
	t-stat					3.84	3.91	3.85
	Aux R^2					0.376	0.402	
	Elasticity					0.199	0.210	0.196
REXCHRT	Beta	11.363	11.175	9.2686	9.0212	14.090	14.919	13.674
	t-stat	2.50	2.45	1.76	1.70	3.59	3.86	3.81
	Aux R^2	0.662	0.667	0.662	0.667	0.377	0.372	
	Elasticity	0.701	0.689	0.572	0.557	0.884	0.936	0.844
RUSAVC	Beta	2.85E-02	2.74E-02	2.13E-02	2.12E-02	3.08E-02	3.04E-02	2.90E-02
	t-stat	2.77	3.01	2.01	2.06	3.49	3.77	3.55
	Aux R^2	0.729	0.650	0.729	0.650	0.730	0.657	
	Elasticity	0.451	0.433	0.338	0.335	0.495	0.489	0.459
RCAVC	Beta	-2.36E-02	-2.37E-02	-1.73E-02	-2.07E-02	-2.38E-02	-1.99E-02	-2.35E-02
	t-stat	-1.32	-1.21	-0.91	-0.99	-1.66	-1.23	-1.70
	Aux R	0.722	0.771	0.722	0.771	0.634	0.685	
	Elasticity	-0.280	-0.281	-0.205	-0.245	-0.287	-0.241	-0.279
BCLRENT	Beta	0.028124		0.006844		0.040561		
	t-stat	0.24		0.06		0.43		
	Aux R^2	0.729		0.729		0.694		
	Elasticity	-0.002		-0.001		-0.003		
BCSTUMP	Beta		0.008146		0.04122		-0.05887	
	t-stat		0.08		0.41		-0.65	
	Aux R^2		0.451		0.451		0.396	
	Elasticity		0.003		0.014		-0.020	
TREND	Beta	0.61310	0.63683	0.63321	0.65690	0.58757	0.58475	0.59934
	t-stat	2.30	2.56	2.02	2.17	12.56	14.65	18.41
	Aux R^2	0.994	0.993	0.994	0.993	0.769	0.600	
Constant	Beta	-26.745	-26.573	-21.069	-19.988	-15.784	-17.276	-15.119
	t-stat	-2.66	-2.57	-2.18	-2.02	-2.80	-2.97	-3.05
	R^2	0.979	0.979	0.982	0.982	0.987	0.987	0.986
	DF	28	28	28	28	29	29	30
	DW	1.31	1.29	1.67	1.66	1.78	1.76	1.75
	HET	ok	ok	ok	ok	***	***	***
	RESET	ok	ok	na	na	na	na	na

The tests for heteroscedasticity indicated that the assumption of normally distributed errors could not be rejected. All of the coefficients in columns three and four have the expected sign; however, the coefficients for USGNP and CUSGNP are insignificant. Multicollinearity among the regressor variables means that the errors of the parameter estimates are inflated; this problem is the most severe for USGNP and TREND which both have Aux

R^2 values of 0.99. Because collinearity in the data does not permit the separation of the trend and demand shifter effects, USGNP and CUSGNP were dropped from the analysis and replaced by the square footage (in millions of square feet) of new U.S. residential construction.

Although residential construction accounted for only 35 percent of U.S. lumber consumption in 1989, the square footage of U.S. residential construction (USFOOT) is a reasonable proxy for total construction activity and therefore of the total lumber demand because construction and remodelling activity in the residential and nonresidential sectors (which together accounted for 80 percent of U.S. consumption in 1989) are highly correlated. Columns five and six in Table 3.12 show the impacts of replacing USGNP and CUSGNP by USFOOT as an indicator of changes in the derived demand for lumber. The Durbin-Watson statistics imply that the assumption of zero autocorrelation in the error term cannot be rejected. Four of the heteroscedasticity tests for the model in column five and three of the heteroscedasticity tests for the model in column six were significant at the 0.01 level of confidence. However, all of the heteroscedasticity tests statistics for these models became insignificant if 1986 was excluded from the time series. Even though 1986 was likely special because of record U.S. consumption and the occurrence of a long International Woodworkers of America strike in British Columbia, removal of this year did not result in substantial changes in the parameter estimates or the pattern of significance[33]. Consequently, an indicator variable for 1986 was not introduced in the analysis.

The t-statistic for the BCLRENT and BCSTUMP coefficients indicate that neither the rents that flowed through to British Columbian lumber producers nor the British Columbian stumpage price had a significant impact on Canada's market share. Column seven shows the results of dropping BCLRENT and BCSTUMP from the analysis. This last model is the preferred specification for explaining changes in Canada's market share. One of the tests for heteroscedasticity failed at the 0.01 percent level; however, all six tests passed when 1986 was excluded from the analysis. Although the Durbin-Watson test for this model was inconclusive at the 0.01 percent level, the stability of the coefficients and elasticities among the last three models suggests that the estimation problems due to serial

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[33] The International Woodworkers of America strike started on July 23 and lasted four and a half months. This strike was at least twice as long as previous post-war IWA strikes and it shut down about 40 percent of the province's lumber producing capacity. By the end of 1986, the strike had lowered lumber production by seven percent and made B.C.'s Coastal region North America's highest cost lumber producer (Paper Tree, September 1986).

correlation are not serious. The Aux R^2 statistics estimation suggest that the estimation and inference problems due to multicollinearity are moderate. The results of various Box-Cox transformations (e.g., log-log) did not indicate the presence of model misspecification. Plots of CMSHR versus the explanatory variable did illustrate any obvious patterns that indicated structural changes in the data.

The signs of the coefficient in the preferred model agree with economic theory. Higher Canadian market share is associated with higher construction activity, a weaker Canadian dollar (relative to the U.S. dollar), higher U.S. manufacturing costs and lower Canadian manufacturing costs. The t-statistic for the trend variable is large and positive in part because USGNP (which is collinear with TREND) was removed from the model. Thus, the trend variable is picking up both the income effect and other unexplained linear patterns in the dependent variable.

The elasticities in column seven indicate that CMSHR is considerably more sensitive to supply factors than to demand factors (although some of the sensitivity to the demand side has been lost to the trend variable). As with the other measures of injury discussed above, REXCHRT continues to be the most important determinant of change with respect to both the measure of injury and Canadian supply. That is, CMSHR and Canadian supply are the most sensitive to a unit change in REXCHRT as compared to a unit change in the other explanatory supply variables.

Over the study period, CMSHR has been more sensitive to changes in RUSAVC than to changes in RCAVC. Thus, everything else being equal, aggregate changes in U.S. factor markets have been more important determinants of Canada's market share than aggregate changes in Canadian manufacturing costs. This suggests that there is more production capacity at the margin in the U.S. than in Canada.

In summary, the results show that most of the variation in Canada's market share can be explained by changes in the real exchange rate. Furthermore, it appears that the business environment plays a less important role in determining Canada's market share than it does in determining the price or output level in the U.S. market. Finally, there is no statistical evidence to support the contention that rents which flowed through to British Columbian lumber producers significantly affected Canada's share of the U.S. softwood lumber market.

3.9.4.0 U.S. Forest Products Return on Sales

The return on sales of U.S. forest products firms (USFPROS) was constructed by calculating the weighted average return on sales of the forest products firms listed in Table 3.8. Gross revenues were used as the weights in constructing the time series of USFPROS.

Anything that increases lumber revenues relative to the costs of production will increase USFPROS. Thus, USFPROS should rise with a rise in USGNP and CUSGNP. During the period from 1951 to 1986, the correlations between USFPROS and these two demand variables were -71.5 percent and 27.4 percent, respectively. The strongly negative correlation between USFPROS and USGNP is due to the fact that USFPROS trended downward at a rate of 3.2 percent per year through out the study period. On the supply side, improvements in U.S. manufacturing costs relative to those in Canada will raise the return on sales. Consequently, USFPROS should rise with a fall in RUSAVC, a rise in RCAVC, a fall in REXCHRT, a fall in BCLRENT or a rise in BCSTUMP. The correlation between USFPROS and RUSAVC was 29.4 percent. The correlations between USFPROS and the Canadian supply shifters were as follows: RCAVC 34.2 percent, REXCHRT -65.9 percent, BCLRENT -81.5 percent and BCSTUMP 60.6 percent. A trend variable was included in the specification to test for unexplained linear trends in the data and to be consistent with the previous analyses.

3.9.4.1 Model Results for U.S. Forest Products Return on Sales

The outcome of estimating the reduced form model of the U.S. forest products return on sales is summarized in Table 3.13. The OLS estimation of the full models resulted in unstable parameter estimates. For example, the significance of the RUSAVC and RCAVC coefficients varied dramatically between the rent and stumpage models. Also, the Durbin-Watson statistics for these initial models suggested the residuals were serially correlated thus, the models were reestimated using the AUTO routine. The results in columns three and four are based on a second-order autocorrelation model[34]. The second-order model was chosen because of the significance of the autocorrelation parameters.

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34 The t-statistics for the first and second order autocorrelation parameters for the model in column three of Table 3.12 were 5.69 and -3.85 respectively. The corresponding t-statistics for the model in column four of Table 3.12 were 6.55 and -3.64.

Table 3.13
Regression Results: U.S. Lumber Industry Return on Sales

Dependent Variable: U.S. Softwood Lumber Industry Return on Sales (%)
Time Series: 1951 to 1986
Estimation: OLS and Second-order Autocorrelation Models

		1 OLS	2 OLS	1 AUTO	2 AUTO	3 AUTO	4 AUTO	7 AUTO
USGNP	Beta	4.07E-03	5.96E-03	4.75E-03	4.74E-03	4.71E-03	4.98E-03	5.30E-03
	t-stat	1.50	2.22	1.42	1.31	1.47	1.45	1.57
	Aux R^2	0.994	0.994	0.994	0.994	0.994	0.994	0.994
	Elasticity	1.645	2.41	1.920	1.917	1.905	2.015	2.140
CUSGNP	Beta	18.999	13.989	14.374	12.634	14.332	12.95	12.869
	t-stat	2.58	1.89	2.43	2.17	2.48	2.27	2.26
	Aux R^2	0.281	0.261	0.281	0.261	0.281	0.250	0.247
	Elasticity	3.023	2.23	2.287	2.010	2.280	2.060	2.047
REXCHRT	Beta	-9.8470	-10.326	-8.0828	-5.8272	-8.0154	-6.3145	-7.8533
	t-stat	-2.77	-2.83	-2.19	-1.48	-2.49	-1.90	-2.42
	Aux R^2	0.662	0.667	0.662	0.667	0.628	0.640	0.628
	Elasticity	-1.710	-1.793	-1.404	-1.012	-1.392	-1.097	-1.364
RUSAVC	Beta	-1.80E-03	9.69E-03	-3.27E-04	2.03E-03			
	t-stat	-0.22	1.34	-0.06	0.32			
	Aux R^2	0.729	0.650	0.729	0.650			
	Elasticity	-0.080	0.432	-0.015	0.090			
RCAVC	Beta	2.16E-02	-2.19E-03	3.00E-02	2.74E-02	2.98E-02	2.91E-02	3.29E-02
	t-stat	1.55	-0.14	2.33	1.90	2.42	2.13	2.57
	Aux R	0.722	0.771	0.722	0.771	0.608	0.695	0.598
	Elasticity	0.721	-0.073	1.00	0.915	0.994	0.971	1.099
BCLRENT	Beta	-0.26452		-0.10671		-0.10667		
	t-stat	-2.89		-1.46		-1.50		
	Aux R^2	0.729		0.729		0.6498		
	Elasticity	0.056		0.023		0.023		
BCSTUMP	Beta		0.20962		0.11681		0.10999	
	t-stat		2.65		1.56		1.58	
	Aux R^2		0.451		0.451		0.451	
	Elasticity		0.194		0.108		0.102	
TREND	Beta	-0.39052	-0.58190	-0.49617	-0.52053	-0.49373	-0.53648	-0.56581
	t-stat	-1.88	-2.94	-1.94	-1.90	-2.00	-2.04	-2.20
	Aux R^2	0.994	0.993	0.994	0.993	0.994	0.993	0.993
Constant	Beta	-10.002	-4.7866	-9.0028	-9.9086	-9.0236	-9.7616	-8.4184
	t-stat	-1.27	-0.58	-1.38	-1.55	-1.43	-1.59	-1.37
	R^2	0.888	0.884	0.924	0.924	0.924	0.924	0.920
	DF	28	28	28	28	29	29	30
	DW	1.35	1.28	1.74	1.74	1.74	1.74	1.66
	HET	ok	ok	***	ok	***	***	ok
	RESET	ok	ok	na	na	na	na	na

The Durbin-Watson statistics in columns three and four of Table 3.13 indicate that the assumption of zero first-order autocorrelation is reasonable. The pattern of significance is quite different between the OLS and the AUTO results in columns one through four. For example, the AUTO procedure resulted in small and insignificant coefficients for RUSAVC in both the rent and stumpage models. In addition, AUTO lowed the significance of BCLRENT and BCSTUMP and raised the significance of RCAVC. Also, the sign of the RCAVC coefficient is stable in columns three and four. Multicollinearity among the regressors means that the standard errors of the parameter estimates are inflated. The collinearity between USGNP and TREND is the major source of multicollinearity.

Due to the lack of significance, the USFPROS models were reestimated without RUSAVC in the specification. Columns five and six in Table 3.13 show the effects of removing RUSAVC form the second-order rent and stumpage models. The Durbin-Watson statistics for these models continue to indicated that the assumption of zero autocorrelation is reasonable. The chi-squared goodness of fit test for normality of the residuals was significant at the 0.01 level for both the rent and stumpage. The removal of RUSAVC had no effect on the insignificance of BCLRENT and BCSTUMP, so these variables were also removed from the specification. The results in column seven of show the effects of removing BCLRENT and BCSTUMP from the USFPROS model.

The model in column seven of Table 3.13 is the preferred specification for explaining the return on sales of the U.S. forest products industry. The Durbin-Watson statistics and heteroscedasticity tests imply that the residuals are normally distributed and uncorrelated. Furthermore, with the exception of the coefficients for USGNP and TREND, the estimation and inference problems due to multicollinearity are only moderate. Box-Cox transformations (e.g., log-log) did not indicate the presence of model misspecification. Also, plots of the dependent versus the independent variables did not indicate the presence of obvious structural changes in the data.

As with the models in columns three through six, the signs of the coefficients in the preferred model agree with prior expectations. That is, higher return on sales in the U.S. forest products industry are associated with a higher income, the upside of the business cycle, a stronger Canadian dollar (relative to the U.S. dollar) and higher Canadian average variable manufacturing costs. The broad pattern of the results indicates that forest products return on sales are primarily a function of demand conditions. When incomes and the business cycle are favourable, the net incomes of the forest industry rise. Canadian supply factors also had a significant effect on the return on sales and, as before, changes in the exchange rate were the dominant reason for shifts in Canadian lumber supply.

In summary, the results in Table 3.13 indicate that the large portion of the annual variation in the annual return on sales in the U.S. forest products industry can be explained by general economic conditions in lumber's traditional end-use markets. Furthermore, as with the analysis of U.S. lumber prices, Canada's excess supply of lumber was also a significant determinant of U.S. return on sales. However, there is no statistical evidence to support the contention that rents which may have flowed through to British Columbian sawmills were a major reason for an upward shift in Canadian lumber supply and, thus, for a lower lumber prices and profits in the U.S. market.

3.9.5.0 Real Standard and Poor's U.S. Forest Products Stock Price Index[35]

The time horizon for the analysis of RSPFPI is from 1965 to 1986 because the index started in January, 1965. The RSPFPI tracks the real stock prices of the seven large integrated forest products companies listed in Table 3.8. Thus, factors in markets other than just the softwood lumber market affected the index. Lumber and building products divisions are very important sources of revenue, however. As shown in Appendix 3.2, building products divisions accounted for 38 to 79 percent of total 1981 revenues; thus, we should expect to find a close relationship between RSPFPI and the level of economic activity in U.S. lumber markets.

We should expect to find a close relationship between the performance of the forest products industry and other industries in the U.S. economy. This is because many of the economic factors that affect industries in general also affect forest products firms. Thus, RSPFPI should be positively related to average movements in the stock market[36]. The correlation between RSPFPI and the real Standard and Poor's stock price index for the top 400 U.S. industrials (RSP400) was 54.2 percent. The relationship between RSPFPI and RSP400 was accounted for in two different ways. First, RSP400 was included as an explanatory variable in the reduced form models of RSPFPI. Second, the average stock market effect was subtracted from RSPFPI before estimating the reduced form models.

Adjusting the real Standard and Poor's stock price index for average movements in the U.S. stock market (RSPAFPI) was accomplished by regressing RSPFPI on RSP400 and then subtracting the product of RSP400 times its coefficient from RSPFPI[37]. Consequently, changes in RSPAFPI represent the above average or abnormal return to forest products stocks. Removing the average market effect did not substantially alter the pattern of RSPFPI over time. There was an 84.0 percent correlation between RSPFPI and RSPAFPI during the period from 1965 to 1986.

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35 The U.S. GNP implicit price deflator was used to convert SPFPI and SP400 into real terms (designated as RSPFPI and RSP400 respectively).

36 We should also expect the RSPFPI to move with the market because this index was included in Standard and Poor's composite indexes starting in 1970.

37 The OLS results for the regression of RSPFPI on RSP400 are as follows:

$$R^2 = 0.294$$

$$\text{RSPFPI} = \underset{(1.31)}{38.411} + \underset{(2.89)}{0.90428}*\text{RSP400}$$

Values in parentheses are t-statistics

Like the other measures of industry performance discussed so far, RSPFPI and RSPAFPI are functions of the factors that determine the demand and supply conditions in the U.S. and Canada. On the demand side RSPFPI and RSPAFPI should rise with the aggregate demand for lumber and, thus, with USGNP and CUSGNP. The correlations between RSPFPI and these two demand variables were -61.4 percent and 1.5 percent respectively. The corresponding correlations for RSPAFPI were -28.8 percent and -23.7 percent. The negative correlations between dependant variables and USGNP are a reflection of the downward trend in RSPFPI and RSPAFPI which declined at annual rates of 3.03 percent and 3.35 percent respectively.

On the supply side, improvements in the relative competitiveness of U.S. forest products industry should improve RSPFPI and RSPAFPI. Thus, we should expect to see RSPFPI and RSPAFPI rise with a fall in RUSAVC. There was a -36.2 percent correlation between RSPFPI and RUSAVC and a 6.9 percent correlation between RSPAFPI and RUSAVC. RSPFPI and RSPAFPI should also rise with downward shifts in Canadian lumber supply. Consequently, RSPFPI and RSPAFPI should rise with a fall in REXCHRT, a rise in RCAVC, a fall in BCLRENT or a rise in BCSTUMP. The correlations between RSPFPI and the Canadian supply variables were as follows: REXCHRT -47.8 percent, RCAVC -2.8 percent, BCLRENT 8.7 percent and BCSTUMP 19.9 percent. Similarly, the correlations between RSPAFPI and the Canadian supply variables were REXCHRT -56.4 percent, RCAVC -29.4 percent, BCLRENT 18.0 percent and BCSTUMP 8.9 percent.

3.9.5.1 Model Results for the Real Standard and Poor's U.S. Forest Products Stock Price Index

Tables 3.14 and 3.15 summarize the estimation results for the models of RSPFPI and RSPAPI. The estimation process stated by performing OLS regressions of the full models and as before, the residuals were serially correlated. The full models were estimated again; however, a third-order correction was required to correct for the autocorrelation[38].

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[38] The t-statistics for the autocorrelation parameters for the RSPFPI model in column three of Table 3.13 were 5.92,-3.08 and 0.54. The corresponding t-statistics for the model in column four of Table 3.13 were 5.98, -3.24 and 0.81. The t-statistics for the autocorrelation parameters for the RSPAFPI model in column three of Table 3.14 were 5.80,-3.00 and 0.47. The corresponding t-statistics for the model in column four of Table 3.14 were 5.68, -3.00 and 0.46.

Table 3.14
Regression Results: U.S. Forest Products Industry Stock Price

Dependent Variable: Real Standard & Poor's U.S. Forest Products Stock Price Index: 1986=100
Time Series: 1965 to 1986
Estimation: OLS and Third-order Autocorrelation Models

		1 OLS	2 OLS	1 AUTO	2 AUTO	3 AUTO	4 AUTO	5 AUTO
USGNP	Beta	2.75E-02	3.43E-02	2.96E-02	2.16E-02	3.47E-02	2.66E-02	2.95E-02
	t-stat	1.01	1.11	1.67	1.29	2.05	1.77	1.93
	Aux R^2	0.847	0.856	0.847	0.856	0.825	0.842	0.811
	Elasticity	0.723	0.902	0.778	0.568	0.913	0.700	0.776
CUSGNP	Beta	-201.70	-175.98	113.25	147.76			
	t-stat	-0.76	-0.55	0.96	1.27			
	Aux R^2	0.305	0.417	0.305	0.417			
	Elasticity	-1.722	-1.502	0.967	1.261			
REXCHRT	Beta	-252.01	-289.86	-362.46	-305.92	-385.15	-399.67	-351.82
	t-stat	-2.03	-1.87	-3.89	-3.41	-4.30	-4.23	-4.43
	Aux R^2	0.713	0.780	0.713	0.780	0.707	0.732	0.683
	Elasticity	-2.408	-2.769	-3.463	-2.922	-3.679	-3.245	-3.361
RUSAVC	Beta	-0.47253	-0.70251	-0.31554	-0.23134	-0.30114	-0.23883	-0.25616
	t-stat	-1.11	1.60	-2.49	-1.76	-2.30	-1.94	-2.15
	Aux R^2	0.911	0.900	0.911	0.900	0.814	0.857	0.670
	Elasticity	-1.139	-1.694	-0.761	-0.558	-0.726	-0.576	-0.618
RCAVC	Beta	1.2987	1.2734	0.22992	0.032083			
	t-stat	1.86	1.14	0.70	0.08			
	Aux R	0.837	0.923	0.837	0.923			
	Elasticity	2.3827	2.336	0.422	0.059			
BCLRENT	Beta	5.8201		-1.3710		-1.4299		
	t-stat	1.67		-0.84		-0.87		
	Aux R^2	0.471		0.471		0.454		
	Elasticity	0.025		-0.006		-0.006		
BCSTUMP	Beta		-0.89644		0.89625		1.0639	
	t-stat		-0.21		0.63		0.92	
	Aux R^2		0.818		0.818		0.110	
	Elasticity		-0.042		0.042		0.050	
RSP400	Beta	1.3676	1.0737	0.83666	0.70398	0.93050	0.8881	0.97491
	t-stat	2.34	1.59	2.55	1.85	3.84	3.53	3.96
	Aux R^2	0.820	0.838	0.820	0.838	0.780	0.806	0.735
	Elasticity	1.031	0.809	0.631	0.531	0.701	0.670	0.735
Constant	Beta	254.15	256.97	293.58	243.38	458.86	411.14	419.39
	t-stat	0.76	0.69	1.81	1.56	4.00	3.87	3.94
	R^2	0.689	0.628	0.915	0.913	0.905	0.906	0.901
	DF	14	14	14	14	16	16	17
	DW	1.28	0.96	1.73	1.74	1.78	1.76	1.80
	HET	ok	ok	ok	ok	ok	ok	ok
	RESET	ok	ok	na	na	na	na	na

The Durbin-Watson tests for the AUTO models indicated that the estimation problems due to autocorrelation were no longer serious. All of the coefficients in Tables 3.14 and 3.15 have the expected sign. Furthermore, the pattern of significance is the same in both tables. That is, REXCHRT and RUSAVC are the most significant

Table 3.15
Regression Results: U.S. Forest Products Industry Adjusted Stock Price

Dependent Variable: Real Standard & Poor's U.S. Adjusted Forest Products Stock Price Index: 1986=100 Time Series: 1965 to 1986 Estimation: OLS and Third-order Autocorrelation Models								
		1 OLS	2 OLS	1 AUTO	2 AUTO	3 AUTO	4 AUTO	5 AUTO
USGNP	Beta	0.19511	0.3308	0.32639	0.26889	0.35481	0.28352	0.28091
	t-stat	0.76	1.12	2.16	1.98	2.27	2.18	2.14
	Aux R^2	0.816	0.843	0.816	0.843	0.794	0.833	0.720
	Elasticity	1.541	2.646	2.578	2.124	2.802	2.239	2.218
CUSGNP	Beta	-1179.6	-1691.7	997.76	1016.1			
	t-stat	-0.47	-0.54	1.10	1.08			
	Aux R^2	0.154	0.399	0.154	0.399			
	Elasticity	-3.026	-4.340	2.560	2.607			
REXCHRT	Beta	-2416.0	-3027.5	-3811.3	-3405.3	-4025.1	-3555.0	-3654.5
	t-stat	-1.93	-1.93	-4.12	-4.02	-4.43	-4.39	-4.54
	Aux R^2	0.699	0.780	0.699	0.780	0.698	0.732	0.646
	Elasticity	-6.94	-8.693	-10.943	-9.778	-11.56	-10.207	-10.493
RUSAVC	Beta	-6.4447	-7.7077	-3.3156	-2.7120	-3.1676	-2.4907	-2.6859
	t-stat	-1.63	-1.83	-2.58	-2.09	-2.40	-2.01	-2.20
	Aux R^2	0.890	0.888	0.890	0.888	0.733	0.769	0.606
	Elasticity	-4.670	-5.586	-2.403	-1.965	-2.295	-1.805	-1.946
RCAVC	Beta	14.185	12.604	2.7026	1.8704			
	t-stat	1.98	1.15	0.88	0.56			
	Aux R	0.835	0.915	0.835	0.915			
	Elasticity	4.782	6.950	1.490	1.031			
BCLRENT	Beta	50.148		-14.110		-15.339		
	t-stat	1.50		-0.85		-0.92		
	Aux R^2	0.388		0.388		0.341		
	Elasticity	0.064		-0.018		-0.020		
BCSTUMP	Beta		-4.1251		5.3395		10.883	
	t-stat		-0.11		0.42		0.97	
	Aux R^2		0.766		0.766		0.452	
	Elasticity		-0.059		0.076		0.155	
Constant	Beta	2490.7	4045.4	3108.0	2776.2	4852.4	4270.9	4515.3
	t-stat	0.72	0.79	1.90	1.72	4.64	4.26	4.65
	R^2	0.540	0.471	0.880	0.875	0.866	0.867	0.859
	DF	15	15	15	15	17	17	18
	DW	1.27	0.98	1.74	1.75	1.78	1.76	1.79
	HET	ok	ok	ok	ok	ok	ok	ok
	RESET	ok	ok	na	na	na	na	na

variables followed by USGNP. Because the coefficients for CUSGNP and RCAVC were insignificant in both of the RSPFPI and RSPAFPI models, they were removed from the analysis[39].

Columns five and six in Tables 3.14 and 3.15 show the impact of dropping CUSGNP and RCAVC. In both tables, the significance levels of USGNP have risen while those for RUSAVC have stayed about the same.

39 CUSGNP was removed first but RCAVC remained insignificant so RCAVC was also dropped from the analysis.

Also, REXCHRT is still the most significant factor explaining stock prices and the adjusted stock prices. BCLRENT and BCSTUMP were also dropped from the analysis because of their continued insignificance.

The results in column seven of Tables 3.14 and 3.15 indicate that these are the preferred models for explaining RSPFPI and RSPAFPI. As with the other models in these tables, the tests for heteroscedasticity do not lead to the rejection of assumption that the residuals were normally distributed. Also, the Durbin-Watson tests suggested that the assumption of zero first-order autocorrelation was reasonable. The Aux R^2 values indicate that the errors of the coefficients are inflated but the multicollinearity problems are not that severe. Finally, the signs of the coefficients agree with economic theory. Higher stock prices (both adjusted and unadjusted) are associated with higher USGNP, a lower exchange rate and lower RUSAVC. In the case of unadjusted stock prices, RSPFPI also rises with a rise in RSP400.

Generally, the results presented in this section indicate that most of the change in the U.S. forest products stock price is due to changes in relative competitiveness as a result of fluctuations in the Canada-U.S. exchange rate and in U.S. average variable costs. Total income has also had a relatively significant impact on the long term profitability of the U.S. forest products industry. This is because higher aggregate income translates into higher construction activity. Thus, for a given production cost, higher income leads to higher lumber prices and profits. Beyond these determinants, it appears that factors affecting the stock market in general also affect the average stock price of U.S. forest products firms.

The insignificance of CUSGNP was not that surprising give the relationship between the average index of the stock market and the business cycle. Finally, the results do not support the allegation that rents captured by British Columbian sawmills caused a significant upward shift in Canada's lumber supply. Thus, there is no significant link between rents captured by British Columbian sawmills and U.S. forest products stock prices.

3.9.6.0 U.S. Sawmill Production Hours

U.S. sawmill production hours (millions of hours) is the last of the six measures addressed in this study that is listed in the U.S. Tariff Act of 1930[40]. The demand for labour by U.S. sawmills (USSMHRS) depends on

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40 USSMHRS represents the total number of production man-hours in all types of U.S. sawmills. Thus, USSMHRS is the sum of production hours in the following types of mills: softwood lumber, hardwood

the level of production which, as discussed above, is a function of the demand and supply conditions in the U.S. and Canada. Consequently, we should expect to see a rise in USSMHRS with a rise in demand and, thus, with a rise in USGNP or CUSGNP. Over the study period, the correlations between USSMHRS and the demand shifters were 83.6 percent and 22.9 percent respectively. The negative correlation between USSMHRS and USGNP is due to the fact that USSMHRS trended downward at an annual rate of 3.2 percent. USSMHRS should also rise with factors that improve the competitiveness of U.S. sawmills relative to Canadian sawmills. Thus, USSMHRS should rise with a fall in RUSAVC, a rise in RCAVC, a fall in REXCHRT, a fall in BCLRENT or a rise in BCSTUMP. The correlation between USSMHRS and RUSAVC was 21.1 percent. The correlations between USSMHRS and the Canadian supply shifters were as follows: RCAVC 18.1 percent, REXCHRT -57.2 percent, BCLRENT -82.1 percent, and BCSTUMP 38.2 percent.

As mentioned above, USSMHRS trended downward over the study period; however, the decline in the demand for labour was not smooth. For example, from 1951 to 1960, USSMHRS declined rapidly at a rate of 5.8 percent. From 1961 to 1986, USSMHRS declined much more slowly at a rate of only 1.7 percent per year.

Much of the decline in the demand for labour in U.S. sawmills was due to a process of rationalization where the production from smaller mills was transferred to much larger mills. The employment effects of this redistribution of U.S. production to more mechanized mills were dramatic (Lea 1962). Tables 3.15 and 3.16 show how rationalization has increased both the average output per mill and labour productivity over the study period. Using data for Washington and Oregon States, Table 3.16 illustrates the rapid drop in the number of sawmills and the related increase in the output per mill for each of the U.S. census years between 1947 and 1987. Table 3.17 shows how the average productivity of labour has increased throughout the period from 1950 to 1985. Tables 3.16 and 3.17 also indicate that mills closures, output per mill and labour productivity rose during the 1950s at nearly twice the rate as during the 1960s, 1970s and early 1980s. It appears that shifting production to fewer but larger sawmills (in con-

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lumber, wood chip, softwood cut stock, softwood flooring and custom saw mills. In 1982, softwood lumber mills accounted for 55.9 percent of all U.S. sawmills and planing mills.

Table 3.16

Redistribution of U.S. Lumber Production: 1947 to 1987

Year	Total Production (BBF) Oregon	Wash.	Number of Establishments Oregon	Wash.	Avg. Output per Establishment (MMBF) Oregon	Wash.
1947	7.10	3.71	1,466	808	4.8	4.6
1954	8.85	3.03	1,201	552	7.4	5.4
1958	7.54	3.45	645	469	11.1	7.4
1963	7.76	3.67	520	389	14.9	9.4
1967	6.97	3.28	396	306	17.6	10.7
1972	7.94	3.75	255	340	31.1	11.0
1977	7.51	4.03	332	255	22.6	15.8
1982	4.68	3.06	287	223	16.3	13.7
1987	8.85	4.65	274	241	32.3	19.3

junction with other sources of technological improvement[41]) was responsible for at least some of the decline in the use of labour in U.S. sawmills.

Constantino and Haley (1989) also found that productivity in U.S. Pacific Northwest sawmills grew faster during the late 1950s and 1960s as compared to the 1970s and early 1980s. In particular, they found that during the period from 1957 to 1971, total factor productivity in U.S. Pacific Northwest sawmills grew at an annual rate of 1.1 percent but, during the period from 1972 to 1982, the annual rate growth in total factor productivity had fallen to 0.2 percent.

An indicator variable and a trend variable were used to account for the two different rates of technological change. An indicator variable (D5160) was used to divide a trend variable (TREND) into a period from 1951 to 1960 and a period from 1961 to 1986. D5160 was given a value of one for the years 1951 to 1960 and a value of zero otherwise. An interaction variable equal to the product of D5160 time TREND (DTREND) was also created. In summary, D5160, TREND and DTREND were added to the reduced form model of USSMHRS to test for two different rates of technological change in U.S. sawmills.

41 For example, chipping headrigs were introduced in the mid 1960s and computers were incorporated into various stages of the lumber production process throughout the 1980s.

Table 3.17

U.S. Sawmill Production and Employment

Year	Employment (Thousands)	Production (BBF)	Production per Employee (MBF)
1950	431.0	30.6	71.0
1955	315.1	29.8	94.6
1960	220.4	26.7	121.1
1965	181.5	29.3	161.4
1970	155.1	27.5	177.3
1975	142.3	26.7	187.6
1980	151.8	28.2	185.8
1985	119.9	30.5	254.4

3.9.6.1 Model Results for U.S. Sawmill Production Hours

Table 3.18 summarizes the OLS results from estimating the full USSMHRS models. Because at least one of the heteroscedasticity tests were significant at the 0.01 percent level, White's heteroscedasticity-consistent estimates of the variance-covariance matrix were used to calculate the t-statistics. The Durbin-Watson statistics in columns one and two indicate that the assumption of zero autocorrelation cannot be rejected. All of the coefficients from the initial estimation have the correct signs except for REXCHRT, RUSAVC and RCAVC. Because the coefficient for the Canada-U.S. exchange rate was insignificant, it was dropped from the analysis.

Columns three and four show the impact of removing REXCHRT from the rent and stumpage models. The assumption of zero autocorrelation among the residuals appears to be reasonable. The pattern of significance in these last two models is similar to the pattern of significance in the first two models, except that removing REXCHRT has made the coefficient of USGNP insignificant. The coefficient of RUSAVC and RCAVC continue to have the wrong sign. In addition, the coefficients of BCLRENT and BCSTUMP remain insignificant. The Aux R^2 values indicate the presence of a high degree of multicollinearity among the regressor variable, most of which is due to the correlation among the trend and USGNP variables. The chi-squared tests for normally distributed residuals were significant at the 0.01 percent level and so White's heteroscedasticity-consistent estimates of the variance-covariance matrix were used to calculate t-statistics. One of the Ramsey Reset tests for specification error was also significant at

Table 3.18
Regression Results: U.S. Sawmill Industry Production Hours

Dependent Variable: U.S. Sawmill Production Hours (Millions of Hours)
Time Series: 1951 to 1986
Estimation: OLS Models

		1 OLS	2 OLS	3 OLS	4 OLS	5 OLS
USGNP	Beta	9.53E-02	6.23E-02	0.10358	6.25E-02	0.11668
	t-stat	2.60	1.59	1.85	0.99	2.17
	Aux R^2	0.996	0.997	0.996	0.997	0.995
	Elasticity	0.663	0.433	0.721	0.435	0.812
CUSGNP	Beta	258.28	243.75	259.78	243.75	249.66
	t-stat	2.73	2.11	1.86	1.80	1.80
	Aux R^2	0.344	0.339	0.343	0.339	0.339
	Elasticity	0.707	0.667	0.711	0.667	0.683
REXCHRT	Beta	27.097	1.5033			
	t-stat	0.54	0.03			
	Aux R^2	0.685	0.717			
	Elasticity	0.081	0.004			
RUSAVC	Beta	0.64368	0.66458	0.63135	0.66406	0.66793
	t-stat	5.09	6.51	3.90	4.37	4.29
	Aux R^2	0.789	0.771	0.781	0.766	0.766
	Elasticity	0.493	0.509	0.483	0.509	0.511
RCAVC	Beta	-0.36323	-0.70051	-0.41304	-0.70495	-0.40010
	t-stat	-1.56	-2.56	-1.39	-2.01	-1.35
	Aux R	0.830	0.898	0.801	0.865	0.801
	Elasticity	-0.208	-0.402	-0.237	-0.405	-0.230
BCLRENT	Beta	-1.3860		-1.5293		
	t-stat	-0.75		-0.88		
	Aux R^2	0.765		0.756		
	Elasticity	0.005		0.006		
BCSTUMP	Beta		2.9855		3.0026	
	t-stat		1.61		1.54	
	Aux R^2		0.768		0.732	
	Elasticity		0.048		0.048	
D5160	Beta	205.33	246.17	206.07	246.45	204.32
	t-stat	10.04	8.57	7.29	6.36	7.28
	Aux R^2	0.903	0.974	0.994	0.972	0.944
TREND	Beta	-14.464	-11.169	-14.933	-11.173	-16.283
	t-stat	-4.72	-3.31	-3.12	-2.02	-3.61
	Aux R^2	0.997	0.997	0.996	0.997	0.996
DTREND	Beta	-18.887	-23.263	-19.150	-23.301	-18.465
	t-stat	-6.40	-6.49	-5.88	-5.30	-5.86
	Aux R^2	0.903	0.955	0.899	0.948	0.893
Constant	Beta	-39.795	75.985	-9.5221	78.171	-20.314
	t-stat	-0.26	0.51	-0.07	0.51	-0.14
	R^2	0.986	0.986	0.986	0.986	0.985
	DF	26	26	27	27	28
	DW	1.87	1.81	1.86	1.81	1.87
	HET	***	***	***	***	***
	RESET	***	***	***	***	ok

the 0.01 percent level, indicating that the models may be misspecified. Because of the insignificance, the of BCLRENT and BCSTUMP, the USSMHRS model was reestimated without BCLRENT and BCSTUMP in the specification.

Column five in Table 3.18 shows the impact of removing BCLRENT and BCSTUMP from the USSMHRS model. The chi-squared goodness of fit test failed at the 0.01 percent level. The Ramsey reset tests statistics were insignificant at the 0.01 percent level. In addition, the results of Box-Cox transformations and a review of residual plots indicated that the linear functional form was reasonable.

The signs of the coefficients for RUSAVC and RCAVC are wrong with respect to economic theory. The significant and positive coefficient for RUSAVC is likely the result of spurious correlation caused by the general rise in labour productivity and corresponding decline in manufacturing costs in U.S. sawmills over much of the study period. The sign on the RCAVC coefficient is negative because Canadian manufacturing costs rose less quickly and fell more rapidly relative to U.S. manufacturing costs over much of the study period.

The coefficients of the remaining variables are significant and have the expected signs. Thus, USSMHRS rises with a rise in USGNP or the upside of the business cycle. Furthermore, the indicator and trend variables indicate that the processes of rationalization and technological change explain a large proportion of the downward trend in the demand for labour in U.S. sawmills. Also, as hypothesized, the results show that the demand for labour decreased more quickly during the period from 1951 to 1960 than during the period from 1961 to 1986.

The OLS model in column five is the preferred model for explaining the variation in the demand for labour by U.S. sawmills despite the insignificance of RCAVC[42]. Dropping RCAVC from the model estimated with OLS resulted in significant Ramsey Reset specification error tests and Durbin-Watson statistics. Reestimation using the second-order Auto routine did not have an appreciable effect on the magnitude of the coefficients or on the pattern of significance. Thus, the model in column five is the preferred model explaining the variation in USSMHRS.

In general, the results in Table 3.18 indicate that most of the variation in the use of labour in U.S. sawmills is due to trends attributable to the process of rationalization and technological change. Factors affecting the U.S. demand for lumber also explain a significant proportion of the fluctuation in the number of production hours. As expected, when demand is high, the hours of production rise, conversely, when demand is low, the hours of production fall.

The spurious correlations which caused the wrong signs on the coefficients of RUSAVC and RCAVC are possibly the result of a substitution of capital for labour due to rising material costs. Rising harvesting and log transportation costs in the U.S., especially during the period from 1968 to 1980, pushed RUSAVC up more quickly

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[42] The coefficient for RCAVC in column 5 of Table 3.17 is significant at the 0.10 level.

than RCAVC[43]. If the use of logs in the production process is quasi-fixed, then the easiest way to lower costs is to control the labour and non-wood input costs. However, since it is widely believed that wages can only be lowered by as a result of protracted negotiations, it seem plausible that U.S. sawmill might have substituted away from labour in the production process.

Finally, Table 3.18 shows that there is no statistical evidence to support the contention rents which flowed through to British Columbian sawmills caused a significant increase in Canada's lumber supply which in turn, caused a decrease in the demand for labour in U.S. sawmills. In fact the results tend to suggest that the factors affecting the Canadian supply of lumber had very little to do with the decline in U.S. sawmill production hours.

[43] During the period from 1968 to 1980, there was a 88.3 percent correlation between the weighted average of real U.S. regional harvesting and log transportation costs and RUSAVC. Also over the same time period, the ratio of RUSAVC to RCAVC trended upward at an annual rate of 2.1 percent, thus U.S. manufacturing costs rose more quickly that Canadian manufacturing costs.

3.10 Economic Significance of Injury Determinants

In this section, the preferred models reviewed above are used to study the response of the injury measures to hypothetical changes in four key variables. The period from 1975 to 1986 was picked for the analysis because Canada's presence in the U.S. market was relatively low in 1975. Also, 1975 marked the start of a period in which the U.S. dollar appreciated in value against the Canadian dollar.

Four counterfactual scenarios were evaluated. First, it was assumed that the real Canada-U.S. exchange rate stayed at its 1975 value of $C1.0490. Second, U.S. GNP was held constant at its 1975 value of $U.S. 2,990 billion. Third, it was assumed that the average real B.C. stumpage price was raised to $C10.00 per cubic metre. Fourth, value of BCLRENT was held at zero.

The results of these scenarios are listed in Table 3.19. The counterfactual values for 1986 were obtained by adjusting the predicted 1986 values by the product of the counterfactual change in a variable times the variable's coefficient. For example, the counterfactual predicted value for the U.S. lumber price index in 1986, assuming that the exchange rate remained at its 1975 value, was obtained as follows. First, the exchange rate coefficient from the preferred model in Table 3.10 was obtained. Next, the difference between the 1986 and 1975 values of REXCHRT (Appendix 3.1) was calculated. Finally, the product of the coefficient times the change in REXCHRT was added to the predicted 1986 value of the U.S. lumber price index (Table 3.19) obtained from the preferred model and actual 1986 data[44].

A review of Table 3.19 shows that five injury measures were affected by the exchange rate scenario. Had the U.S. dollar not appreciated against the Canadian dollar, the results indicate that the U.S. lumber price and U.S. lumber production would be higher by 17.3 percent and 4.50 billion board feet, respectively. Furthermore, the rise in the exchange rate from its 1975 value lowered the competitiveness of U.S. sawmills and allowed Canada's market share to rise about 4.0 percent by 1986. Finally, if the exchange rate had not risen above its 1975 level, the average

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44 The 1986 predicted value for USLMPI in Table 3.18 is 102.78. The coefficient for REXCHRT in column six of Table 3.9 is -59.035. The 1975 and 1986 values of REXCHRT obtained from Appendix 1 are 1.049 and 1.342 respectively. The counter factual 1986 value of USLMPI assuming a 1975 exchange rate was obtained as follows:

$$1986 \text{ counter factual value} = 102.78 - 59.035(1.049-1.342) = 120.08$$

Table 3.19

Economic Importance of Variables

Simulation Description	Affected Injury Measure	Actual 1986 Values	Predicted 1986 Values	Counter-factual 1986 Values	Change From Actual	Change From Predicted
Exchange Rate at 1975 Value	USLMPI	100.00	102.78	120.08	20.08	17.30
	USLMPROD	34.20	31.44	36.48	2.28	4.50
	CANMSHR	30.35	32.98	28.97	-1.38	-4.01
	USFPROS	4.59	2.71	5.01	0.42	2.30
	RSPFPI	100.00	102.82	205.90	105.90	103.08
U.S. GNP at 1975 Value	USLMPI	100.00	102.78	90.15	-9.85	-12.63
	USLMPROD	34.20	31.44	15.44	-18.76	-16.00
	USFPROS	4.59	2.71	-3.32	-7.91	-6.03
	RSPFPI	100.00	102.82	69.20	-30.80	-33.62
	USSMHRS	247.70	227.79	94.87	-152.83	-132.92
B.C. Stumpage at $10.00	USLMPI	100.00	102.78	115.52	15.52	12.74
	USLMPROD	34.2	31.44	33.11	-1.09	1.67
Zero B.C. Rent	USLMPROD	34.20	31.98	32.17	-2.03	0.19

return on sales in U.S. forest products industry would have been 2.3 percent higher and the U.S. forest products stock price index would have been 103.1 percent higher.

The second scenario assumed that U.S. GNP did not rise from its 1975 value of 2,990.0 billion U.S. dollars. The 38.1 percent increase in real U.S. GNP has had a strong and positive impact on the U.S. lumber industry. Table 3.19 indicate that the sharp rise in U.S. GNP since 1975 has increased both U.S. lumber prices and production by 12.6 percent and 16.00 billion board feet respectively. Also, coincident with higher lumber demand and prices, the expanding economy caused the return on sales and the stock price index in the U.S. forest products industry to rise by 6.03 percent and 33.6 percent respectively. Finally, the rise in U.S. GNP translates into 132.92 million more production hours by 1986. At an average of 1.95 thousand hours per worker per year, the rise in U.S. GNP between 1975 and 1986 is equivalent to about 68 thousand production jobs.

The fourth scenario assumes that the real (constant 1986 dollars) British Columbian stumpage price in 1986 was $C10.00 per cubic metre. This represents a 112 percent increase in the average British Columbian stumpage price for the period from 1975 to 1986. The results indicate that this hypothetical stumpage prices increase would reduce Canada's excess supply of lumber, causing an increase in the U.S. price of lumber of 12.7 percent. However, the hypothesized rise in British Columbian stumpage prices only causes U.S. production to rise by 3.5 percent or 1.67 billion board feet.

In the last scenario analyzed, the amount of rent which flowed through to British Columbian sawmills was set to zero. The actual value of BCLRENT in 1975 was -0.32 dollars per cubic metre so this scenario is similar to assuming that BCLRENT was kept at its 1975 value. The results show that the value of rent collected by British Columbian sawmills caused U.S. lumber production to fall by 0.19 billion board feet or 0.6 percent. This is a small impact relative to those caused by changes in the exchange rate and the level of U.S. GNP.

In summary, the results of the four simulations highlight the sensitivity of the injury measures to general economic factors that relate to level of lumber demand in the United States. Furthermore, the results indicate that the exchange rate has played a very important role in eroding the long-run competitiveness of the U.S. softwood lumber industry.

3.11 Discussion and Conclusions

The reduced form models for the six measures of injury were all estimated using Version 6.2 of SHAZAM (White et al. 1990). The approach to estimating the models started with the development of an economic framework that recognized the relationships between the U.S. and Canadian lumber markets and included a proxy for the alleged timber subsidy received by British Columbian sawmills. This lead to Expression 26, a general reduced form model of the six injury measures. Next, the main factors affecting the supply and demand in the U.S. and Canada were specified. This resulted in Expression 27 which linked changes in the six injury measures to changes in factors affecting the excess demand and supply of lumber in the United States. Demand shifts were traced to changes in U.S. GNP and the business cycle. Supply shifts were traced to changes in the real Canada-U.S. exchange rate, modifications in U.S. and Canadian manufacturing costs and fluctuations in the level of infra marginal rents captured by British Columbian sawmills and British Columbian stumpage prices. The six reduced form models were then empirically estimated using data for the years 1951 to 1986.

Initially, the parameters for the six models were estimated using ordinary least squares, but serial correlation among the residuals lead to the choice of an autocorrelation routine. The analysis of residuals for heteroscedasticity and model misspecification indicated that linear functional forms were reasonable. Regression analysis based on Box-Cox transformations of the dependant and independent variables did not suggest that another functional form (e.g., log-log or semi log) would have been more appropriate. The estimation and inference problems due to multicollinearity among the independent variables were not unusual for empirical studies of this type. However, some of the standard errors of the parameter estimates were inflated by factors of five or more (i.e., Aux R^2 values of 0.80 or more) and variance inflation of this magnitude is generally considered to be severe.

This study found that the real Canada-U.S. exchange rate was an important determinant of the injury suffered by U.S. lumber producers during the period from 1951 to 1986. Five of the six preferred injury models contained significant parameter estimates for the real Canada-U.S. exchange rate. In the counterfactual scenario that held the exchange rate at its 1975 level, the largest impact was on the U.S. softwood lumber price which rose 16.8 percent by 1986, relative to the base case prediction. This scenario also resulted in a 14.1 percent increase in U.S. lumber production by 1986. Holding the exchange rate at its 1975 level also resulted in a 2.3 percent increase in the return on sales and a 100.2 percent increase in the stock price index. Thus, the exchange rate appears to be a very important determinant of profitability.

The results of the scenario that held U.S. GNP at its 1975 level indicate that income is also an important determinant of U.S. lumber prices and production. The hypothesized drop in U.S. GNP to its 1975 value caused the price of lumber and U.S. production to fall by 12.3 percent and 51.7 percent respectively. Furthermore, this scenario resulted in 58.4 percent drop in the demand for U.S. sawmill labour. The preferred model for Canadian market share does not contain U.S. GNP explicitly[45]. However, the direction of the effect on Canadian market share caused by a drop in GNP is known. A lower level of U.S. GNP will lower the demand for housing and, thus, the square footage of U.S. residential construction will drop. This study found a positive relationship between the square footage of U.S. residential construction and Canadian market share consequently, a drop in U.S. GNP lowers Canada's market share.

One of the primary contentions of U.S. lumber producers in Canada-U.S. softwood lumber dispute was that stumpage prices in Canada and in B.C. in particular were too low (i.e., below fair market value) and that this constituted a subsidy which caused a large distortion in Canadian lumber production. From a statistical perspective, the U.S. allegation was that British Columbian production decisions were distorted by the timber rents captured by sawmills and that the resulting increase in lumber shipments to the U.S. injured U.S. producers.

To test this allegation, the average real value of rents flowing through to British Columbian sawmills (i.e., the proxy measure of the alleged subsidy) was entered into each of the six reduced form models. With the exception of the model for U.S. lumber production, this study found that the alleged subsidy had very little impact on the long-run performance of the U.S. lumber sector. In the case of U.S. lumber production, a simulated reduction in the level of captured rents to zero increased U.S. lumber output by only 1.4 percent. Thus, the results of this analysis do not support the U.S. allegations. That is, timber rents that may have flowed through to British Columbian sawmills do not appear to have been a major source of injury.

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[45] As shown in Table 3.11, the preferred model specifies Canadian market share as a function of the following variables: USFOOT, REXCHRT, RUSAVC, RCAVC and TREND. U.S. GNP and the business cycle effect were replaced by the square footage of new U.S. residential construction because of multicollinearity problems. However in the section above outlining the specification of Expression 20, the following model was reported:

USFOOT = - 4.0414 + 0.92523E-03*USGNP + 4.5691*CUSGNP - 0.11819*USINT

Thus, the square footage of new U.S. residential construction is positively related to U.S. GNP and to the business cycle.

The sensitivity of the six injury measures to the British Columbian stumpage price was also assessed in this study. Of the six injury measures, only the models for the U.S. lumber price and U.S. production contain significant British Columbian stumpage price coefficients. In response to a simulated increase in the British Columbian stumpage price to $C 10.00 per cubic metre, it was found that the U.S. lumber price and U.S. production rose by 14.6 percent and 5.6 percent respectively. Like the exchange rate scenario, the U.S. price of lumber is affected more dramatically by a shift in Canada's excess supply of lumber than by changes in the level U.S. lumber production.

In general, the results of this study tend to support Canada's counter claim in the lumber dispute that it was changes in U.S. domestic lumber demand and factor markets that were the major cause of the suffering in the U.S. lumber industry. Over the time horizon in this study, the conditions faced by U.S. producers changed dramatically. The real appreciation of the U.S. dollar against the Canadian dollar, rising demand for saw timber from plywood and other panel products, increased competition from substitute products in traditional end-use markets and higher average variable manufacturing costs in the U.S. than in Canada over most of the study period put U.S. producers in dire straits.

The notion of injury is inherently a problem of comparing healthy and injured states using an appropriate measure. By adopting the measures of injury reviewed in this study, the comparison of healthy and injured states becomes an empirical exercise that can be addressed using relatively simple reduced form models and standard econometric techniques. Although there will inevitably be situations where data availability or structural complexity will limit the usefulness of reduced form models in injury determinations, there are quite likely a great many cases where this approach would ensure or improve the objectivity of the various processes that are currently being used to decide if an unfair trading practice has caused injury to domestic producers.

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Appendix 2.1

U.S. LFV Data and Predicted Values

YEAR	Actual ULFV	Pred ULFV	USREFEXR 1980=100	JREFEXR 1980=100	USJCI	URDPFT Billion 1980 $ U.S.	URIMP Billion 1980 $ U.S.
1975	8	0.00	110.4	103.5	1.07	28.61272	143.5116
1976	14	21.15	114.4	102.5	1.12	42.52717	169.3071
1977	15	24.61	111.4	110.5	1.01	49.17197	193.0318
1978	23	12.80	100.3	127.6	0.79	52.90629	208.8375
1979	24	19.00	99.0	110.8	0.89	40.67612	229.3239
1980	103	78.70	100.0	100.0	1.00	21.30000	245.2600
1981	32	35.84	111.5	108.8	1.02	19.16058	238.1204
1982	181	183.36	125.7	97.1	1.29	1.79949	209.0403
1983	55	48.20	129.8	101.3	1.28	14.19142	212.9125
1984	101	115.14	139.7	102.3	1.37	30.26211	258.7212
1985	95	87.80	145.6	99.9	1.46	21.99074	266.4198
1986	95	84.81	117.0	119.8	0.98	23.14050	277.9564
1987	18	44.59	101.5	123.9	0.82	29.90518	296.1342

Appendix 2.2

Canadian LFV Data and Predicted Values

YEAR	Actual CLFV	Pred CLFV	CREXR 1980=100	GREXR 1980=100	CGCI	CGRPC %	CMEI 1980=100	CIP 1980=100	RTCMLAP
1975	8	0.00	111.9	91.9	1.2176	4.7	97.98	84.7	1.00
1976	32	24.33	124.3	93.6	1.3280	6.5	99.30	89.3	1.04
1977	60	52.62	116.4	99.6	1.1687	3.2	97.98	91.6	1.04
1978	32	35.23	103.8	102.3	1.0147	3.4	98.95	95.5	1.03
1979	26	22.07	100.3	103.6	0.9681	2.9	101.93	100.7	1.02
1980	21	21.91	100.0	100.0	1.0000	2.2	100.00	100.0	1.01
1981	24	25.96	106.5	91.0	1.1703	2.3	100.61	101.0	1.00
1982	73	70.95	109.7	91.1	1.2042	-2.6	91.24	90.2	0.98
1983	29	32.10	114.0	92.5	1.2324	3.4	88.69	95.3	1.09
1984	25	24.55	111.7	90.2	1.2384	4.6	85.89	103.7	1.12
1985	35	35.25	106.4	89.7	1.1862	5.2	87.64	108.2	1.02
1986	19	37.41	198.3	97.8	1.0051	4.4	89.48	109.6	0.99
1987	32	25.63	99.9	104.4	0.9569	4.5	101.23	114.9	0.93

Appendix 3.1

Data Listing for Imports as a Cause of Injury

YEAR	USLMPI Real 1986=100	USLMPROD Billion fbm	CANMSHR %	FPROS %	RSPFPI Real 1986=100	RSPAFPI Real 1986=100
1950	120.31	30.6	8.70	13.27	-9999	-9999
1951	124.52	29.5	6.74	12.98	-9999	-9999
1952	122.16	30.2	6.71	10.28	-9999	-9999
1953	117.85	29.6	7.62	8.97	-9999	-9999
1954	114.13	29.3	8.70	9.12	-9999	-9999
1955	117.71	29.8	9.93	11.11	-9999	-9999
1956	114.80	30.2	9.34	10.72	-9999	-9999
1957	104.11	27.1	9.06	9.17	-9999	-9999
1958	100.11	27.4	10.29	8.36	-9999	-9999
1959	106.06	30.5	10.89	8.56	-9999	-9999
1960	97.99	26.7	12.06	6.85	-9999	-9999
1961	92.00	26.1	13.37	5.64	-9999	-9999
1962	92.23	26.8	14.65	4.22	-9999	-9999
1963	93.00	27.6	15.60	5.30	-9999	-9999
1964	92.65	29.3	14.58	6.51	-9999	-9999
1965	90.16	29.3	14.53	6.95	112.69	16.30
1966	91.42	28.8	14.46	5.84	93.03	-110.81
1967	90.98	27.3	15.25	4.89	109.40	13.62
1968	104.65	29.3	16.88	5.79	166.05	537.52
1969	110.60	28.3	17.46	6.06	192.72	872.64
1970	88.14	27.5	17.79	4.43	190.09	1085.68
1971	104.35	30.0	19.76	4.67	180.98	862.58
1972	117.95	31.0	22.88	6.99	150.05	449.77
1973	141.48	31.6	22.75	8.80	143.60	481.93
1974	128.09	27.7	20.43	7.20	121.08	553.04
1975	110.61	26.7	18.30	5.13	119.13	582.86
1976	128.67	30.6	21.41	6.78	152.26	842.64
1977	144.53	32.7	24.80	6.66	127.59	643.43
1978	156.67	33.5	26.77	6.85	104.58	466.57
1979	158.19	33.3	26.01	7.59	100.71	427.21
1980	131.69	28.2	26.69	4.83	94.38	313.03
1981	119.38	25.4	28.16	3.76	84.93	248.79
1982	105.23	24.9	28.12	1.86	69.98	150.70
1983	116.44	28.9	30.57	2.12	90.40	230.35
1984	107.27	30.8	31.20	1.91	74.10	68.50
1985	101.83	30.5	33.34	2.07	75.71	-7.84
1986	100.00	34.2	30.35	4.59	100.00	100.00

Appendix 3.1

Data Listing for Imports as a Cause of Injury Continued

YEAR	USSMHRS Million Hours	USGNP Billions $U.S.	CUSGNP	REXCHRT Real 1986 $C/$U.S.	RUSAVC Real 1986 $U.S./MBF
1950	751.0	1335.4	-9999	1.2286	86.73
1951	693.3	1473.6	1.103	1.1195	92.93
1952	687.7	1531.1	1.039	1.0113	94.15
1953	645.6	1592.4	1.040	1.0337	97.59
1954	558.4	1571.2	0.987	1.0223	90.47
1955	598.9	1658.5	1.056	1.0649	103.96
1956	592.7	1692.7	1.021	1.0581	103.93
1957	532.0	1720.9	1.017	1.0468	109.01
1958	407.4	1707.8	0.992	1.0661	90.61
1959	442.1	1807.4	1.058	1.0587	91.28
1960	432.5	1847.5	1.022	1.0759	98.59
1961	380.7	1895.7	1.026	1.1134	92.17
1962	378.1	1996.4	1.053	1.1833	92.10
1963	364.2	2078.4	1.041	1.1851	93.87
1964	354.2	2189.3	1.053	1.1737	93.15
1965	358.7	2316.1	1.058	1.1646	93.83
1966	346.7	2450.1	1.058	1.1515	95.06
1967	322.7	2520.0	1.029	1.1410	103.77
1968	316.2	2624.6	1.042	1.1569	105.93
1969	316.6	2688.5	1.024	1.1622	121.57
1970	306.0	2680.7	0.997	1.1375	118.45
1971	301.9	2756.8	1.028	1.1266	122.18
1972	301.9	2894.1	1.050	1.0941	156.15
1973	314.4	3044.4	1.052	1.0831	176.20
1974	328.5	3028.1	0.995	1.0096	226.94
1975	281.2	2990.0	0.987	1.0490	201.17
1976	301.6	3136.1	1.049	0.9949	222.68
1977	315.6	3282.5	1.047	1.0775	258.17
1978	304.8	3456.2	1.053	1.1704	283.02
1979	331.9	3541.7	1.025	1.1884	324.88
1980	296.8	3536.1	0.998	1.1692	363.22
1981	272.7	3604.5	1.019	1.1861	395.14
1982	219.5	3512.6	0.975	1.1961	349.17
1983	244.9	3638.1	1.036	1.1811	363.94
1984	245.2	3879.7	1.066	1.2506	350.29
1985	238.3	4014.9	1.035	1.3166	352.33
1986	247.7	4129.2	1.028	1.3420	344.88

Appendix 3.1

Data Listing for Imports as a Cause of Injury Continued

YEAR	RCAVC Real 1986 \$C/MBF	BCSTUMP Real 1986 \$C/m^3	BCLRENT Real 1986 \$C/m^3	RSP400 (1986=100)	USFOOT Billion ft^2
1950	60.46	5.75	-4.57	26.67	2.132890
1951	70.26	7.46	-5.93	29.29	1.718450
1952	70.22	8.70	-8.37	33.47	1.786035
1953	66.92	6.32	-4.60	33.54	1.680086
1954	65.74	6.11	-4.59	41.85	1.891150
1955	66.26	8.11	-6.16	57.31	2.145485
1956	70.55	11.08	-9.68	64.46	1.848560
1957	61.68	6.74	-6.77	60.28	1.711866
1958	59.64	4.61	-5.49	63.79	1.877838
1959	58.77	5.86	-5.75	76.21	2.055872
1960	59.56	5.44	-0.95	74.90	1.715565
1961	59.66	3.94	-1.46	85.96	1.751612
1962	59.70	4.27	0.70	81.00	1.914356
1963	67.97	5.14	-0.38	90.45	2.125682
1964	72.22	6.65	-1.60	106.66	2.075821
1965	72.46	7.91	-2.76	113.09	2.065415
1966	76.29	6.57	-0.37	105.62	1.729896
1967	81.15	4.55	1.81	113.07	1.949663
1968	85.55	6.71	1.57	122.77	2.271030
1969	94.90	8.66	0.63	118.67	2.282104
1970	95.02	4.38	1.85	95.46	2.141256
1971	96.42	4.15	3.15	111.48	3.767111
1972	110.62	6.93	0.11	121.55	3.593265
1973	130.95	13.12	-4.46	104.31	3.333518
1974	151.48	7.73	-3.20	66.83	2.279989
1975	156.25	2.26	-0.32	62.51	1.951696
1976	162.00	2.24	4.52	71.82	2.578916
1977	171.08	3.31	1.42	66.54	3.289558
1978	196.62	7.67	0.41	60.17	3.337581
1979	236.58	12.57	-0.22	58.05	2.923198
1980	252.11	10.84	-2.45	59.77	2.166899
1981	268.72	3.18	-0.09	56.95	1.844315
1982	267.94	2.30	3.46	54.01	1.778640
1983	256.54	2.55	2.03	68.15	2.756250
1984	270.54	2.47	2.13	68.37	2.857488
1985	267.38	2.45	1.40	79.96	2.840746
1986	266.89	3.10	0.67	100.00	2.994623

Appendix 3.2

U.S. Contribution to Earnings from Building Products Divisions: 1981

Company	Division	To Sales	To Operating Profit
Weyerhaeuser Co.	Building Products	50%	56%
Lousiana-Pacific Corp.	Building Products	79%	100%
Champion Int. Corp.	Building Products	38%	4%
Georgia Pacific Corp.	Building Products	56%	29%
Boise Cascade Corp.	Wood Products & Building Materials	37%	*

* Two divisions combined posted an operating loss of 23 million dollars