FORECASTING FUTURE CONSUMPTION OF CONIFEROUS WOOD IN INDIA: A QUANTITATIVE APPROACH

by

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Abstract

Over the last few years, Canada has been very successful in increasing its trade in wood products with China. India however, still remains an elusive market. There is a large amount of peer reviewed literature on the specifics of the Indian wood market, and the potential for trade in softwood products. Whereas the majority of studies describe in great detail the opportunities and constraints in dealing with India, very little quantitative information is available about the trends and patterns that determine the Indian wood market. This study uncovered and described one such trend by identifying the relationships between the level of imports of softwood products and such factors as India's Gross Domestic Product (GDP), domestic production, the price of lumber on international markets, tariffs, and the price of Teak logs as a substitute for softwood products. This study analyzed 13 years of quarterly data using the ordinary least square regression technique. Diagnostics were conducted using Akaike and Schwartz criterions, the Durbin-Watson test, and the Breusch-Pagan-Godfrey test for heteroscedasticity. Results suggest that the indicated variables collectively explain 74% of variability in import levels. Two variables in particular, real GDP and the price of Teak have a significant, positive impact on the level of imports of softwood products with 0.45 and 0.49 as respective elasticities. Continuing growth of India's GDP will ensure an ever increasing demand for imported wood products in the years to come. To maximize this opportunity, North American exporters should not compete with New Zealand's low quality pine, but should instead focus on competing with dark coloured tropical hardwoods that are becoming prohibitively expensive as world wide supplies of Teak and other tropical hardwoods continue to diminish.

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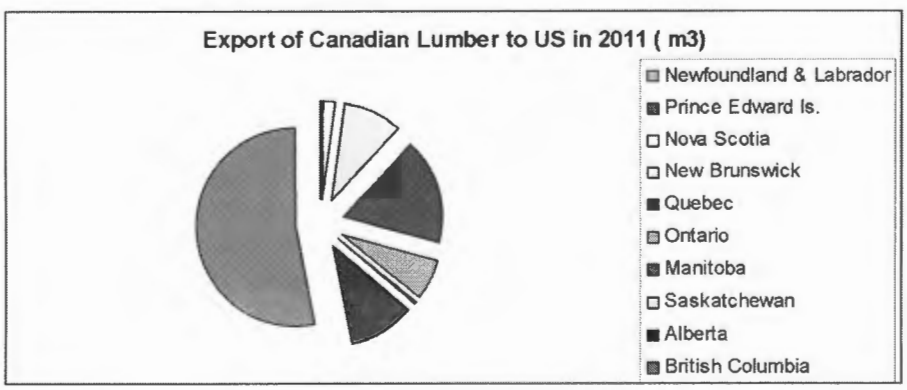
Chapter 1

Introduction

British Columbia (BC) is endowed with a rich forest resource. Forests cover about two-thirds (60 million hectares) of the province's total land mass. Major species of trees harvested in the province are coniferous, and include Western Red Cedar, Hemlock, Douglas-fir, White Spruce, Ponderosa Pine, and Lodgepole Pine. Due to the fact that 95% of BC's land base is publicly owned, the management of forest resources rests largely with the provincial government, which allocates the right to log crown land through the sale of stumpage fees and the regulation of annual allowable cut. Almost all of the wood produced in BC is softwood ie. produced from coniferous species, and is used to make lumber (sawn wood), plywood, shakes, shingles, newsprint, and pulp and paper products. In this paper, I define coniferous or softwood products as unprocessed coniferous logs and coniferous sawn wood or lumber. Over half of the lumber produced in Canada comes from BC, as measured by quantities exported (Figure 1).

Figure 1. Export of Canadian Lumber to the US in 2011 by Province



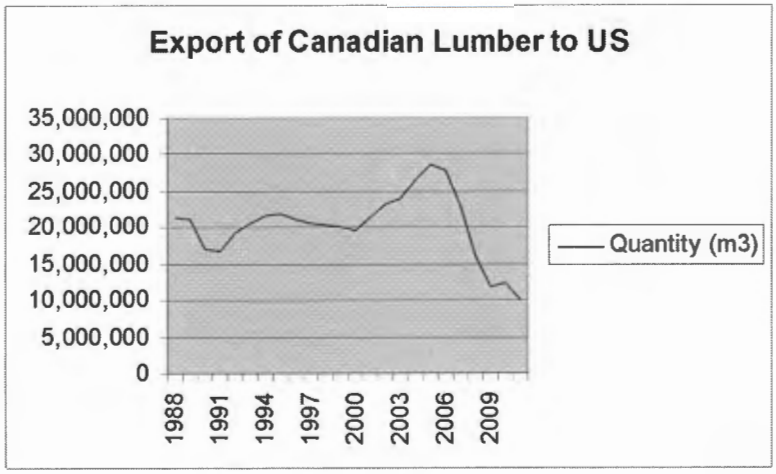
Source: COFI, 2011

Forest products are the province's most important export commodity, historically accounting for more than half of the total value of BC's international goods exports. This has changed in recent years, as the value of energy and industrial goods sold to other countries has been rising, while forest product exports have fallen.

The forest sector has faced many challenges in recent years. The downturn in the United States (US) housing market is one reason for the current difficulties in the province's forest sector. Other challenges include lower prices for forest products, a long dispute over softwood lumber exports to the US (which began in the 1980s and continued until 2006, when the Canadian and US governments signed a framework agreement to end the dispute) and a mountain pine beetle epidemic which devastated forests in the Province's interior.

The housing situation in the US is of particular importance to the well being of the forest industry in BC. Housing starts in the US have prolonged and significant effect on Canadian lumber production, exports, and prices (Jennings *et al.,* 1991). The collapse of the housing market occurred in 2008 and, to this day, it has not recovered.
As the construction of new housing units fell from the historic level of 1.5mln to 0.55 mln in 2009 (US Census Bureau, 2012), the export of Canadian lumber to the US decreased dramatically (Figure 2).

Figure 2. Export of Canadian Lumber to the US by Year



Source: COFI, 2011

This situation illustrates the larger phenomenon of the decoupling of Canadian natural resources exports from the US economy.

Substantial reduction in the demand from the US, has forced the Canadian forest industry to look elsewhere for export opportunities.

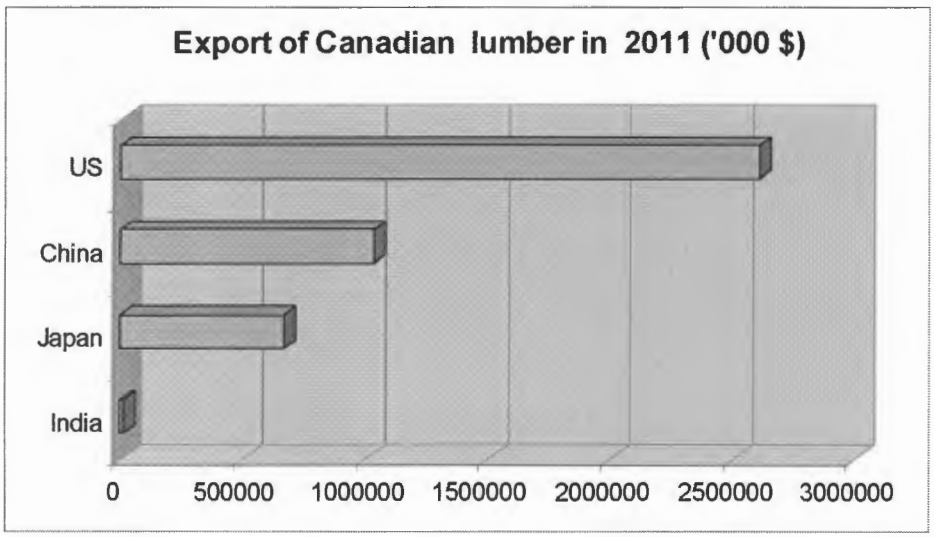
Over the last several years the demand from traditional overseas markets such as Taiwan, South Korea, Japan and the EU has remained flat or has grown only slightly. However, new markets have began to grow in importance, particularly China, and to a lesser extent, India.

Between 2006 and 2010, the export of logs from Canada to China increased 13-fold, and the export of lumber increased 11-fold. Trade figures show the value of softwood lumber exported to China surpassed the U.S. for the first time in May of 2010, underscoring the importance of the Asia-Pacific markets for B.C.'s economy. According to Pat Bell, the former BC Forests Minister and the current Minister of Jobs, Tourism and Innovation, China

has become the most important market for British Columbia's lumber. At the same time, the export of logs to India has also increased, but has still remained marginal.

Figure 3 illustrates the size of the major export markets for Canadian coniferous products. India remains insignificant in this comparison.

Figure 3. Export of Canadian Lumber in 2011 by destination



Source: COFI, 2011

In spite of the minor role India plays as a market for Canadian coniferous products, several factors point to future growth of this market, perhaps in the magnitude of what has happened in China over the last four to six years. Factors such as the need for housing, the growing wealth of India, the emergence of the middle class, and the shortage of raw material for the wood products industry, are creating real opportunities for countries such as Canada that export wood products. Canada is presently very successful in exporting some forest products

to India. In particular, Canada is a leading provider to India of chemical wood pulp dissolving grades (73mln USD in 2009-2010), and newsprint (50 mln USD in 2009-2010). This trade is estimated to reach 272 mln USD by 2015. In contrast, as mentioned above, sawn wood (lumber) exports are negligible, and amounted to little more than 2 mln USD in 2009-2010. This represents only 2% of India's total imports of sawn wood (Ace Global, 2011). Canada's export of unprocessed logs is also negligible.

The question then is this: why can the successful market penetration achieved by pulp and paper products not be repeated with solid wood products? Why does India remain an "elusive market" for BC's coniferous products?

Several studies of this issue have concluded that, to improve its trading opportunities, Canada must focus on the following areas:

- Finding specific opportunities for attractive positioning against tropical hardwoods;
- Raising consumer/industry awareness;
- Building partnerships with wood product manufacturers to promote Canadian wood, and
- Maintaining final price competitiveness vis a vis hardwoods

Before embarking on such a costly and time consuming undertaking, it is crucial to have a good understanding of the trends in the future consumption of coniferous product and of factors that influence this consumption.

1.1 Study Objectives

The purpose of this study is to predict future consumption of coniferous products in India. The particular objectives are as follows:

- To identify the most important factors or independent variables that determine consumption of coniferous products and find out in what way they influence consumption
- To construct a statistically valid econometric model that would best describe the relationships between identified independent variables and the consumption of coniferous products.

Chapter 2

Review of Literature

In 1991, India initiated sweeping reforms of the economy. The new policies included opening for international trade and investment, deregulation, initiation of privatization, and tax reforms. The Government's initiative to abandon socialism and to allow for a free market economy resulted over time, in high economic growth, reduction of poverty, and creation of a 300 mln large middle class. The Gross Domestic Product (GDP) reached 9.7% in 2008 and is currently at 7.8% . India became one of the fastest growing major economy in the world, second only to China.

The rapid economic growth of India in the past two decades has set the stage for fundamental change among the country's consumers. It resulted in creating a massive middle class centered in the cities. A study by the McKinsey Global Institute (Ablett, *et al.*, 2007) suggests that if India continues its recent growth, average household incomes will triple over the next two decades. India will become the world's 5th-largest consumer economy by 2025, and the country's middle class will grow from about 5 percent of the population to more than 40 percent. Along the way, spending patterns will shift significantly as discretionary purchases capture a majority of consumer spending. India's potential should make it a high priority for most consumer goods businesses, but to succeed in this complex market they must overcome major challenges.

The current population of India is 1.2 bln people and is growing by 1.4% annually adding 15 mln new residents per year. This fact, coupled with rising incomes, created a strong demand for housing and as a result, the construction sector grew by 6.5% in 2010 (ITTO,2010). The World Bank estimates that India's housing shortage is between 20 and 70 mln residential units (The Economic Times, 2010). Recently, the Government of India announced the start of a low-cost housing scheme which will benefit 32 mln slum dwellers in 250 cities (India Business Insight, 2011).

All these factors suggest that the size of the Indian market for wood products can be substantial, and some early estimates put it at as high as 150 mln people (Cintrafor, 2007).

Until 1982 India was a net exporter of wood products. However, the dramatic reduction of the forest cover from 23% to 8% prompted the government to undertake several forest conservation measures. These included a drastic ban on felling in Indian forests, allowing imports of wood and wood products, and a ban on exports of round as well as sawn timber. Conservation policies still continue, and today India is a net importer of timber and panel products. In consequence, the forest cover has increased to 24%.

The majority of domestic logs are produced from forest plantations of fast growing species. These logs support the local plywood and fibre board industry. Approximately 22% of logs are produced from natural forests. Since the harvest of natural forests has been very much restricted, India is looking for replacement by using many imported species. Among the most accepted substitutes has been New Zealand Radiata Pine which is a substitute for Himalayan conifers. Tropical hardwoods imported from Malaysia, Indonesia, and West Africa supplement and

replace India's domestic hardwood supply. Log imports are supporting 20% of the demand for logs (GAIN Report, 2008).

In 2010, India imported just below 600,000 m3 of softwood logs and lumber. India's approach to economic growth differs from China's in two ways. First, the Indian government is less interventionist, does not control economic activity and does not intervene in capital markets. Secondly, foreign direct investment is not embraced to the same degree as in China. (Khanna, 2004). As a result, manufacturing industries that rely on infrastructure, and the infusion of foreign capital do not fare well in India for the time being. Forest products manufacturing is very fragmented, and very labour intensive. In spite of these constraints, several wood product exporting countries have paid attention to this emerging market. Australia , New Zealand, the US, and Canada have investigated trade opportunities, and literature on this subject is abundant. Recent Australian study points out that India has a culture which appreciates the use of wood, the country will not be able to increase domestic wood production, so imports of wood will continue to grow (Salwood, 2007).
The New Zealand Trade and Enterprise Commission (NZTEC, 2008) states that the market demand for that country's timber is rapidly increasing , and the long term demand for Radiate Pine is excellent. The US Department of Agriculture in its GAINS Reports (USDA, 2008; USDA, 2009) while recognizing opportunities, also pointed to potential challenges such as fragmented marketing chain, small scale manufacturing units, and a general lack of awareness of high quality of softwood species.

The biggest opportunities exist in exporting unprocessed logs or round wood. This category includes raw logs and roughly squared logs with some bark still left on them.

The import of logs is preferred by India because a large number of sawmills and inexpensive labour can process these logs into lumber at a low cost. Log imports are favored by low import tariffs of 5%.

India imported 5mln m3 of logs in 2010 (ITTO, 2010). The majority of imports (4.5mln m3) are of tropical hardwood species like Teak, Red Meranti, and Kapur from Malaysia, Myanmar, and Ghana. New Zealand, Australia and the US also participate by exporting primarily softwood logs of Douglas-fir, Hemlock, Cedar, and Pine with New Zealand fulfilling 7.5% of total log imports to India. While Australia's participation in log imports increased recently by 230%, Canada's share fell by 38% and represents only 0.07% of the total of India's imports. (Government of India, 2011).

Australia and New Zealand provide the Indian market with Radiata Pine logs. These logs are used primarily in construction for scaffolds and concrete forms ie. low end uses.(NZTEC, 2008)

The US and Canada have the opportunity to tap into the higher end market with the softwood species of Douglas-fir, Western Red Cedar and Hemlock, which are all attractive because of their versatile nature and wide range of applications including woodwork/joinery, interior paneling, flooring and specialty products. The value of their imports from the US has increased five-fold to 2.7 mln USD from 2005 to 2009 (GAINS Report, 2009) indicating great future potential of this presently small market.

In the case of Canada, and particularly BC, the trade in logs is severely restricted. Provincial legislation states that, unless exempted, timber harvested must be used or manufactured in BC (Forest Act, 1996).

Softwood species must compete with Teak and other "dark" tropical hardwoods for acceptance by the Indian consumer (Ace Global, 2011).

Whereas round wood comprised of 84% of all wood products imports to India, sawn wood contributed only 3% to the total in 2010 (Ace Global, 2011).

Major exporters of sawn wood to India, besides West African, and South East Asian countries, are New Zealand, the EU, and the US. Canada's share of the market was 0.7% in 2009 (Government of India, 2011), and in 2010, Canada exported to India lumber worth 3.2 mln CAD, consisting mostly of softwood species such as Douglas-fir, Larch, Hemlock and SPF (Spruce, Pine, Fir). To put these numbers in perspective, in the same year Canada exported lumber worth 651 mln to Japan, 722 mln to China, and 3 bln to the US (COFI, 2011).

Canadian lumber exports can be roughly divided into two categories:

The first is lumber for high-end uses like doors, windows, architectural timbers, and other interior decorative applications. This category includes tree species such as Douglas-fir, Western Red Cedar, and Hemlock from BC's Coast. These softwoods can replace or complement the use of Teak and other high priced, and difficult to obtain hardwoods like Meranti, Merbau, and Kapur.

The second category is what is known as SPF, a mixture of Lodgepole Pine, White Spruce and Balsam fir originating in BC's Interior. The best grades of these species can be used for higher end purposes as appearance grades. To successfully penetrate the Indian market, these species should be priced only slightly higher (10-15%) than Radiata Pine – a major competing species from New Zealand (Ace Global, 2011).

At the beginning of 2011, India conducted a pest-risk assessment of Canadian Spruce, Pine and Fir sawn wood and determined it was suitable for entry into India. Higher grade lumber can now be exported to India, and it is estimated that this market can dramatically increase within four to five years (B. Zak, personal communication, May 29, 2011).

Canada's closest competitor, the US exported lumber worth of 3.8 mln USD in 2010. This export of softwood lumber grew by 740% between 2010 and 2011 (USDA, 2011).

The consumption of imported softwood products is influenced by many factors. Some of them are tariffs, local preferences, competition, price, and no awareness of Canadian products (Luna, 2006).

Tariffs: Since the early 1990's, India has moved gradually away from a strategy of industrialization to a more open, market-oriented trade and investment regime. Nevertheless, policies continue to protect some domestic producers from foreign competition (Muthoo, 2004). India recognizes the importance of log imports to supply its sawmills, therefore the total import duties for logs and squared logs (cants) is 5%. Import duties for sawn wood are much higher at 14,7%, and for value added products such as plywood and wood-based panels are the highest at 24.4% (GAIN Report, 2009). Over the last 20 years tariffs were lowered several times with the

last adjustments being made in 2005 (ITTO, 2005). Presently, Canada and India are negotiating a free trade agreement. One of the objectives of this agreement is to "contribute to trade and investment facilitation through minimizing tariffs and non-tariff barriers, reducing any administrative costs" (Canada -India Joint Study Group Report, 2010).

Preference for Teak: Indian customers show a strong preference for dark-colored wood like Teak (Rattan, 1999). All other species are compared to Teak for appearance, strength and resistance to insects. Teak however, is loosing its pre-eminent position because of declining quality and escalating price. Supplies of highest quality Teak imported from Myanmar, Malaysia, and Burma are dwindling. The price of Teak logs on international markets have more than doubled in the last decade as indicated by the ITTO by-weekly Market Information Reports for this period. Traditional sources of log imports located in ASEAN countries might over time become unreliable due to heightened controls over illegal logging, and increased competition for logs from China and Europe. In addition, the highest quality logs are purchased by Japan, leaving India with logs of lower quality (Cintrafor, 2007).

Domestic production: As reported by the ITTO in their annual reports, and other publications (Muthoo, 2004), domestic production of coniferous wood products since 1990 continues to decline with production of industial roundwood declining by 0.7% and the production of coniferous sawn wood declining by 8.7% over the last decade. This situation indicates inadequate domestic supplies and restrictions on forest logging.

Real GDP: Economists use the gravity model of world trade (Krugman *et al.*, 2012) to explain the relationship between gross domestic product and the level of trade between countries. The value of trade between any two countries is proportional to the product of the two countries' GDP, and diminishes as the distance between the two countries increases. Essentially, large economies tend to spend large amounts on imports because they have large incomes. India's economy is rapidly expanding, and has grown in the last decade by an average of 7% annually. An economic forecast prepared by Goldman Sachs (Wilson *et al.*, 2003) predicts that India has the potential to attain the fastest growth among the BRIC countries over the next 30 years. Growth is expected to be higher than 5% annually if development proceeds successfully.

A few publications provide quantitative analysis of the factors influencing the trade in forest products between countries. A study of export demand for Ghana's timber products (Nanang, 2009) found that the trade was influenced mostly by the income of importing countries, exchange rates, and world prices for timber products. A study done in India (Malik, *et al.*, 2003) predicts that the combined effect of economic growth and increasing population size on demand for forest products will be significant in the future.

A study of Canadian lumber imports into the US revealed that US domestic producer prices, and the level of housing starts in the US had significant impact on import prices. Among trade barriers examined, a softwood quota raised the import prices, but the high tariffs lowered it (Pandit, 2009). Another study (Sarker, 1996) concluded that lumber price, disposable income, housing starts, construction wage rate, and exchange rate significantly impacted the level of

imports of Canadian lumber to the US, and that these factors are more powerful determinants of the lumber trade than the alleged stumpage subsidy.

Chapter 3

Data Base and Methodology

In this paper, I attempted to predict the future consumption of coniferous products in India. The historic consumption data in India is incomplete, unreliable, and for some periods of time, completely unavailable. Furthermore, the data does not separate the use of wood for fuel from industrial use. For these reasons I used the import of coniferous products to India as a proxy for consumption. This variable (IMP) became the dependent variable.

Six independent variables are listed in Table 1:

Table 1: List of Independent Variables

Variable	Description	Source
PRO	Domestic Production in '000m^3	ITTO
POP	India's Population	GoI
PRL	Price of Lumber (random length) in USD per m3	NAHB
PRT	Price of Myanmar Teak in USD per m3	ITTO
RealGDP	Real Gross Domestic Product	GoI
TAR	Tariffs imposed by Indian government on imports	GoI

GoI - Government of India
ITTO - International Tropical Timber Organization
NAHB - National Association of Home Builders

Data was collected from a variety of sources. Below is a more detailed account of data origin:

3.1 Domestic Production (PRO), and Imports (IMP)

Data for these variables was collected from materials published by the International Tropical Timber Organization. The ITTO is an intergovernmental organization, promoting the conservation and sustainable management, use, and trade of tropical forest resources. Its 59 members represent about 80% of the world's tropical forests and 90% of the global tropical timber trade. Every year the ITTO publishes its Annual Review. This review contains several tables presenting information on trade, production, imports, exports, and the prices of major forest products. Table 1-2 in the Annual Review contains data for logs (separately coniferous and non-coniferous), and for sawn wood (separately coniferous and non-coniferous) (ITTO, 2010).

The ITTO relies on information provided by member states. They admit, that many of the statistics received from members contained significant and obvious errors in one or more data categories. India is listed as one of the countries that reported at least some categories of data. To make data complete, the ITTO uses supplementary sources of information such as the UN COMTRADE, and FAOSTAT.

Both domestic production and imports figures are expressed in thousands of cubic metres.

3.2 The Price of Softwood Lumber (PRL)

Softwood lumber, or coniferous sawn wood for the purpose of this paper, is defined as sawn wood in the size of 2x4, random length, produced from Spruce, Pine or Balsam, kiln dried. This commodity is traded on the Chicago Mercantile Exchange under ticker LB, and price is expressed in USD per 1000 board feet. Data was obtained from the National Association of Home Builders (NAHB, 2012). Prices were converted to USD per m3.

3.3 The Price of Teak

Teak is a hardwood species highly valued in India. Teak is considered to be a substitute for imported coniferous products. Limitations on domestic logging of Teak resulted in increased imports from countries like Myanmar, Malaysia, Gabon, and Tanzania. Data from India is incomplete to allow for capture of changes in price of Teak over the study period. For this reason, as a proxy, Myanmar Teak log prices of sawlog quality grade 2 were used. The original numbers were collected from the bi-weekly Market Information Service publication. The ITTO Tropical Timber Market (TTM) Report, an output of the ITTO Market Information Service (MIS), is published in English every two weeks with the aim of improving transparency in the international tropical timber market. The TTM provides market trends and trade news from around the world, as well as indicative prices for over 400 tropical timber and added-value products. Original prices expressed in Euro per Hoppus ton and were converted to USD per m3.

3.4 Tariffs (TAR)

Tariff figures for the period under study were obtained from the Government of India, Central Board of Excise and Customs (Government of India, 2012).

3.5 Real GDP (RealGDP)

Figures were obtained from the Reserve Bank of India and its publication: The Handbook of Statistics on Indian Economy: Quarterly Estimates of Gross Domestic Product at Factor Cost. Numbers are expressed in rupee crore.

3.6 Population (POP)

Population figures were obtained from the Government of India's Office of the Registrar General & Census Commissioner. Numbers are based on census results conducted in 1991, 2001, and 2011.

In order to meet the objective of this study, the relationship between the IMP variable and a set of independent variables was examined using statistical methods. In the first step, an economic model was formulated.

3.7 Economic Model

An economic model is a theoretical construct that explains economic processes by a set of variables and quantitative relationships between them. The economic model is a framework designed to illustrate complex processes, using statistical techniques.

The economic model in this study was formulated as follows:
The consumption of coniferous products in India as expressed by the level of import of these products is a function of price of coniferous products imported, import tariffs, real GDP of India, price of substitute (Teak), level of domestic production of coniferous products, and India's population.

$$IMP = f(PRO, POP, PRL, PRT, RealGDP, TAR)$$

Next, descriptive statistics were derived and analyzed.

Descriptive statistics provide summaries about the data sample and the measures. Together with simple graphics analysis, they form the basis of quantitative analysis of data. Descriptive Statistics are used to present quantitative descriptions in a manageable form. Univariate analysis involves the examination across cases, one variable at a time. There are three major characteristics of a single variable that were looked at:

- Distribution
- Central tendency

- Dispersion

Univariate analysis was complemented by creation of scattergrams.

A scattergram can suggest various kinds of correlations between variables with a certain confidence interval. One of the most powerful aspects of a scattergram, is its ability to show the nonlinear relationships between variables. Furthermore, if the data is represented by a mixture model of simple relationships, these relationships will be visually evident as superimposed patterns.

After determining the type of relationship between variables, the economic model was formulated in a testable form for acceptance or rejection.

A mathematical equation was written that describes the relationship between import and independent variables, and a random error (ε) to reflect simplification and imprecision of the theoretical model.

$$IMP = \beta_0 + \beta_1 RealGDP + \beta_2 PRL + \beta_3 TAR + \beta_4 PRT + \beta_5 PRO + \beta_6 POP + \varepsilon.$$

Regression analysis was used to estimate the unknown parameters β_0, β_1, β_2, β_3, β_4, β_5,β_6 in the relationship, using available data. The model was then tested for statistical significance as to whether a change in independent variables is associated with a change in the quantity of imports.

In the classic Keynesian consumption model, consumption function describes the relationship between consumption and income. Economic theory suggests a negative correlation between the demand for a commodity and its price. Therefore we can expect that

the level of import will be affected by the price of lumber, and the level of tariffs. The more expensive the softwood lumber is, and the higher the import tariffs are, the less products will be imported. The domestic market will try to switch to substitutes like Teak, or will limit the demand. The price of the substitute will be positively correlated with the import of softwood products.

Higher income, as expressed in real GDP, and population growth imply greater demand for forest products, therefore coefficients on the GDP variable, and population variable are expected to be positive.

Finally, a decrease in domestic production (supply) at a time of increased demand will positively favour imports, therefore the domestic production coefficient is expected to be negative.

The variables chosen for inclusion in the model can have a positive, negative or neutral effect on the level of imports.

3.8 Hypothesis

I expect that all independent variables are significantly related to the level of import, therefore my null hypothesis is:

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$$

the alternative hypothesis is

$$H_A: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$$

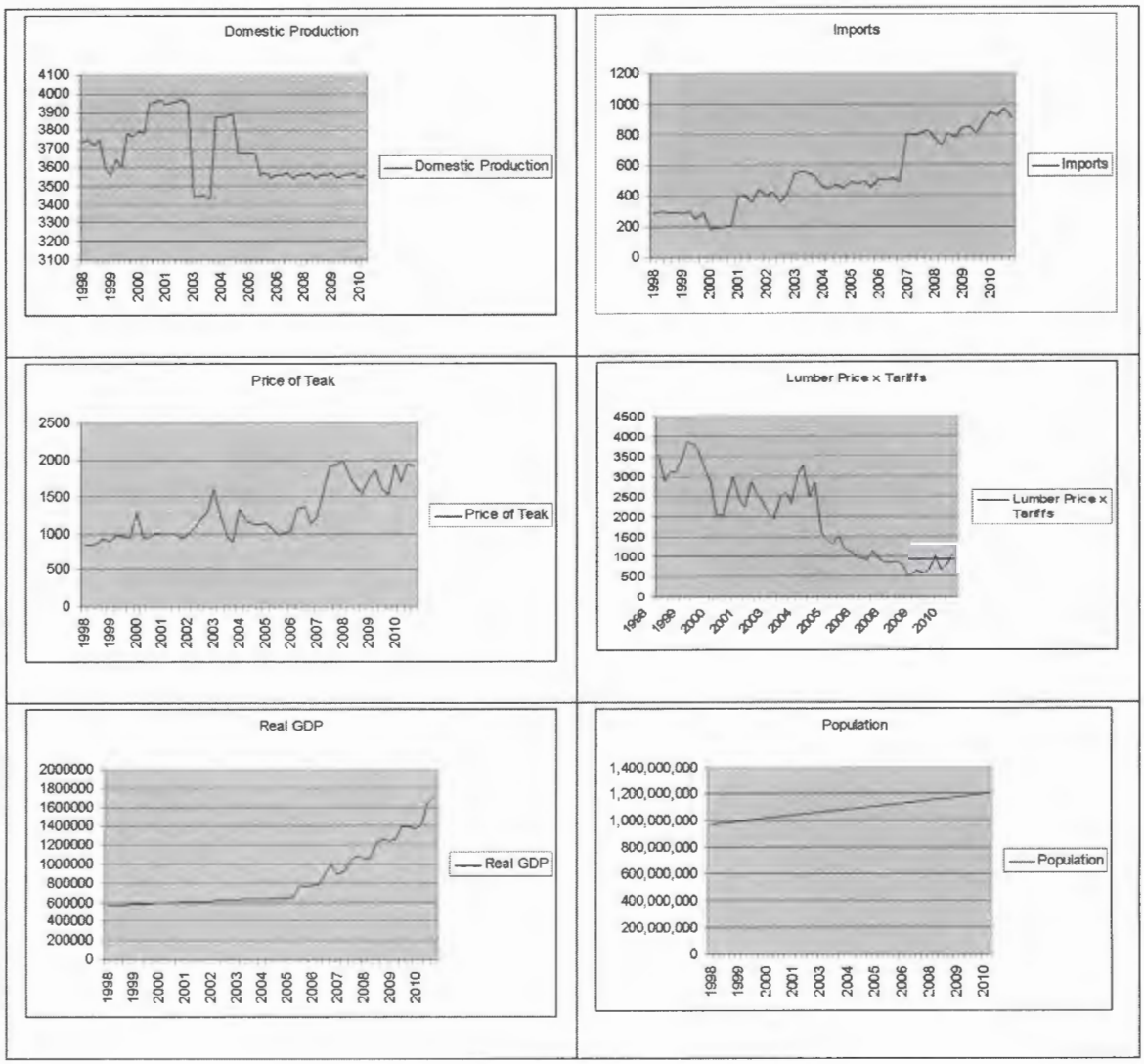
Chapter 4

Empirical Results

Quarterly data (Appendix) collected from various sources was analyzed using ordinary least squares (OLS) regression technique.

Each variable was plotted against time to observe its time dependent behaviour (Figure 4).

Figure 4. Time Plots of Variables



Domestic Production of coniferous wood products fluctuated significantly until 2004 when it reached its peak. After 2004 it gradually decreased, and by 2006 it reached a steady level of approximately 3.5mln m3.

The price of Teak logs almost doubled over the study period, perhaps reflecting a dwindling domestic supply, international bans on illegal logging, and increased competition from other developing markets such as China.

India's GDP remained flat until 2005 and then substantially increased in the last five years of the study. As the domestic production decreased, and the price of the substitute increased, the level of imports of coniferous wood products increased for every year within the study period, and currently provides 26% of demand. North American softwood lumber prices fluctuate cyclically, and do not show a long term pattern of systematic change. On the other hand, import tariffs are gradually decreasing in India. While tariffs for logs have decreased more dramatically to very low levels (5%), tariffs for sawn wood have remained much higher in order to protect the domestic sawmill industry. However, these tariffs also show a tendency to become lower over time. For the purpose of this study, I combined the tariffs for logs and for sawn wood into one variable by calculating an average of both figures for each time period. In order to better capture the effect of diminishing tariffs on the price of softwood lumber, I created an interactive term which is the cross product of price of lumber and tariffs. As noted by Krugman *et al.* (2012), a tariff can be viewed as a cost of transportation. Exporters will be unwilling to move the product unless the price difference between the importing and exporting markets is at least equal to the tariff. The effect of the tariff in India is that it raises the prices of the imported goods in the country imposing the burden by the full amount of the tariff. Production of the imported good

rises, while consumption of the good falls. As a result of the tariff, imports fall in the country imposing the tariff. India's import market is too small to affect the change of foreign export prices. On the other hand, domestic production cannot compensate for lower imports simply because there are not enough logs available. This situation results in the systematic lowering of tariffs.

The population grew in India at an average rate of 1.7% per year during the study period (Government of India, 2011). Population growth together with increasing GDP indicates that the size of the consumer market increased. Indeed, it is reported (Cintrafor, 2007) that this market is currently150mln consumers strong.

Among the variables listed, the price of North American softwood lumber is not a demand shifter. These prices will not shift demand, but instead will cause movement along the demand curve.

Variables that are demand shifters are: real GDP, the price of substitutes (Teak), and the number of buyers on the market (population that is increasing, getting richer, and is not ageing).

Table 2 shows basic statistics for independent variables.

Table 2. Descriptive Statistics

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	ewness	Obs.
IMP	532.32	485	970	188	230.03	0.38	52
POP	1,084,223,619	1,083,398,553	1,202,541,306	966,483,581	69,047,728	0.01	52
PRL	117.12	121	168	58	24.48	-0.15	52
PRO	3,677.56	3,600.5	3,970	3,425	164.64	0.51	52
PRT	1,274.63	1,138.5	1,997	830	361.43	0.70	52
REALGDP	830,364.38	637,091.07	1,716,765	568,339.38	317,265.2	1.19	52
TAR	16.28	19.6	25.5	8.75	7.02	0.00	52

In the second step of analysis, I created scattergrams of the dependent variable IMP and each independent variable separately to see what kind of relationship exists in the pair. Possible outcome included linear relationship, non linear relationship or no relationship at all. Figure 5 shows the results.

The scattergrams indicate that the dependent variable (IMP) has a positive linear relationship with POP and PRT. It seems logical that the more consumers enter the market, and the more expensive a substitute product is, the more demand there will be for imported coniferous wood products.

IMP has a positive logarithmic relationship with REALGPD, and a negative logarithmic relationships with PRL*TAR, and PRO. As the cost of bringing the forest products to India declines, and as domestic production diminishes, this creates positive conditions for increases in imports.

From these scattergrams, I concluded that the coefficients for variables POP, PRT, and REALGDP will be positive, and for variables PRL*TAR and PRO will be negative. I proposed four models that would express the relationships between the dependent variable and the independent variables, and analyzed them for best fit.

Model 1- Double Log:

$\ln IMP = \beta_0 + \beta_1 \ln REALGDP + \beta_2 \ln PRO + \beta_3 \ln PRT + \beta_4 \ln(PRL*TAR) + \varepsilon.$

Model 2 - Linear:

$IMP = \beta_0 + \beta_1 REALGDP + \beta_2 PRO + \beta_3 \ln PRT + \beta_4 (PRL*TAR) + \varepsilon.$

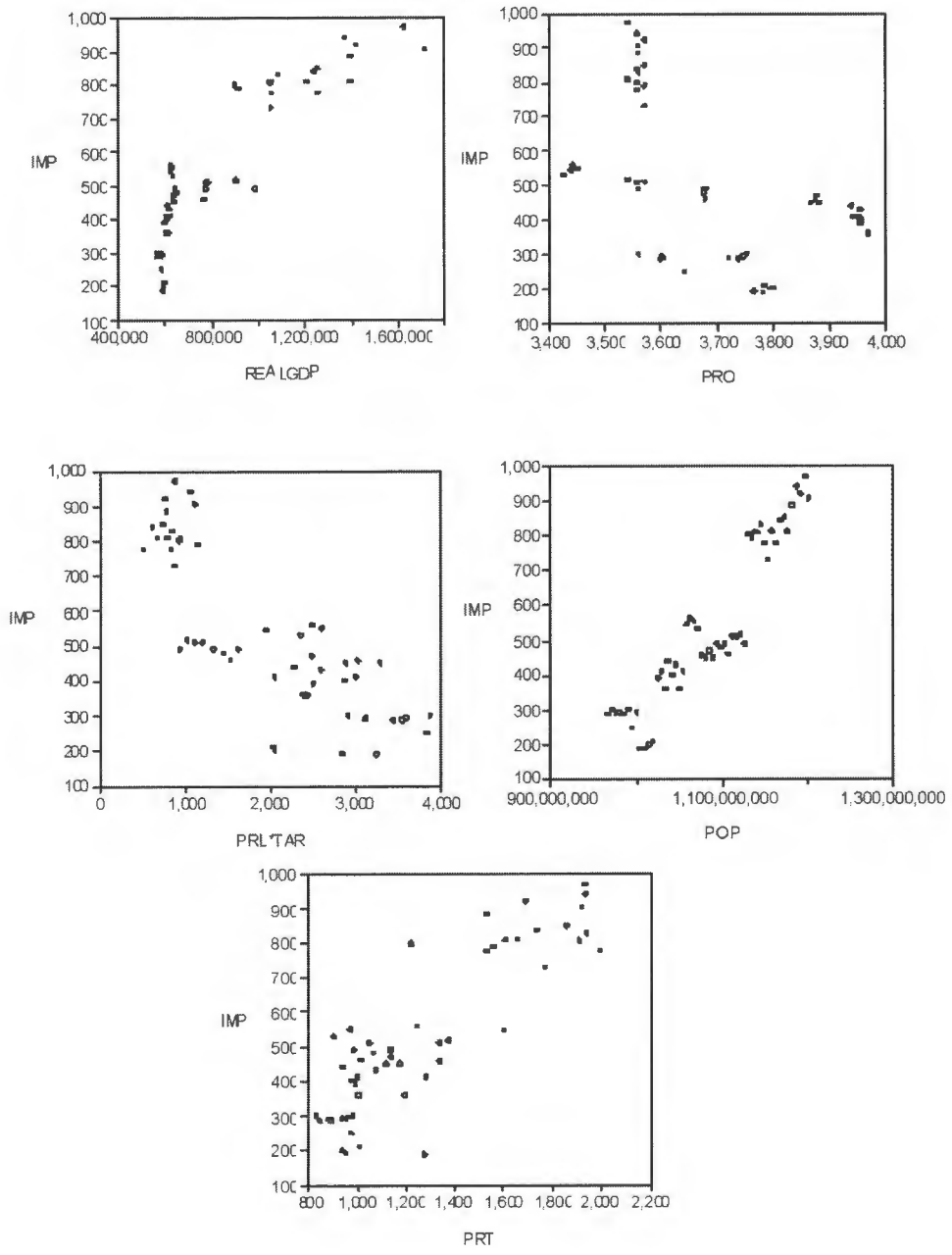
Model 3- Semi log:

$IMP = \beta_0 + \beta_1 \ln REALGDP + \beta_2 \ln PRO + \beta_3 PRT + \beta_4 PRL*TAR + \varepsilon.$

Model 4- Semi log:

$\ln IMP = \beta_0 + \beta_1 REALGDP + \beta_2 PRO + \beta_3 \ln PRT + \beta_4 (PRL*TAR) + \varepsilon.$

Figure 5. Scattergrams of independent variables.



Final regression results are presented in Table 3 with four different model specifications to check the sensitivity of the estimates. This sensitivity was tested by the inclusion and exclusion of certain variables. As discussed earlier, the population variable (POP) had a very minimal effect on IMP, and therefore was removed from all models.

Model 1 was chosen as the one that best explained the economic theory in terms of the size of variables, and their signs. This model has good explanatory power with R^2=0.74. Furthermore, the joint test of all independent variables, the F-test is high and equals 37. It is statistically valid at 1%. Other diagnostics like the Akaike, and Schwartz criterions indicate that the double log model is preferable. The model has some evidence of minimal serial correlation as indicated by the Durbin-Watson stat and the BG test. This is quite a normal occurrence in the demand function. There is no heteroskedasticity in model 1 as indicated by the BPG test.

Figure 6 illustrates the distribution of residuals. The residuals are plotted against the left vertical axis, and both actual and fitted series are plotted against the vertical axis on the right. The actual and fitted values follow each other quite closely indicating good fit of the model. The graph illustrates also that model 1 fits better in the latter part of the sample than in the earlier years since the residuals become smaller in absolute value.

Figure 6. Actual, Fitted, Residual Graph.

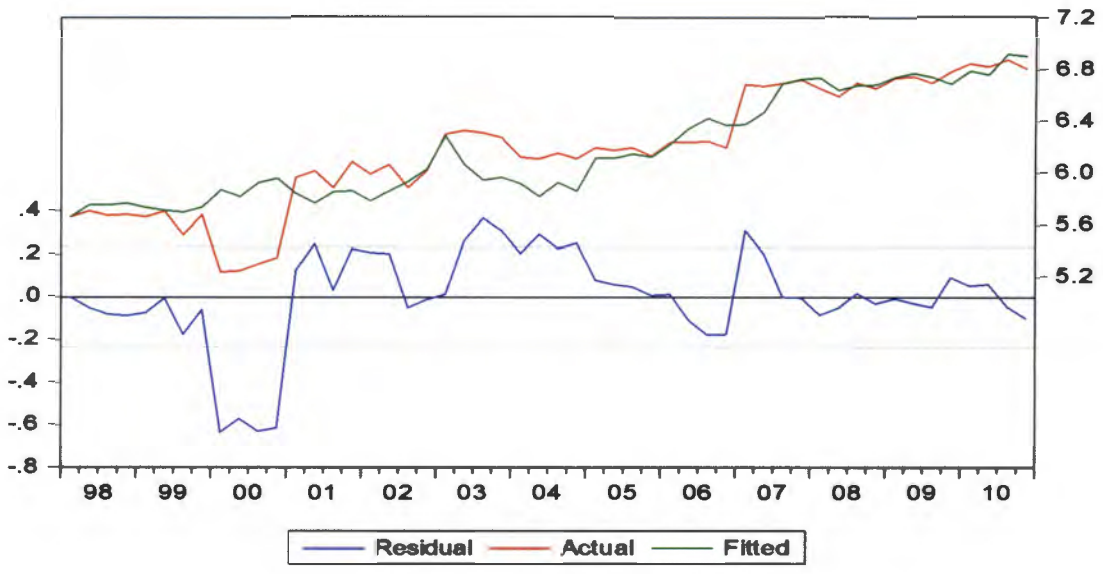


Table 3. Final Regression Results

Dependent Variable- IMP

Indep.Variables	Model 1-Double Log		Model 2- Linear		Model 3 Semi-log		Model 4 Semi log	
	Coefficient	t-Stat	Coefficient	t-Stat	Coefficient	t-Stat	Coefficient	t-Stat
Intercept	4.62	*0.55*	587.16	*1.75**	-932.58	*-0.31*	6.58	*7.13****
REALGDP	-----		0.00	*3.85****	-----		0.00	*1.69**
LOG(REALGDP)	0.47	*1.80**	-----		351.58	*4.13****	-----	
PRO	-----		-0.13	*-1.47*	-----		0.00	*-1.02*
LOG(PRO)	-0.83	*-0.94*	-----		-423.02	*-1.35*	-----	
PRT	-----		0.20	*3.21****	0.18	*2.88****	0.00	*2.21***
LOG(PRT)	0.49	*2.14***	-----		-----		-----	
PRLxTAR	-----		-0.05	*-2.56****	-0.03	*-1.51*	0.00	*-2.91****
LOG(PRLxTAR)	-0.19	*-1.52*	-----		-----		-----	
Adj R^2	0.74		0.86		0.87		0.74	
F-statistic	37.72***		81.90***		85.67***		37.70***	
Akaike info criterion	0.02		11.81		11.77		0.02	
Schwarz criterion	0.21		12.00		11.96		0.21	
Durbin-Watson stat	0.58		0.85		0.84		0.62	
S.E.E.	0.04		0.16		0.16		0.04	
Serial Correlation BG Test (Chi ^{2})	27.25***		18.88***		19.05***		26.04***	
Heteroskedasticity BPG Test (Chi^2)	5.67		3.83		5.08		4.81	

***, **, and * refer to 1%, 5%,10% level of significance

Chapter 5

Discussion and Conclusions

5.1 Discussion

Model 1 indicates, that fluctuations in domestic production, price of Teak, price of lumber, tariffs, and real GDP of India explain 74% of the import demand for coniferous logs and sawn wood. The remaining 26% of variability in trade are influenced by factors not identified in this study.

None of coefficients of tested independent variables are equal to zero, therefore I reject the null hypothesis. Furthermore, as expected in the economic model, coefficients for PRO and PRL*TAR have negative signs indicating that the lower the domestic production of coniferous wood products is, and the lower international prices for softwood lumber paired with lower tariffs are, the higher the import level of coniferous wood products is.

Model 1 indicates that statistically significant variables which impact the level of imports are: real GDP, and the price of the substitute (Teak). A 1% increase in the real GDP increases the imports of coniferous wood products by 0.47%. This finding is consistent with the gravity model of trade proposed by Tinbergen in 1962 (Nello, 2009), and the findings of Sarker (1996), and Nanang (2010). As the economy of India grows, its size slowly approaches the size of its softwood producing trading partners, and this causes the increase in the volume of trade.

On the basis of the gravity model one can assume that countries located closer to India such as Australia and New Zealand will enjoy higher trade levels than countries located farther away such as the US and Canada.

The price of Teak on international markets, which more than doubled over the last decade, affects the amount of Teak logs and sawn wood consumed in India. As the price increases, less Teak is consumed, and the demand for imported coniferous logs and sawn wood increases. My statistical analysis shows that a 1% increase in Teak prices increases level of imports by 0.49%.

Other variables, although not statistically significant, also have some impact on imports. The price of North American softwood lumber fluctuates cyclically and imports to India are poorly correlated with this variable. However, when this variable is coupled with Indian import tariffs, the model indicates that together they have some influence in that as they decrease, the level of imports increases. This suggests price sensitivity of the market, and a beneficial effect of lower tariffs.

Domestic production of coniferous wood products has been slowly decreasing over the last decade, primarily as a result of government imposed restrictions on logging of natural forests in the Himalayan subalpine zone. My statistical analysis indicates that the continuous decline in domestic production helps to increase the level of imports.

5.2 Conclusions

The objective of this study was achieved. The statistical model constructed on the basis of 13 years of data, provides a business intelligence tool for predicting future demand as expressed by imports for coniferous wood products. The constructed model indicates that the change in two variables, real GDP, and the price of Teak has a direct and positive impact on the level of imports. While these two variables were statistically valid shifters of the demand curve, others like domestic production, tariffs and the price of lumber were less significant, and negative.

Over the next decades, as the economy of India grows, the demand for forest products will be increasingly met through imports. This trend creates very good trade opportunities for Canada. India, however is not a second China. It is located father away from Canada, the wood processing and construction industries are highly fragmented, and consumers have different preferences.

Trade statistics quoted earlier in this paper support the assumption that countries located closer to India will enjoy higher trade levels than countries located farther away. This indicates that Canada and the US are in competitive disadvantage as compared to New Zealand and Australia. Whereas the competitive advantage of Canada and the US is not in proximity to the Indian market, the key to successful trade might lay elsewhere.

Extensive literature on the topic, as well as the results of this paper, indicate that Canada and the US should concentrate on trade in high quality softwood species such as Douglas-fir, Cedar and Hemlock. This strategy will position them to successfully compete with tropical hardwoods, particularly Teak, for use in joinery, furniture, and decorative applications. Severe restrictions on domestic harvest of Teak and other tropical hardwoods, as well as diminishing availability of high quality imported logs for the Indian market have resulted so far and will continue to result in ever higher prices. This paper found that higher prices of Teak result in higher levels of coniferous wood imports. The Indian consumer will look for viable alternatives. Provided that they are aware of the advantages of North American softwood products, these high quality softwoods are a natural choice.

To secure future success in the Indian wood products market, Canada should consider allowing a larger amount of logs to be exported as the current ban on exports of unprocessed wood "denies Canada a major opportunity in India's current wood imports scenario"(AceGlobal, 2011). Exports of softwood lumber can be greatly increased if Canada obtains preferential tariffs, and this topic should be on the agenda of current Free Trade negotiations.

Finally, government agencies and industry groups in Canada should start developing partnerships with wood products manufacturers to promote Canadian wood in high potential applications.

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