ANALYSIS OF INDIA AS A MARKET AREA FOR SAWNWOOD

Thesis submitted for a M.Sc. degree in Forest Sciences and Business

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Tiivistelmä — Referat — Abstract

India is a fast growing economy with a high rate of gross domestic product that has improved the local spending power and has turned the country into a potential player in the global economy. In terms of wood products, India has been a net importer and currently is one the largest consumers of hardwood sawnwood in the world. The demand for sawnwood is rapidly growing in India and due to this situation, the country is a potential destination for Finnish and foreign exporters able to reach this market.

The research attempted to increase the understanding of the importance of the demand for sawnwood in India. Thus, the purposes of this study are to: 1) provide a general description about the market environment of sawnwood in India and its situation at global level; 2) model and estimate potential factors impacting the demand level for Indian imports of sawnwood; 3) draw general conclusions about key opportunities and challenges for Finnish and major foreign exporters of sawnwood in the Indian market.

Despite there is valuable information published about India's wood market, empirical research on the Indian sawnwood market is scarce and unreliable. Hence, based on descriptive and explanatory methods, this study gathered secondary data from official and international sources for background and statistical information. The purpose was to analyze the sawnwood market through empirical modelling. Thus, econometric time-series modeling, for the period of 1992-2013, was used to explain the demand for imports of sawnwood in the Indian market by testing the conventional demand model, for income and price variables, and ad hoc models, for several explanatory variables. In addition, Engle and Granger, MacKinnon and Johansen methods were used to test cointegration among variables. The results suggest that the demand for imports of sawnwood is positively related to consumer income and negatively to prices. In addition, it depends on other factors such as population density, unemployment and economic openness. However, based on the elasticity estimates, the Indian sawnwood demand seems to be income and price elastic.

The knowledge obtained in this study provides a valuable tool for foreign wood-based industries searching for market prospects to export their products as well as for public authorities involved in formulating forest and economic policies. However, further modelling is left for future research in this area.

Avainsanat — Nyckelord — Keywords

India, Wood Products, Sawnwood, Demand, Imports, Time-Series Modelling, Econometrics, Elasticities

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Muita tietoja — Övriga uppgifter — Further information

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ACRONYMS AND ABBREVIATIONS

%	Per cent
ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criteria
AIFTA	ASEAN- India Free Trade Area
APFSOS	Asia-Pacific Forestry Sector Outlook Study
ARMA	Autoregressive Moving Average
ASEAN	Association of Southeast Asian Nations
BC	British Columbia
BCD	Basic Customs Duty
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BG	Breach-Godfrey
BMTPC	Building Materials and Technology Promotion Council
CESS	Tax
CINTRAFOR	Centre for International Trade in Forest Products
CSIL	Centre for Industrial Studies
CVD	Countervailing Duty
DGCIS	Director General of Commercial Intelligence and Statistics
DOI	Digital Object Identifier
DW	Durbin-Watson
ECM	Error Correction Model
ECT	Error Correction Term
Ed/Eds.	Editor(s)
EEUU	United States
EFI	European Forest Institute
e.g.	For example
et al.	et alii, meaning *and others*
etc.	And so on
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	FAO Statistical Databases

FDI/FDIs	Foreign Direct Investment(s)
FII	Foreign Institutional Investment
Fig.	Figure
FIPPI	Federation of Indian Plywood and Panel Industry
FSI	Forest Survey of India
FTA	Free Trade Agreement
GAIN	Global Agricultural Information Network
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GoI	Government of India
ha.	Hectare
HQC	Hannan-Quinn Information Criteria
IDKN	Indian Disaster Knowledge Network
IIASA	International Institute for Applied Systems Analysis
IMF	International Monetary Fund
Inc.	Incorporated
inh.	Inhabitants
IPMA	Indian Paper Manufacturers Association
ITTO	International Tropical Timber Organization
ISBN	International Standard Book Number
ISSN	International Standard Serial Number
ITC HS	Indian Trade Clarification based on Harmonized System
IUFRO	International Union of Forest Research Organizations
JB	Jarque-Bera
kg	Kilogram
km.	Kilometer
km^2	Square kilometer
LAC	Latin American and Caribbean
LM	Lagrange Multiplier
LUKE	Natural Resources Institute Finland (from Finnish)
LS	Least Squares
m^2	Square meter
m^3	Cubic meter
MERCOSUR	Southern Cone Common Market (from Spanish)

MIT	Massachusetts Institute of Technology
N/A	Not available
NBER	National Bureau of Economic Research
NLS	Non-Linear Least Squares
No.	Number
NWFP/NWFPs	Non-Wood Forest Product(s)
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
OY	Limited Company
p. / pp.	Page(s)
PPP	Purchasing Power Parity
PTT	Pellervo Economic Research (from Finnish)
R^2	R-square
SAFTA	South Asia Free Trade Agreement
SACU	South African Customs Union
SCVD	Special Countervailing Duty
SEIDI	Stora Enso Inpac Delta India
SIC	Schwartz Information Criteria
TLF	Total Labor Force
UCSD	University of California, San Diego
UK	United Kingdom
UN Comtrade	United Nations Commodity Trade Statistics Database
UNCTAD	United Nations Conference on Trade and Development
UNECE	United Nations Economic Commission for Europe
UPM	United Paper Mills
US	United States
USD	US Dollar
USDA	United States Department of Agriculture
WWF	World Wide Fund for Nature

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1 INTRODUCTION

Through globalization, wood and wood products are traded by regions and all around the world. Thus, only the most competitive countries are able to invest or attract investors that could increase the production and improve the processing methods of their wood-based industries for commercialization of wood and wood products. According to Bartosh (2007), today India is the second fastest growing economy in the world, with a high rate of gross domestic product (GDP) obtained in the last two decades due to economic liberalization policies (Ablett et al., 2007). This economic growth improved the spending power in a strong and rising middle-class population and this transition turned India into a potential player in the global economy. However, part of this growth occurs mainly in the service and manufacturing sectors but not in the forest industry.

Today, India is one of the largest consumers of wood products in the world (e.g. tropical hardwood sawnwood) and a net importer of forest-based raw materials (e.g. logs) demanded by the local wood-based industries. Its population growth rate and economy development are among the highest in the world just next to China. This change in the Indian economy has attracted the interest of foreign investors to build commercial relationships in terms of wood and wood products in the country.

The rapidly growing demand for sawnwood, used within the construction sector for furniture and wood-based interior applications, has opened a new possible export market for foreign and Finnish wood-based industries that are suffering from tightening competition in markets of solid wood products. Finland for example, which globally is a strong wood manufacturer, has marketed paper products in India through top companies such as UPM and Stora Enso. Moreover, the major exports of forest products from Finland into India are not significant and are represented mainly by paper, softwood sawnwood and pulp for paper. In this context, from a Finnish perspective there is a need for developing opportunities in trade to enlarge and diversify exports to other markets. Therefore, based on India's economic indicators and raw material scarcity, there is a strong possibility for Finland that India could become a potential destination for Finnish wood products.

2 BACKGROUND OF THE STUDY

2.1 Previous Research

One of the reasons for the economic growth in India is the increasing trade in forest products (wood and non-wood) that has supported the rural poor populations that depend on forests economically. Furthermore, India has become a large consumer market for forest industry products due to economic and population growth and increasing urbanization development. There are previous studies conducted in India regarding this matter. This research attempts to increase understanding on the importance of the sawnwood demand in India. For this purpose the previous research study "Status of Forest Products Production and Trade", conducted by Yadav and Basera (2013), is used to assess the situation in the availability, production and trade of forest products in India. In addition, the authors try to explain the production, use and trade of forest products, as well as their role at global, regional and national level. The authors address their study based on a collection of secondary data associated to forest products and wood's availability, production and marketing, among other variables. The study forecasts an accelerating performance in the compound annual growth rate of the Indian forest products industry from 2011 until the end of 2016. Furthermore, the research highlights a demand for imports of logs to meet the requirements of the domestic production of forest products, including sawnwood. A similar data collection process is followed for this study to address the state of India's general economic development.

The purpose of this study is to describe the Indian market for wood products and provide relevant information for foreign and Finnish wood-based industries interested in exploring the Indian market. Because of that, this study takes into account diverse research conducted by two major players in the global sawnwood market, such as British Columbia (Rattan 1999, Agarwal and Shang 2004) and the United States (Ganguli and Eastin 2007). On one hand, from the British Columbian side, Rattan (1999), explored the Indian sawnwood and wood products industry with the intention of finding a potential opportunity for British Columbian sawnwood and wood products exports to the Indian market. The study concluded that in India there

is a lack of knowledge mainly for softwood sawnwood and wood products. At the same time that a growing demand for finished wood products in the market exists. Whereas for Agarwal and Shang (2004), the focus of the study was to present valuable information to major Canadian softwood sawnwood producers interested in entering the Indian market. The study revealed a great potential for good quality softwood due to depleting supplies and therefore, high prices for high quality hardwood in the Indian domestic market. Additionally, there is a stiff competition for low priced softwood from countries other than Canada. On the other hand, a study conducted by Ganguli and Eastin (2007), presented an overview of the Indian market for American wood products. The study confirmed less consumption of teak in India due to its high price and low quality of imports, as well as a major tending towards more use of high-end furniture. The authors also confirm that India should aim to become more open to the use of value-added wood products such as sawnwood by accelerating the rationalization of import tariffs in order to avoid protecting local manufacturers through non-tariff barriers. Thus, these studies aim to find opportunities to enter the Indian wood market.

The background information of these previous studies is used to evaluate the data collected and consequently, analyze the factors that affect the Indian imports of sawnwood. With this information is possible to deduce the prospects and challenges that the foreign and Finnish wood-based industries have to face in order to enter the Indian market. Additionally, this study uses a statistical model to analyze India's sawnwood market. The model is based on previous empirical research studies based on sawnwood market modeling. Thus, the methodology used to determine the facts that have an impact on the imports of sawnwood in India broadly follows Wan et al. (2011) analysis of China's plywood market and Hurmekoski et al. (2015) analysis on factors affecting sawnwood consumption in Europe. On one hand, in the first approach, Wan's econometric analysis uses time series data and is based on the idea often applied to the analyses for the demand of forests products, where demand is modelled as consumer demand (e.g. Buongiorno 1979) or thereafter most often as derived demand (e.g. Chou and Buongiorno 1982, Hetemäki et al. 2004, Hänninen et al. 2007a). Wan explains the apparent consumption of plywood by using two variables. For the purpose of this study, such variables are the Indian consumer

income and the real price of the forest product. On the other hand, Hurmekoski et al. (2015), based on an econometric analysis and panel data of different countries, assesses whether the conventional demand model and common variables considered as potential factors affecting sawnwood consumption patterns, are able to explain the level and growth rate of the sawnwood consumption or thereafter as apparent sawnwood consumption per capita. In addition to this, Hurmekoski et al. (2015) convert all the common variables into per capita variables. Thus, the common variables, such as price and income, are part of the conventional model of the study and have been broadly validated in previous empirical research to estimate the demand of the forest sector (e.g. Simangunsong and Buongiorno 2001).

For the purpose of this study, the import variable is used instead of the consumption variable because of the uncertainties in statistical data. In their intention to explore further potential factors of sawnwood consumption, the authors experimented with other variables that, based on economic activity, can replace or complement the variables used in the conventional model. Hence, in this study, some of these independent variables such as import price of plywood, import price of Portland cement, population density, unemployment and economic openness are used to support the understanding of the common factors affecting sawnwood demand in the Indian market.

2.2 Overview of the Global Market of Sawnwood

According to data collected from FAOSTAT (see Table 10 and 11 in Annex 1), during 2013 the total global production of sawnwood (hardwood and softwood), reached nearly 421 million m^3, which was around 18 per cent higher than experienced in 2009, the lowest production in almost 25 years and caused by the recent global economic recession. Moreover, in 2013 the total global consumption of sawnwood reached about 418 million m^3, of which only around 29 per cent comes from hardwood species (see Fig. A based on Table 12 in Annex 1). (All the consumption quantities presented in this study are calculated as apparent consumption due to the unavailability of observed consumption figures). Thus, comparing both groups of species, hardwood and softwood, the total global

consumption of softwood sawnwood declined more drastically and for a longer period of time than the consumption of hardwood sawnwood. The reason was due to a decline in the European and North American global market share of softwood sawnwood. On one hand, for the consumption of softwood sawnwood, the decline that started in 2006 (the highest peak) and ended in 2009 was a bit more than 25 per cent. On the other hand, the decline in the consumption of hardwood sawnwood was nearly 20 per cent and started in 2007 and ended two years later, in 2009.

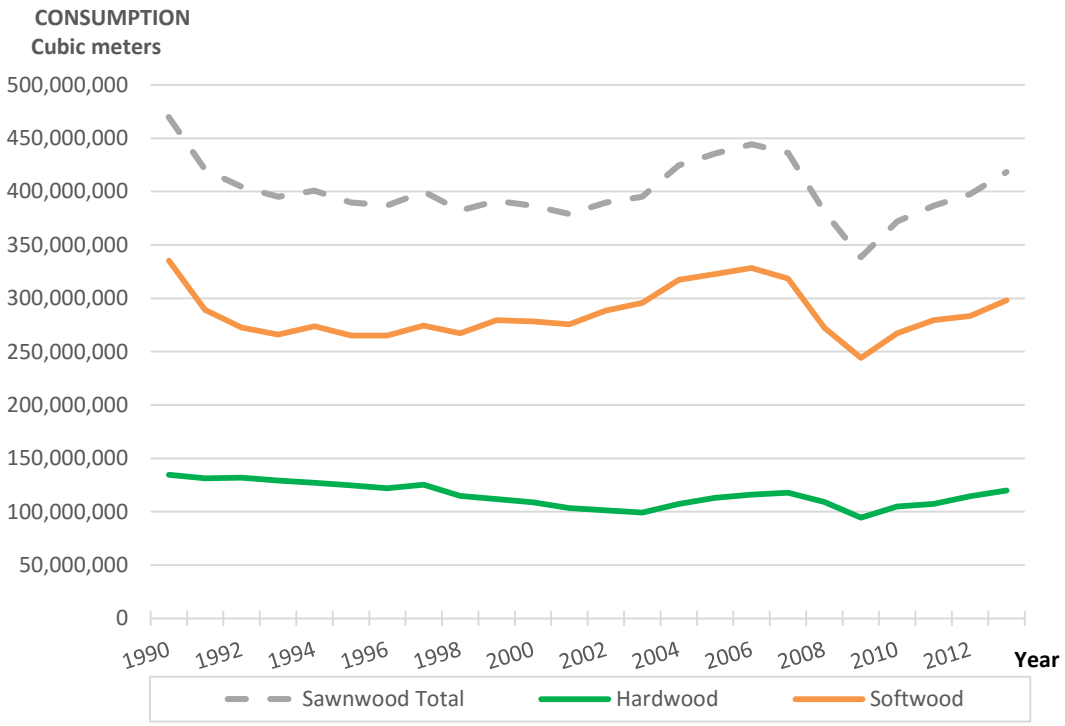

Figure A: Global consumption of hardwood and softwood sawnwood (m3), 1990-2013. Data: FAOSTAT 2014.

In both groups of species, hardwood and softwood, it was mainly the influence of major consumers of sawnwood such as Europe and North America, that caused the decline trend. In this way, while in 2009, North America consumed close to half of its consumption of sawnwood reported in 2005, Europe in 2009, consumed 25 per cent less than its consumption of sawnwood reported in 2007. Contrary to what happened in North America and Europe, it was during the period of 2009 to 2013 when the Asian region increased its participation in the global consumption of sawnwood by 33 per cent. Meanwhile the Latin American and Caribbean (LAC) region remained steady. One of the reasons that explains the rise in the consumption of sawnwood in the Asian region is the increment of imports and production in Asian

countries, but above all in China. For instance, in 2011, China surpassed Canada's production of sawnwood and has ranked second in the list of the largest producers of sawnwood in the world, and, as if this were not enough, during the same year, China became the largest importer of sawnwood by overtaking the United States (FAO 2012). Currently, the total global consumption of sawnwood has been recovering gradually for both species groups since 2010 (see Fig. B based on data extracted from Table 13 in Annex 1).

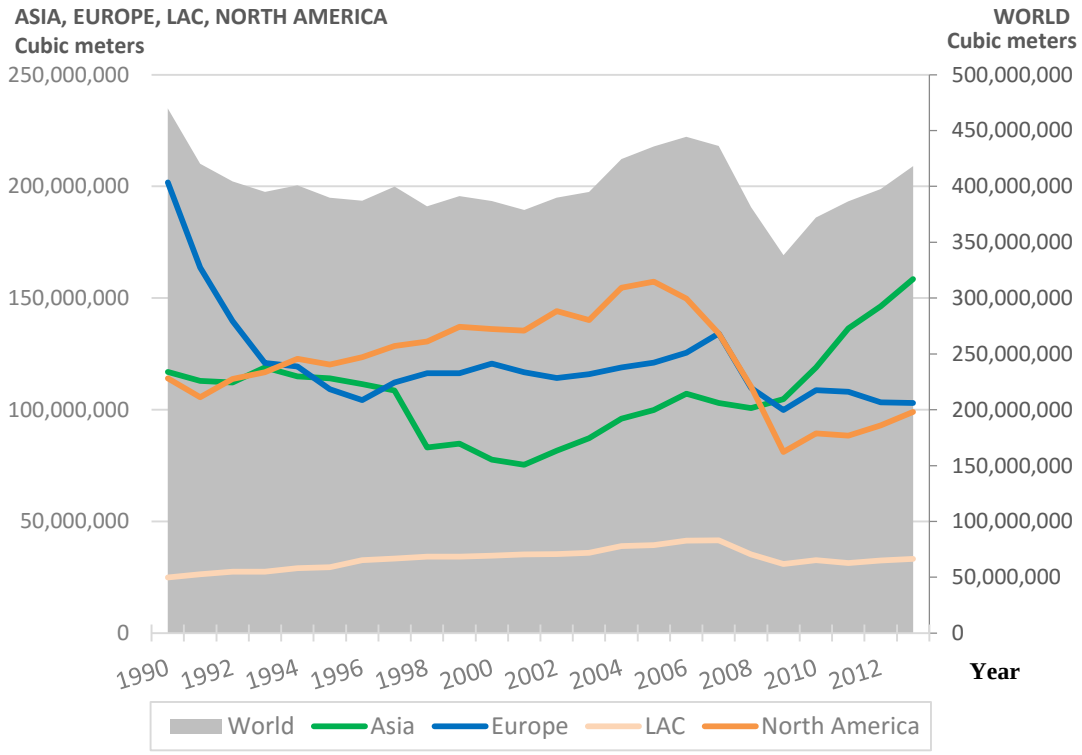

Figure B: Consumption of hardwood and softwood sawnwood by regions (m^3), 1990-2013.
Data: FAOSTAT 2014.
Note: LAC= Latin America and Caribbean.

2.3 India's situation in the Global Market of Sawnwood

Despite India satisfies its local demand of wood through imports of logs, the use of sawnwood is considered as an alternative for some wood-based industries that require small volumes of this forest product. As such, considering the entire wood market in India, the segment of sawnwood is still small and it is mainly supplied by tropical hardwood species and by a minor percentage of softwood species. According to Pandey and Rangaraju (2008), in India nearly 80 per cent of the wood of tropical hardwood species is transformed into sawnwood in comparison to 20 per cent that

correspond from softwood species. Nevertheless, it is important to indicate that no other hardwood species are reported as part of the Indian production of sawnwood. On the contrary, in 2013, the Indian production of softwood sawnwood was reported on 2 million m^3 (see Table 14 in Annex 1). This amount is insignificant if it is compared to the amount produced by the United States, which is about 50 million m^3. The United States is so far the largest producer of softwood sawnwood in the world with a global share of more than 20 per cent.

Thus, in terms of production of sawnwood, India is known as part of the top five tropical hardwood sawnwood producing countries in the world (Clark 2011). Along with Brazil, Indonesia, Malaysia and Vietnam, (see Fig. C based on data extracted from Table 15 in Annex 1), in 2013, these countries accounted for nearly 70 per cent of the global share of tropical hardwood sawnwood production. Meanwhile India, together with the other Asia-Pacific countries accounted for around 36 per cent of the global production of tropical hardwood sawnwood and alone its share is about 10 per cent (4.8 million m^3). This amount of production of tropical hardwood sawnwood has been stable in India since 2008 and places the country in the third rank globally just behind Brazil and Vietnam (16 and 6 million m^3, respectively).

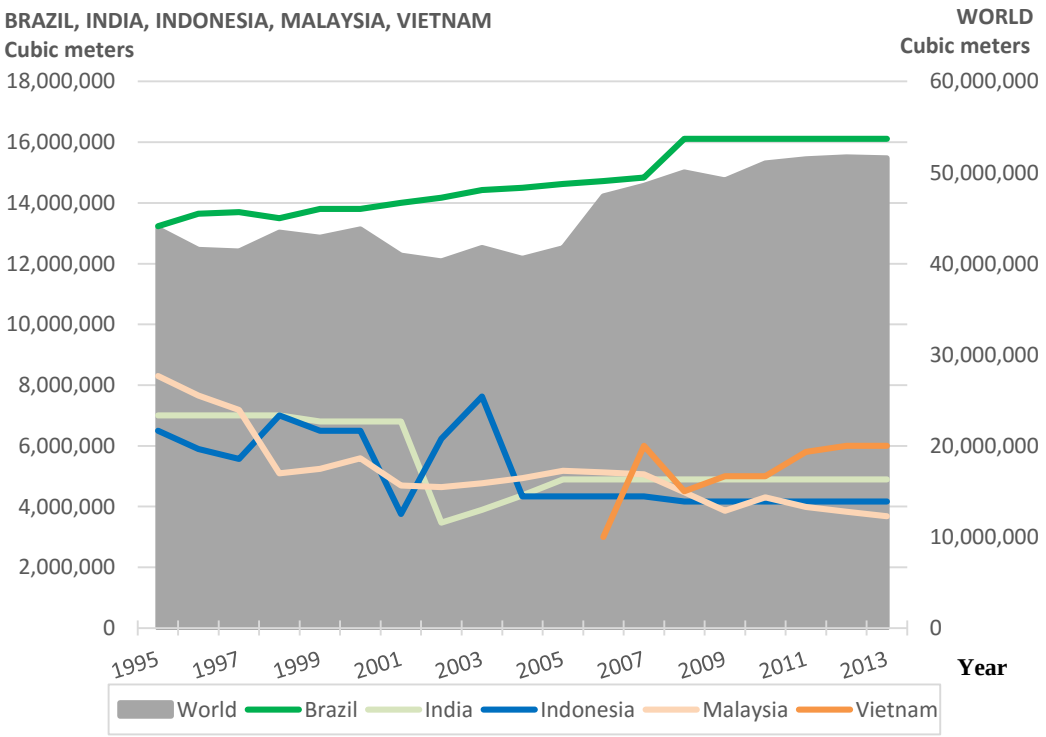

Figure C: Major tropical hardwood sawnwood producers (m^3), 1995-2013.
Data: ITTO 2014.

India produces sawnwood and also consumes it locally. Pandey and Rangaraju (2008) estimate that the share of sawnwood consumed in Indian local industries such as construction for housing is about 70 per cent, while commercial packaging and furniture industries account for 6 and 7 per cent, respectively. However, local end users prefer the use of tropical hardwood species instead of other hardwood and softwood species, meaning that both production and consumption of tropical hardwood sawnwood are in balance (around 4.8 million m^3 per sector). Consequently, India is part of the top five consuming countries in the world (see Fig. D based on data extracted from Table 16 in Annex 1). In 2013, the five countries altogether accounted for more than 70 per cent of the global consumption of tropical hardwood sawnwood. Meanwhile, the share of the Asia-Pacific countries (China, India, Indonesia and Vietnam) is above 40 per cent. In the case of India, with a total consumption of nearly 5 million m^3, the country globally ranked 4th just behind Brazil, China and Vietnam (15.6, 6.5 and 6.2 million m^3 respectively). Moreover, this amount represents nearly 10 per cent of the total consumption of tropical hardwood sawnwood in the world and has remained relatively stable since 2005.

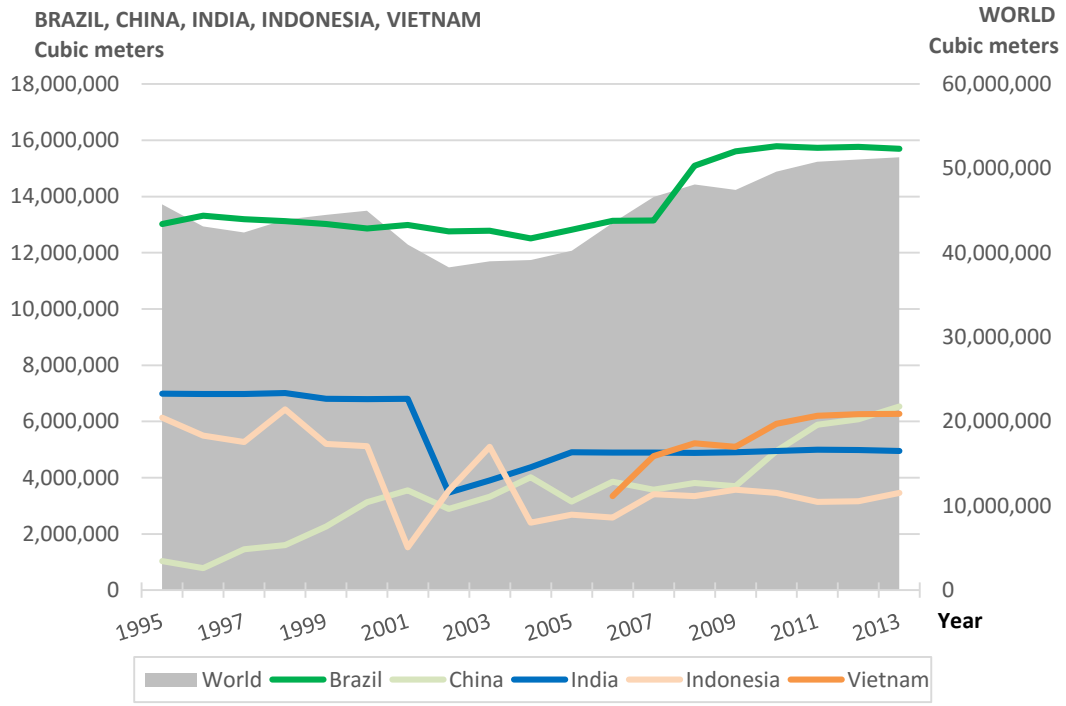

Figure D: Major tropical hardwood sawnwood consumers (m^3), 1995-2013.
Data: ITTO 2014.

With respect to wood species, a little more than half of the sawnwood consumed in India comes from tropical hardwood species. However, there is also a small consumption of sawnwood from other hardwood species (128 thousand m^3), which are mainly supplied by imports into the country. This small amount is insignificant when is compared to the 33 million m^3 of China on a global level. China is the largest consumer country of other hardwood sawnwood in the world with a global share of 55 per cent (see Table 17 in Annex 1). Thus, instead of other hardwood species, end users prefer to consume more softwood sawnwood (about 2 million m^3). At global level, this amount remains small when is compared to the total consumption of softwood sawnwood of the two largest consuming countries in the world, as they are the United States and China (62 and 39 million m^3 respectively) (see Table 18 in Annex 1). Therefore, in terms of consumption of wood species, the country can still be considered immature.

Finally, regarding imports of sawnwood into India, the total amount imported is around half a million m^3. In terms of wood species, the scenario is different when compared to production and consumption of sawnwood. Imports of softwood sawnwood (277 thousand m^3), represents 51 per cent of the total imports of sawnwood in the country. The rest relates to hardwood species, where from this total, coincidentally 51 per cent is due to tropical hardwood species (139 thousand m^3). However, these amounts of imports of sawnwood, independently the type of wood species, are insignificant when compared to the largest importer country of sawnwood worldwide. So far, China widely dominates the global imports of sawnwood including softwood, tropical hardwood and other hardwood species with global shares of 21, 48 and 31 per cent respectively. Thus, considering the importance of tropical hardwood species in India, at global level Indian imports of tropical hardwood sawnwood are even far from the top 10 of major importer countries, ranking 14th in 2013 (see Fig. E based on data extracted from Table 19 in Annex 1). Nevertheless the amount of sawnwood imported for these particular wood species has been rising since 2009, showing also the same trend for softwood and other hardwood species (see Tables 20 and 21, respectively, in Annex 1).

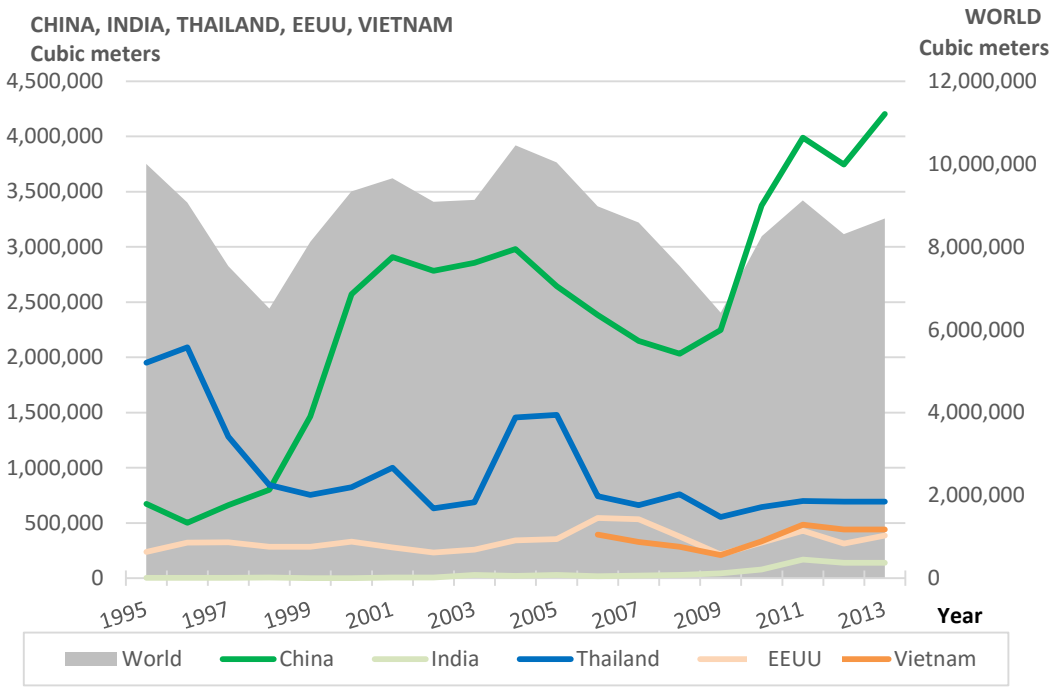

Figure E: India and major tropical hardwood sawnwood importers (m^3), 1995-2013.
Data: ITTO 2014.

3 MOTIVATION AND PURPOSE OF THE STUDY

3.1 Motivation of the Study

Today, India is, along with China, one of the largest economies in the world. Due to open economy policies in India since the last decade, the country has been facing changes in its economy, such as continued, fast growing and more macroeconomic stability. This economic liberalization has contributed to raise the trade value in both imports and exports. It is a fact that the country will continue implementing the same economic strategy in order to generate employment and incomes. Because of this, in terms of wood, India has become an important player in the Asian-Pacific Region market and an interesting target for major wood-based companies around the world as an expanding market for their products. Moreover, India as a country faces some challenges that are obstacles for a persistent high level of economic growth. These are poor infrastructure, quality services and restrictive labor laws. Furthermore, wood-based industries are challenged by the raw material availability, which is

counteracted mainly by private forest plantations established for that purpose. This results in the role of imports of unprocessed wood that has become essential for the wood-based industry. Therefore, considering the potential of India's wood market in the long-term basis, the main motivation of this study is to make a description of the demand of the Indian wood products markets focusing on sawnwood. Thus, through exploring and analyzing the Indian market demand for wood and primary wood products, provide a better understanding on the facts that impact the consumption and imports of sawnwood in India as well as the influence of Indian's wood products market globally.

At domestic level, India has a large trade of forest products and wood but the market is still not regulated. Thus, the role of the forestry sector in the local gross domestic product (GDP) is unknown because insufficient data. In addition to this, the market information published in India is relatively scarce due to there is not an appropriate market information system and consequently portions of time-series data are missing and are unreliable. For these reasons, another motivation for the study is to contribute to the enrichment of available sources about the Indian wood market based on sawnwood. In such case, those major foreign and Finnish wood-based industries searching for information on possible market opportunities and challenges for new export businesses outside their frontiers will be benefited through the relevant results provided by this study.

3.2 Purpose of the Study

The scope of the study is to explore and create a general description about the market environment of sawnwood in India between 1992 and 2013. This report analyzes and provides quantitative estimates of the background macro-information on the facts that impact the consumption and imports of sawnwood in India. The study models sawnwood as a total, including softwood (coniferous) and hardwood (non-coniferous) species according to the possibilities related to the data availability. Moreover, the study aims to provide relevant information to major foreign and Finnish wood-based industry producers of wood products that are searching for information on possible market prospects and challenges for new export businesses

outside their frontiers. Furthermore, this research provides an appropriate platform for enhanced future studies.

In order to reach the aim of the study, a collection of annual time-series data starting from 1992, where possible, is used for the analysis. Notwithstanding time-series are missing and unreliable, most of the information regarding Indian wood market is scarce. Therefore, the purpose of this research is to fill this gap and increase the understanding on the Indian wood and primary wood product markets.

Considering the aim of the study, there are four research questions to be answered:

1. What is the current state of India's general economic development and possible future prospects?

2. What is the current state of India's woodworking sector markets especially focusing on sawnwood and how is going to be in the future?

3. What are the market opportunities and challenges that the Indian wood product market features for foreign and Finnish wood-based industry companies and shareholders?

4. What factors explain sawnwood demand in India?

3.3 Structure of the Study

The study is structured in four different sections:

1. The first section is a background of the study. This chapter starts with a review of previous research studies regarding the Indian market of sawnwood. Thus, the theoretical bases on the methods used in these previous studies are discussed as well as a summary of their findings is included. This section also provides a general overview of current information surrounding

the global market of sawnwood as well as brief description of the Indian situation in the global market of sawnwood. In addition, the important factors that influence the trade and demand for sawnwood in the Indian market are summarized. Therefore, the purpose of the background study is to serve as a base for the formulation of the research questions that are going to prove the relevance of the study.

2. Following the background of the study, the second section is focused on the motivation and purpose of the study. The motivation of the study is defined and analyzed. Moreover, this section comprises the purpose of the study that also refers to the research questions that will be analyzed. Consequently, the answers obtained for all the research questions will be presented in the last section of the study that corresponds to the results, discussion and conclusions of the study.

3. The third section contains the theoretical framework of the study and empirical modeling as well as the data and data analysis of the study. On one hand, the theoretical part provides to the reader a broad range of information about theories and statistical models that are used as a background to facilitate the interpretation of the research. Such information is based on literature review of scientific articles as well as previous studies and publications. On the other hand, the framework aims to connect the relationship between theories and the statistical analysis of the study. Regarding the data and statistical analysis of the study, they are basically explained by the theoretical framework and the empirical modeling. The analysis of the data is based exclusively on secondary data collected from a wide range of sources, which include qualitative and quantitative research. Thus, the analysis of the data collected will be based on a descriptive analysis and an empirical data analysis. Hence, the best methodology will be used according to the aim and data characteristics.

4. Finally, the last section encompasses the results obtained from the previous section. The main findings will be summarized and discussed as a deeper

insight of the research. At this phase of the study, the discussion and interpretation of the results will facilitate the conclusions that will answer the research questions that refer to the research problem as well as to determine the possible opportunities and challenges that the Finnish and foreign companies should face in order to participate in the Indian market of wood products.

4 THEORETICAL FRAMEWORK OF THE STUDY AND EMPIRICAL MODELING

4.1 Theoretical Framework of the Study

The aim of the study is to determine the potential drivers that have an impact in the Indian demand for sawnwood. The purpose of the theoretical framework is to define the range of significant data that based on certain variables will be analyzed and interpreted in the study. Also, the theoretical framework is used as a guidance for the empirical phase of the study that later will facilitate new knowledge. Therefore, for the purpose of this study, the use of econometrics is considered since it integrates economics, mathematics and statistics that will provide numerical estimates from different factors of the economic relationships that are based on economic theory.

The framework of the study is basically carried out in one phase and based on one empirical model (see Fig. F). For the empirical analysis of the study, an existing econometric model structure developed in earlier empirical research (Buongiorno 1979, Wan et al. 2011, Kayacan et al. 2013) is used with the purpose of determine the feasibility in the interaction between the conventional demand model and the variables, dependent and independent, that are considered to impact the Indian imports of sawnwood. This econometric model bases the imports of sawnwood as its dependent variable. In addition, following the economic theory, the dependent variable is related to the consumer income and product price. Since the study addresses imports of sawnwood, some other variables presented in previous literature are also tested (McKillop 1967, Buongiorno 1979, Hurmekoski et al. 2015). For the

modelling purpose of this study consumer income is described by gross domestic product per capita and product price by import price of sawnwood. The other variables tested are population density, unemployment, economic openness and import prices of Plywood and Portland cement. All the import product prices are described by import unit values.

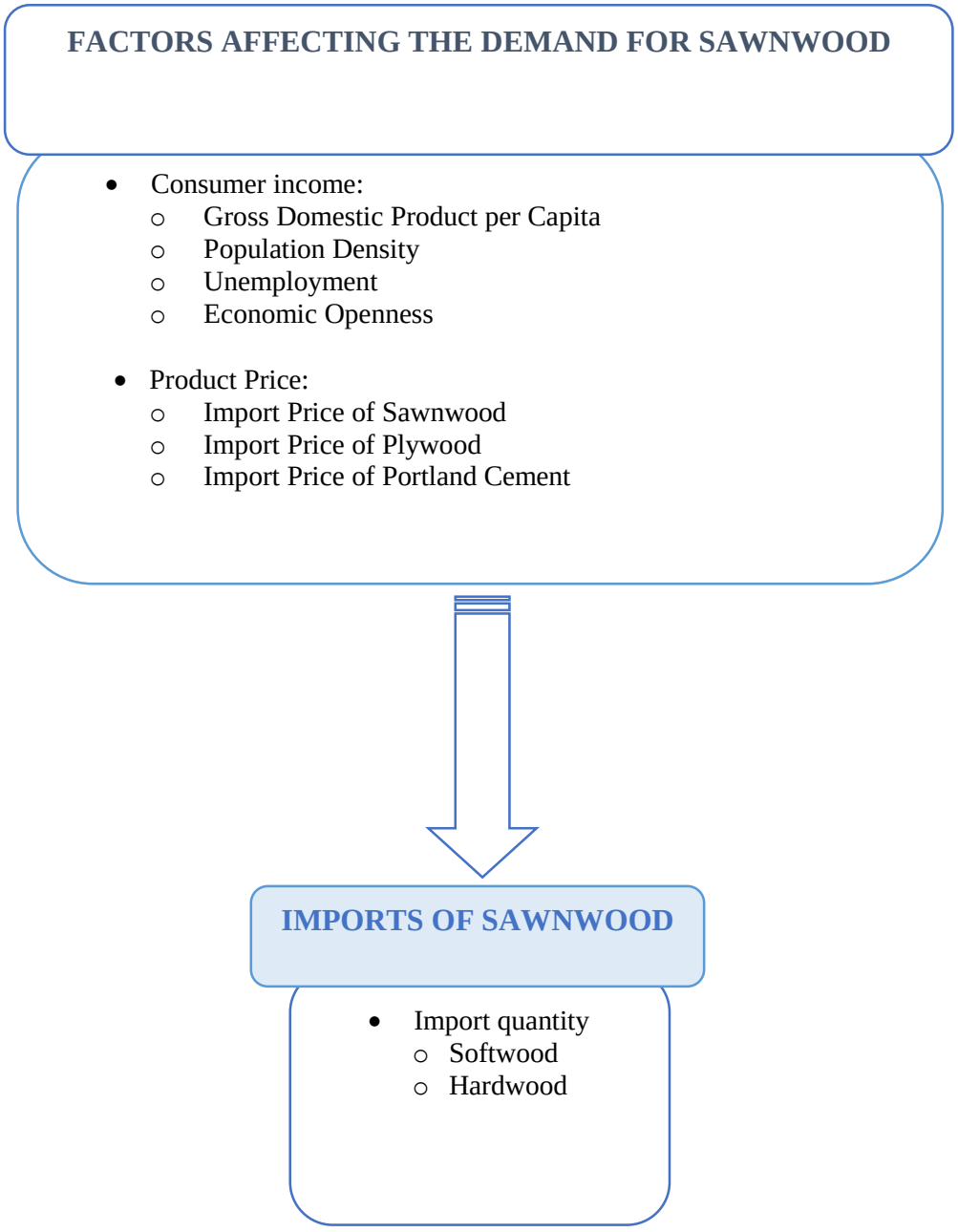

Figure F: Framework of the Study.

4.2 Theoretical and Empirical Modeling

In this study, the use of econometrics concerns to the analysis of a collection of numerical data that support the development of a market model. The use of econometrics provides empirical content to economic theories through the application of mathematics and statistics when analyzing economic data. (Gujarati 2003). Among all the market forces that govern the economic theory, the law of supply and demand is considered as the backbone where other economic theories and models are founded. It is in market economy theories where resources are allocated efficiently due to the relationship between demand and supply. The concept of supply refers to the quantity of certain good that producers can produce and supply at a certain market price. Meanwhile, demand represents the quantity of goods that consumers desire to buy at a certain price. Consequently, both concepts are relate to price (for a certain commodity or other commodities), products availability and consumer's income or desire to acquire the product. (Koutsoyiannis 1977, O'Connor and Faille 2000).

4.3 Indian Sawnwood Demand Model

According to Buongiorno et al. (1979), it is possible to model the demand for forest industry products as consumer demand. Then, on this basis, modeling demand is generally based on the derived demand approach (Chou and Buongiorno 1982, Buongiorno 1996, Chas-Amil and Buongiorno 2000, Buongiorno et al. 2003, Hetemäki et al. 2004, Hänninen et al. 2007a). For the purpose of this study, the demand is modeled as import demand.

In terms of this study, the time-series model will provide information concerning numerical values of variables from period to period (Koutsoyiannis 1977), i.e. the model is used to understand the common determinants of Indian imports of sawnwood. Moreover, the demand model based on a pure time-series data analysis considers yearly records from India covering a period from 1992 to 2013. However, the analysis of time-series data models has some disadvantages. For instance, time-

series data models are not always stationary and when observations are over long time periods, these are not easy to achieve and there is regularly a very little variability in the data. Additionally, there may be high collinearity among explanatory variables, which is not possible to assess throughout periods of consistent economic growth than can carry out complications in accurately estimating structural coefficients. (Buongiorno 1979). In the present study one source of uncertainty is also quite short observation period of annual data.

Consequently, the study uses as the basic demand equation the classic double-logarithmic formula for the general time-series model (Buongiorno 1979):

$$\log IMPt = a + b \log GDPCt + c \log DPSt + ut \qquad \text{(Eq. 4.2.1.A)}$$
$$\qquad\qquad\qquad\qquad\qquad\quad + \qquad\qquad - \qquad\qquad$$

where *IMPt* is the Indian import of sawnwood in year *t*; then, *GDPCt* is India's gross domestic product per capita in year *t*; *DPS* is the unit price of Indian sawnwood imports in year *t*; and finally, *ut* is an error term. In addition to this, the coefficient *a* is the constant term, *b* is the income elasticity of demand and *c* is the price elasticity of demand. This model is considered static due to there is no explicitly in the formulation (Labys 1973). Note that the symbols below the coefficients (+,-) indicate the expected signs of the estimated coefficients (+ for positive and – for negative). Thus, following the economic theory, it can be deduced that Indian imports of sawnwood are influenced positively by an increment in Indian consumer income, while the imports of sawnwood in India declines when there is an increment in the import price of Indian sawnwood.

According to Klemperer (2003), consumption models for forest products are based on the concept of derived demand, which is commonly linked to factors of economic activity such as price and income. In this study is considered to define the model of imports that will serve as baseline of the econometric analysis as:

$$IMP = f(GDPC, DPS) \qquad \text{(Eq. 4.2.1.B)}$$

where *GDPC* is the gross domestic product per capita and *DPS* is the import price of sawnwood. This per capita scale for the GDP normalizes the data in terms of the size of the market (Kangas and Baudin 2003, Hurmekoski et al. 2015).

However, when addressing sawnwood demand, some literature such as Kangas and Baudin (2003), Klemperer (2003), Virtanen (2005) and Hänninen et al. (2007b) propose different potential factors that also can be used to determine imports. As such, Hurmekoski et al. (2015), after experimented with a large number of potential variables determining demand, suggests that variables such as income and price can be replaced by or complemented with comparable variables that represent economic activity. Consequently, the explanatory variables that are considered for the analysis of the empirical model are defined in the general form ad hoc model following (Hurmekoski et al. 2015):

IMP = f(GDPC, UE, EO, POPD, DPS, DPP, DPPC) (**Eq. 4.2.1.C**)

where *GDPC* is Gross Domestic Product per Capita; *UE* is Unemployment; *EO* is Economic Openness; *POPD* is Population Density; *DPS* is Import Price of Sawnwood; *DPP* is Import Price of Plywood (substitute); and *DPPC* is Import Price of Portland Cement (component product) (Virtanen 2005, Hurmekoski et al. 2015).

5 DATA AND DATA ANALYSIS OF THE STUDY

5.1 Data of the Study

This study focuses on the Indian sawnwood demand sector (softwood and hardwood), due to its importance as a possible market prospect for Finnish and foreign wood-based industry producers of wood and sawnwood products. For this purpose, the entire data collected is secondary and has been compiled from different sources such as scientific journals, consulting analysis and reports, news, among others, and is used as a base to analyze the Indian market. For the empirical analysis and hypothesis testing, annual time-series data has been collected to be used as a set

of variables for the econometric model (Table 1 shows the variables used in the empirical analysis by unit data). The data is mainly gathered from international sources with the only intention to avoid incongruity and differences between national and international sources. In addition to this, at national level most of the variables might not exists as published statistics due to the lack of an efficient data collection system in India. Thus, macroeconomic statistics such as population density, unemployment, economic openness and GDP per capita were obtained from the World Bank Development Indicator Database (2013); forest and forest products statistics were collected from the Food and Agriculture Organization of the United Nations Statistical Database (FAOSTAT); and other variables statistics used as complemented products were obtained from the United Nations Commodity Trade Statistics Database (UN Comtrade). The data collected is assumed to be the most accurate available and it is presented in Annex 2 as Table 22 and 23.

Table 1: Variables used in the empirical analysis.

ID	VARIABLE	UNIT	DATA SOURCE	H_0	r
IMP	Indian Imports of Sawnwood	m^3	FAOSTAT, UN		
GDPC	Indian Gross Domestic Product per Capita	USD	World Bank	+	0.87
DPS	Indian Import Price of Sawnwood	USD/m^3	FAOSTAT, UN	-	-0.01
UE	Indian Unemployment	% of TLF	World Bank	-	-0.69
EO	Indian Economic Openness	% (trade of GDP)	World Bank	+	0.79
POPD	Indian Population Density	inh/km^2	World Bank	-	0.76
DPP	Indian Import Price of Plywood	USD/m^3	FAOSTAT, UN	+	0.25
DPPC	Indian Import Price of Portland Cement	USD/kg	Comtrade, UN	-	-0.39

H_0: Hypothesis for the sign of the correlation between IMP and the variable based on consumer theory.
r: Pearson correlation coefficient.

5.2 Data Analysis of the Study

Different methods were used for the analysis of the data collected. A descriptive method is used to analyze the data for background information and for global and local markets. Then, the empirical modeling is assessed by using the statistical software Econometric Views (EViews). The main purpose is to evaluate how a variable is affected by the changes in one or more variables. Thus, an empirical regression modeling is used to analyze the relationships between dependent and independent variables within the statistical model. Hence, a dependent variable is

explained by independent or explanatory variables. In terms of regression, dependent variables are considered as random variables while, on the contrary, independent variables are considered as non-random variables. For statistical interpretation purposes, the empirical regression modeling is used for testing hypothesis about the model as well as to predict the dependent variable based on the new values of the independent variables. Furthermore, it is important to identify the distribution of the dependent variable. In this way, in regression modeling, a function describes how related is the dependent variable to the independent variable and a term models the random variation in the dependent variable. A straight-line is the most common function in regression and is known as linear regression modeling. Therefore, for the purpose of this study and considering Hurmekoski et al. (2015) previous analysis on the relationships of the explanatory variables, a linear regression modeling is used to explain the collinear relationship between a dependent variable and independent variables (Larsen 2008).

In order to understand the forces that have an impact on the demand of forest products, previous studies on forest products market modelling (McKillop 1967, Buongiorno 1979, Kayacan et al. 2013) have used empirical models depending of the data facilitated. That is how time-series data models, based on yearly or quarterly variations of significant variables from the region studied, have explored the feasibility in estimating income and price elasticities of demand for forest products (Buongiorno 1979). In this study, the general time-series model is used to define the elasticities of Indian imports of sawnwood -IMP-. Hence, for this purpose annual data over the period of 1992 to 2013, which corresponds to variables related to the Indian consumer income and the import price of sawnwood to India, is used to explain IMP. Furthermore, the domestic demand of sawnwood in India is represented as the total quantity demanded of imports of sawnwood, which include the total imports of softwood and hardwood.

Table 2 describes the objects and methods of analysis for this study. Thus, a descriptive analysis method, based on charts (line, area and pie), summary data tables and numbers, is used to describe an overview of the Indian market of wood products in order to determine the demand of sawnwood in India. Then, the inferential

statistical analysis used for the Indian sawnwood demand modeling is the regression analysis method (OLS), including Breusch-Godfrey (BG) serial correlation Lagrange Multiplier (LM) test, Jarque-Bera (JB) Histogram-Normality test, Heteroskedasticity test, Augmented Dickey-Fuller (ADF) unit root test and Johansen Cointegration test.

Table 2: Objects and methods of analysis for the Study.

OBJECT OF ANALYSIS	METHOD OF ANALYSIS
Overview of global markets of sawnwood • Consumption of sawnwood	**Descriptive Statistical Analysis** • Charts • Summary Data Tables • Numbers
Indian sawnwood in the global market • Production of sawnwood • Demand of sawnwood • Consumption of sawnwood	
Indian sawnwood demand modeling	**Inferential Statistical Analysis** • Regression Analysis • BG serial correlation LM test • JB Histogram-Normality test • Heteroscedasticity test • ADF unit root test • MacKinnon critical values • Johansen Cointegration test
Ad hoc models	**Inferential Statistical Analysis** • Regression Analysis • BG serial correlation LM test • JB Histogram-Normality test • Heteroscedasticity test • ADF unit root test

Regarding the analysis methods, the Breusch-Godfrey (BG) Lagrange Multiplier (LM) test developed by Breusch (1978) and Godfrey (1978), is used to assess the presence of serial correlation beyond the first order, and is valid when lagged dependent variables exist in the regressors. This test is more wide-ranging compared to the standard Durbin-Watson (DW) statistic due to unlike DW, this test can be used for general hypotheses concerning serial correlations in the errors, takes into account higher orders of serial correlation and avoids presenting inconclusive results. A serial correlation occurs when an ordinary least square is no longer an efficient linear estimator and when the standard errors are incorrect. (Asteriou and Hall 2007). Furthermore, a serial correlation exists when the residual or the dependent variable show correlation with its values in past periods (Mittelhammer et al. 2000). The problem affects statistical inferences due to standard errors are not consistent. Thus, the null hypothesis of the BG test is that there is no serial correlation up to the

specified number of lags (Godfrey 1991). Moreover, the BG test is able to regress the residuals on the original regressors and lagged residuals up to the specified lag order (Godfrey 1988). Then, the Obs*R-squared statistic is the BG serial correlation LM test that in the regression test is calculated as the number of observations multiplied by R^2. The LM test statistic is, under general conditions, asymptotically distributed under the null hypothesis as χ^2 (p), where p is equal to 1 degrees of freedom. Therefore, in order to reject the null hypothesis of no serial correlation, then the p value of F-statistic should be smaller than the significance level tested (Asteriou and Hall 2007).

Parametric statistics methods are used with data that is measurable on ratio scales or intervals. Thus, the Jarque-Bera test (JB) is recommended to use before applying methods that require distribution normality. The JB test is used when is necessary to test if the errors of the regression model are normally distributed (Bera and Jarque 1982), or to test a null hypothesis where each variable is assumed to have a normal distribution (Jarque and Bera 1987). This is due to JB test is based on comparing how far the sample skewness and sample kurtosis measures diverge from values characteristics of the normal distribution (Domański 2010). Therefore, when applying the JB test, the residuals can be considered normally distributed if the p value is greater than the 5 per cent level of significance. For this reason, a measure of deviation from a normal distribution could be estimated as the absolute value of these parameters.

In regression, one of the main assumptions is that the variance of the errors is constant across observations. On the contrary occurs hereroskedasticity (Bohannon 1988). According to Engle (1982), heteroskedasticity might be a problem in time series data. Etymologically, heteroskedasticity means unequal spread or differing variance. Then, considering that in econometrics variance is commonly used for spread, hence the importance of heteroskedasticity to deal with unequal variances (Asteriou and Hall 2007). For heteroskedasticity tests the null hypothesis is that the variance of the error is constant. Thus, the null hypothesis when there is no heteroskedasticity is rejected if the p value of F-statistic is smaller than the significance level tested. On the contrary, the null hypothesis is accepted.

For econometrics, unit root in time-series samples is widely tested by the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller 1979). This practical method is used to evaluate if the form of the data-generating process contains a unit root or to determine the number of unit roots that are present in the series (Asteriou and Hall 2007). A unit root confirm that the time-series is non-stationary. On the contrary, without unit roots the residuals are stationary and the variables are cointegrated. (Pupongsak 2010). In such cases, the ADF test is commonly used when is necessary to difference time-series data in order to make it stationary.

According to the ADF test, is possible to obtain the first or second difference when the level is non-stationary. Moreover, the main reason for applying the ADF test is to exclude autocorrelation by including extra lagged terms of the dependent variable. (Seddighi 2013). In the test regression, the ADF test can be implemented by adding a constant, a constant and linear trend, or neither of them (Asteriou and Hall 2007), but not only a trend. In cases when only the trend is significant then a constant and linear trend should be implemented. Also, in the regression is possible to include lagged values of the difference of the variable. (Fu 2012). Another important practical reason for using the ADF test is the specification of the lag length *p*. Thus, when *p* is too small, then the remaining serial correlation in the errors will bias the test. On the contrary, when *p* is too large, then the power of the test will suffer. (Kwiatkowski et al. 1992).

There are different methods to select the number of included lags, which can be determined by the Schwartz Information Criteria (SIC), the Akaike information Criteria (AIC) or the Hannan-Quinn information Criteria (HQC). In terms of this study, AIC is used to estimate the correct lag length considering that the number of observations is less than 60 (Liew 2004). Considering that testing the existence of unit roots in a time-series depends on the existence of deterministic drifts and trend (Campbell and Perron 1991). If the time-series contains a drift or trend, then is possible to test the null hypothesis of a unit root by using a standard normal distribution. The null hypothesis is that the variable contains a unit root, while the alternative hypothesis is that the variable was generated by a stationary process. The null hypothesis of a unit root against the one-sided alternative is rejected if the ADF

statistics is smaller than the critical value (at 5 per cent level) and therefore, the series is stationary (Asteriou and Hall 2007). However, another alternative to reject the null hypothesis of a unit root or cointegration (1 or more than 1 variables, respectively) is by comparing the ADF test result with MacKinnon's response surface estimates of critical values. Such values are related to 1, 5 and 10 per cent significance level. The advantages of MacKinnon's response surface estimates are that accurates asymptotic p-values for any finite sample size (MacKinnon 1996) and allows to tabulate results for any different sample size (MacKinnon 2010).

Cointegration is known as the phenomenon where certain linear combinations of a time-series process are stationary (Granger 1983). Granger also studied the relation between cointegration and error correction model. Thus, empirical cointegration analysis is important to understand economic data. Johansen (1988, 1991) proposed a methodology to test the cointegrating rank or number of cointegrating relationships among the variables. In addition to the cointegrating rank, this approach includes within a relationship other factors such as the number of the non-zero eigenvalues of the matrix and the rank of the matrix. The advantage of using the Johansen test is that if the data set contains more than two time-series, then it enables to estimate more than one cointegration relationship (Johansen 1988). Therefore, the maximum number of cointegrating relationships will be the same number of variables in a model. Also, two cointegrating relationships would determine that the variables do not have unit roots.

Thus, two different likelihood-ratio are proposed, such as the trace test and the maximum eigenvalue test. On one hand, the maximum eigenvalue method examines the null hypothesis of r cointegrating vectors against the alternative hypothesis of (r+ 1) cointegrating vectors. The eigenvalues should be non-negative and real. In more detail, the test using the largest eigenvalue starts with $r = 0$ and an alternative hypothesis where $r = 1$. If the rank of the matrix = 0, so is the largest eigenvalue and therefore, no cointegration and no more tests. If the rank of the matrix is at least one and the largest eigenvalue is non-zero, then there is a possibility of more cointegration relationships. However, when testing the second largest eigenvalue = 0, there is one cointegration relationship and no more tests. But if the second largest

eigenvalue is non-zero and there are more than two variables, then there is a possibility of more cointegration relationships. This procedure continues until is not possible to reject the null hypothesis of an eigenvalue = 0. (Johansen and Juselius 1990). On the other hand, the trace method examines the null hypothesis of *r* cointegrating vectors against the alternative hypothesis of *n* cointegrating vectors. If *r* = 0, it means that there is no relationship among the variables that is stationary. In both statistic tests, the null hypothesis of no cointegration is tests against the alternative of cointegration. The only difference between both tests is in terms of the alternative hypothesis. (Johansen 1991). Finally, the resulting integrated model is estimated based on the normalized cointegrating relationships.

6 RESULTS OF THE STUDY

6.1 Description of the Indian Market

6.1.1 India's development in the global market of wood products

Today, in emerging countries where forests are valuable, forest products and primary wood products contribute to their economies by generating employment and opening new industries based on wood processing products. According to Lebedys (2008), during the period of 1990 to 2006, only India accounted for around 5 per cent of the global employment in the forestry industry. Meanwhile in the same period, India together with China, Canada and the United States accounted for nearly 43 per cent. The aim is to produce value-added wood products from the existing raw materials that later can be traded under the premise of sustainability and legality of the use of forests. Moreover, globalization has changed the structure of the wood-based products industry towards the access to new markets, especially in rapidly developing nations, due to saturation of traditional markets, particularly in North America and Europe (Toppinen et al. 2010).

It is precisely in developing countries with large populations and a constantly growing middle-class segment, where particular sectors of the wood products industry have been increased. In the case of countries of the Asia-Pacific Region, their consumption and production of forest products have increased and globally are becoming important manufacturer countries for wooden furniture as well as major producers and consumers of wood-based panels, paper and paperboard. India is one of these countries and based on a market-oriented economy, today the country is more focused on trade and investments with the rest of the world. At regional level, a major participation of India exists in the production, consumption and trade of wood products in the Asia-Pacific region due to the country has been actively pursuing multilateral, regional and bilateral approaches with different countries. Consequently, India is today part of different free trade agreements (FTA) such as the South Asia Free Trade Agreement (SAFTA), BIMSTEC, ASEAN, MERCOSUR, GCC and SACU, among others (Midgley et al. 2007).

The change in the economy of India also increased the interest of foreign companies to establish operations in the domestic market or build trade relationships related to wood and wood products in the country. Based on the World Bank's "Doing Business 2008" report (2007), today is easier to build businesses with India due to that the current business regulation enables tracking the time and cost of the requirements for business start-up, taxation and closure. Furthermore, it was between the years 2008 and 2010, that countries such as India and China, which are part of the Asia-Pacific Region, were chosen by the United Nations Conference on Trade and Development (UNCTAD) as world's most attractive locations for Foreign Direct Investments (FDIs) (Toppinen et al. 2010). In fact, India's return on investment is considered as one of the highest in the world with 19 per cent. Thus, there are two forms of foreign investments in India, as a direct investment by an entity (FDI) or as a foreign institutional investment (FII). FDIs in India are especially in the paper industry thus, the country is growing rapidly within the global paper industry and accounts around 1.6 per cent of the global production of paper and paperboard, with an annual turnover of USD 6 billion (Manoharan 2013).

In terms of paper industry, despite newspapers are widely whispered to be in crisis, the popularity of newspapers is significant in Asia. Is in this region where the newspaper markets are on the ascent. Thus India, together with China and Japan, has the highest daily newspaper circulations in the world. According to the Indian Paper Manufacturers Association -IPMA- (2014), India accounts for around 1.6 per cent of the global production of paper and paperboard, with an annual turnover of USD 7 billion. Therefore, the country is already considered as one of the fastest growing paper markets worldwide (Manoharan 2011).

India is a country that tends to increase the amount of imports of raw materials, such as logs, in order to satisfy the domestic production of sawnwood and plywood, and to create new opportunities to export wood products. Thus, an important sector within the Indian wood-based industry is the tropical plywood production. Is in this sector where India plays an important role as a major plywood manufacturer country in the world, just behind China, Malaysia and Indonesia. Coincidentally, the top four tropical plywood producer countries together with Japan accounted for 2011 about 74 per cent of total ITTO plywood consumption. (ITTO 2012). In India, the production of plywood depends significantly on imported tropical hardwood logs and it is mainly used locally in the housing and construction sectors. The reason is due to that loan subsidies and taxation incentives are provided by the local government in order to benefit directly the building industry.

Finally, within the manufacturing sector, the furniture industry in India presents a promising outlook to increase its participation in the global market in the coming years. The main reasons are the size of the country in terms of population and purchasing power, as well as the entry of global firms in the sector. In addition, its exceptional designs, high quality and elegance have contributed to be recognized worldwide. Based on these facts, according to the Centre for Industrial Studies -CSIL-, in 2011 India's furniture consumption ranked eighth worldwide, satisfying its domestic demand around local production. Currently, the contribution of the furniture sector to India's GDP is around 0.5 per cent (Imaya and Padhmanaban 2013).

6.1.2 Overview of India´s Economic Development and National Features

6.1.2.1 Economic Environment

The Republic of India is one of the largest countries by land in the world with 3.29 million km^2. Constitutionally the country is democratic and it is made up of 29 states and seven union territories (IDKN 2014). Globally, it is the second most populous country with around 1.21 billion inhabitants and an annual growth rate of 1.3 per cent (see Fig. G based on data extracted from Table 24 in Annex 3). However, it is expected by 2050 that India with 1.6 billion inhabitants will surpass China to be most populous country in the world (Hubacek et al. 2007). To date, India together with China share about one third of the world population.

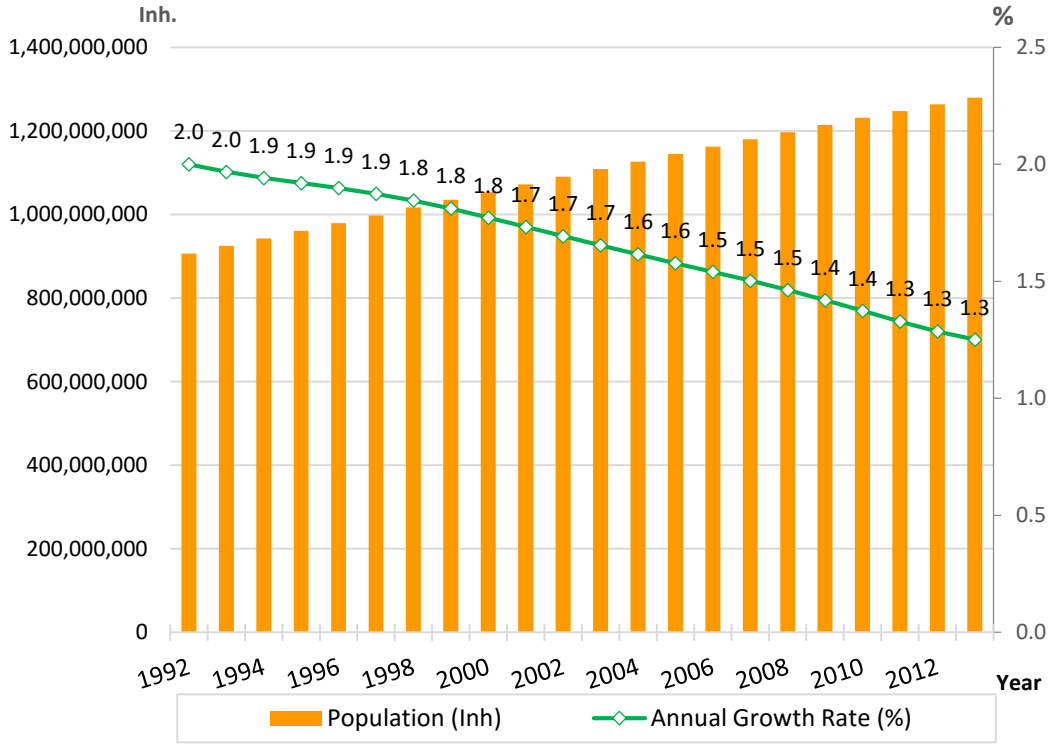

Figure G: India's population (inh.) and its annual growth rate (%), 1992-2013.
Data: World Bank 2014.

In India, the outgrown population and its migration to urban areas have caused an increment in demand in the domestic urban market that has accelerated the use of local resources. This uncontrolled use of resources has minimized the domestic stock of wood therefore a wood deficit in the country. So then, in order to face this

challenge, in 1991 the government adopted the National Forest Policy of 1988 and the Forest Conservation Act to focus on the conservation of forests. As a result, agroforestry programs along with forest plantations in non-forest areas became important sources of raw material for the local wood-based industries. Moreover, in order to satisfy the demand of wood and deal with the local wood deficit, since 1996 the government adopted an economic liberalization policy focused on trade. This policy addressed the reductions in domestic tariffs as well as the elimination of most quantitative restrictions (licensing requirements) on imports. Thus, the policy allowed wood imports based on a tariff structure that favors logs supply (with only a total duty of 9.35 per cent) while banning their exports (Pandey and Rangaraju 2008). Also, this policy acts as a tariff barrier that protects the local wood processing industry against the supply of processed wood (a duty of 17.3 per cent for sawnwood) and wood products (a duty of 36.8 per cent for wood-based panels such as veneer and plywood) but supporting their exports (see Table 3).

Table 3: India's import tariffs on logs and wood products.

ITC HS CODE	BASIC CUSTOMS DUTY -BCD	COUNTERVAILING DUTY -CVD	SPECIAL COUNTERVAILING DUTY –SCVD	TOTAL DUTY %	WOOD PRODUCT
44.01	5	0	4	9.4	Logs, Chips
44.07	12.5	0	4	17.3	Sawnwood, >6mm thickness
44.08	12.5	16.3	4	36.8	Veneer sheets
44.12	12.5	16.3	4	36.8	Plywood, laminated wood

Source: USDA 2014.
Note: ITC = India Tariff Code; HS = Harmonized System; Total Duty = BCD + CVD + SCVD + CESS (2% Education + 1% Higher Education).

India's open participation in the world economy allowed major trade of goods and services. Thus, the resulting economic growth transformed agriculture into a self-sufficient sector. In addition to this, the Indian industry grew and diversified its operations and the economic growth became service-oriented. According to the Economic Survey published by the Ministry of Finance of India (GoI 2013a), during the period 2012-2013, both sectors of services and manufacturing grew at 6.6 and 1.9 per cent, respectively. This transformation in the economy is based on the industrialization and modernization of its domestic market. All this factors were important for the market liberalization in India that increased not only the amount of

educated workers but also incomes due to higher salaries mainly in the service sector. Thus, the opening in India's economy has renovated the local economic structure in the recent years. As a result, the domestic market was developed due to an accelerated consumption that along with the growth of the service sector, promoted an increase in GDP (Nayyar 2012). Fig. H shows the rising participation of the service sector as the main contributor to India's GDP growth. The service sector has steadily increased its share in India's GDP since 2008 in contrast to the steadily declining shares of the agriculture, forestry and industry sectors.

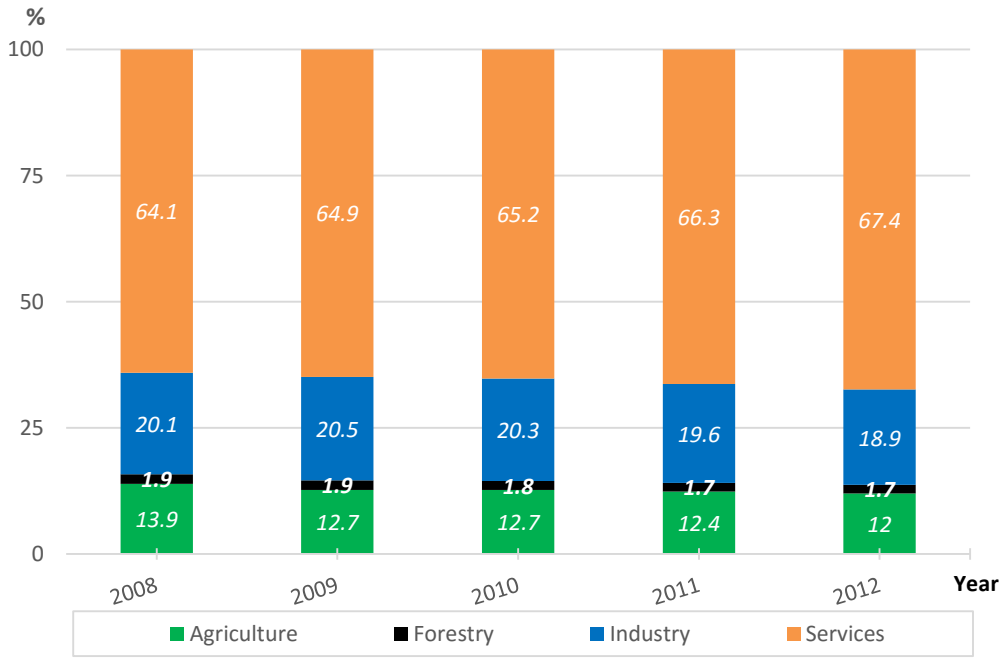

Figure H: Contribution of different sectors to GDP growth (%), 2008-2012.
Source: GoI 2013b.

It was between years 2002 and 2010 when the Indian GDP percentage growth increased from 5 to 10 per cent, respectively (see Fig. I, based on data extracted from Table 22 in Annex 2), with a drastic decline in 2008 caused by the global financial crisis. That is how during 2010 the shares of the total GDP growth accounted for 65 per cent of the services sector, 20 per cent for industry and about 15 per cent between agriculture and forestry (see Fig. H). That is how, from year 2000 it is said that the country achieved a decade of economic development due to the rapid growing rate that has doubled India's per capita income (Bajpai and Sachs 2000). For these reasons, the country has been acknowledged as a flourishing developing economy (Hubacek et al., 2007). Despite the Indian economy faced another down in the GDP

after this decade (with growth rates of 6.6% in 2011 and 5.1% in 2012), India was one of few countries to recover earlier from the global financial crisis. This time, the down in the GDP could be caused to external and domestic factors, such as an elevated current account deficit and a persistent inflation among others, respectively. To date, India contribute with 7.7 per cent of world GDP and according to the World Bank, it is forecasted that its GDP will steadily increase in the coming years (with a forecasted growth rate around 8 per cent). However, on a purchasing power parity (PPP) basis, (CIA, 2006 cited in Midgley et al., 2007), positioned India as the third world-largest economy with a GDP per capita equivalent of USD 3,400. In addition to this, Leslie (2015) confirms that personal incomes in India are rising by 50 per cent from 2010 to 2015, based on IMF estimations. Moreover, it is expected that this trend will allow converting the Indian market into the fifth largest consumer market by 2025 (Ablett et al. 2007).

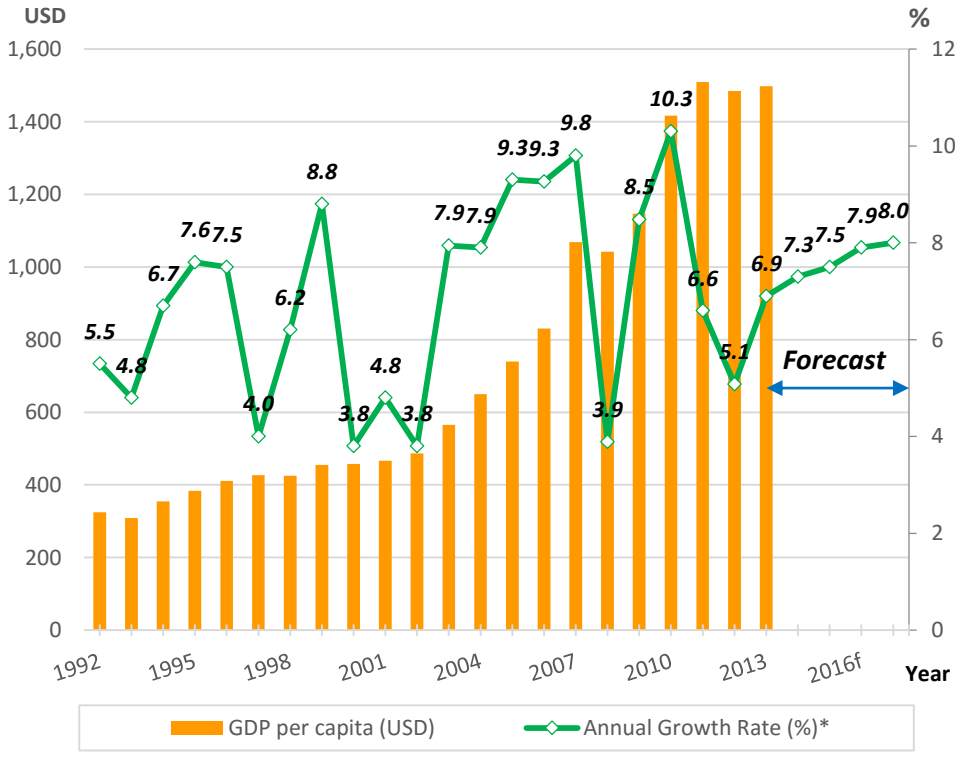

Figure I: India's GDP per capita (USD), annual growth rate (%) and forecast, 1992-2016.
Data: World Bank 2014.
Notes: * = aggregates are based on constant 2005 USD; e = estimate; f = forecast.

India is also known as the second-fastest growing economy in the world and in terms of growth performance the country has been in the top 10 since 1980 (World Bank 2006). India has opened its economy to foreign markets and it is expected to occupy

an important role in the global economy in the coming years. Despite the progress of the country, the fiscal deficit and government debt should be addressed, as well as developing infrastructure. However, Indian economy is still complex. The country still depends on subsistence agriculture but at the same time also depends on high technology. (Midgley et al. 2007). That is how the steady economic growth in India have caused two different scenarios. On one hand, an increasing share of the population started becoming wealthier, improving their quality of life and causing a major consumption in the country in different segments such as high nutrient food, health care and living. On the other hand, despite Indian economy is rising, poverty remains as a major challenge due to in the country remains a large number of people (around 26 per cent of the total population) surviving under the poverty line (1 USD/day). (Hubacek et al. 2007). Thus, India ranks 65th among the countries where hunger exists. Hence, considering that India counts with one third of the world's poor population, the main challenge is to distribute equally the current benefits of economic growth at all the levels.

6.1.2.2 Employment and Unemployment

According to the Report on Employment and Unemployment Survey, 2009-2010 (Labor Bureau 2011), about 36 per cent of the Indian population (about 428 million inhabitants) is under the working age and 9.4 per cent (41 million inhabitants) is unemployed. Moreover, in all the different regions in the country there is a similar trend in terms of employment and unemployment (see Fig. J). However, regarding gender, almost half of the male population is employed compared to 14 per cent of females.

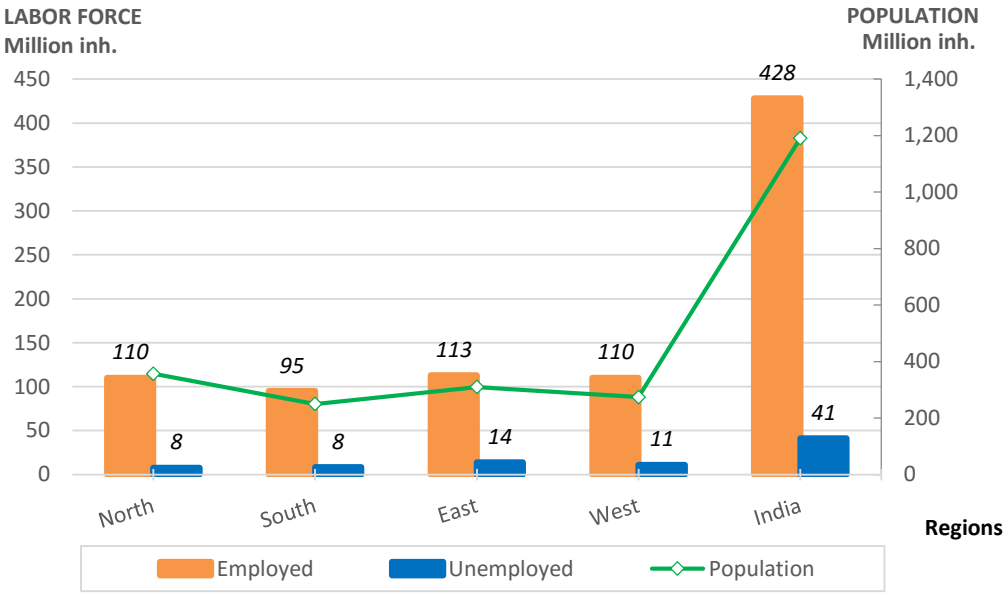

Figure J: Labor force in India by regions in 2010, million inhabitants.
Source: Labor Bureau 2011.

One of the reasons for Indian success as one of the fastest growing economies in the world, is that agriculture (including forestry) together with the sectors of services (including construction) and industry, have not only been the main contributors to GDP in the country, but also have become the main sources of employment. Agriculture (including forestry), has been since 1980 the primary employment-providing sector in India and the trend continued in 2010 (see Fig. K), representing a rate of 54 per cent. It is followed by the industry and services sector (21.5 and 24.5 per cent, respectively). It is important to mention, that despite the global economic slowdown in 2009, the upward trend of employment in India has been maintained since then. However, the only change after the recession of 2009 in the sectoral composition of employment in India has been the decline of the service sector in favor to the agriculture sector. As a result, it is possible to estimate that the domestic corporate performance is still weak due to the declining levels of the services sector.

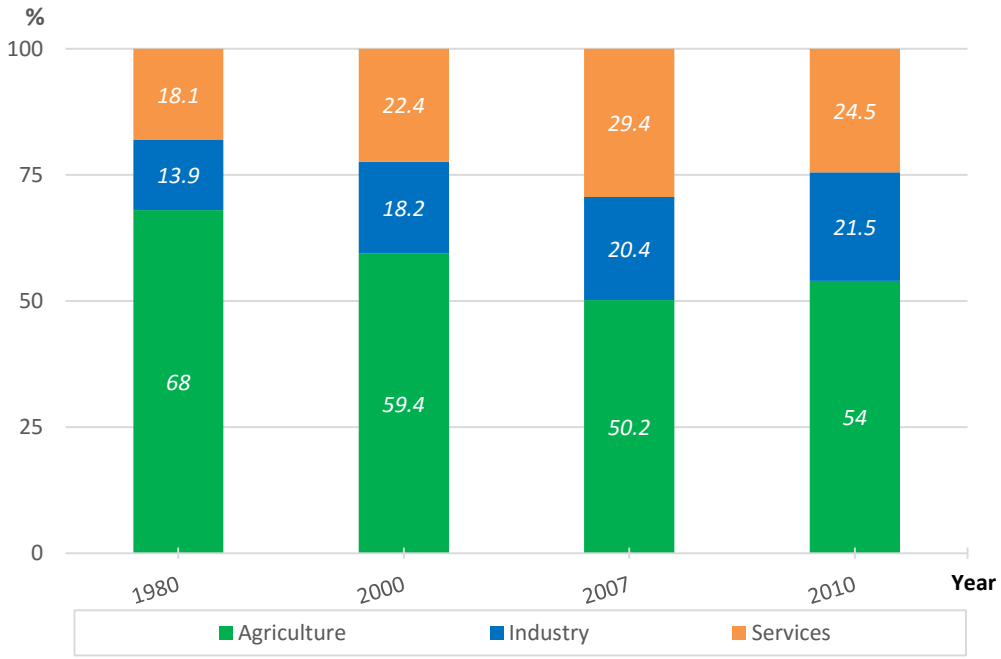

Figure K: Sectoral composition of employment in India (%), 1980-2010.
Source: GoI 2013a, GoI 2013b.

In terms of forestry, the contribution of this sector to employment in India has steadily increased during the last decade (see Fig. L based on data extracted from Table 25 in Annex 3). Whereas other countries has suffered a decline due to the recent economic downturn and the faster growth in the industry and services sectors. In India, both industries, wood and furniture, are the only sectors that have maintained a positive growing trend in the local economy and have provided employment to more people. As a result, there is an increment in the production of wood products in the country. However, the situation in the forestry sub-sector is different considering that the trend remains stable. Some reasons could be due to government conservation programs that have contributed to control the domestic indiscriminate clearing and the declining illegal logging of wood in the country due to reforms in logging policies. Finally, the only sector that shows declining employment is the Pulp and Paper Industry and it can it be estimated that the main impact of this negative trend is the recent global economic downturn, since the this sector started to decline in 2007. Moreover, the rapidly growing use of digital media influenced the drop in the demand for paper products. Thus, it can be considered that during this period the Pulp and Paper Industry sector has invested less capital to

replace manual work with machinery resulting in shutting down inefficient mills that have reduced the amount of people employed.

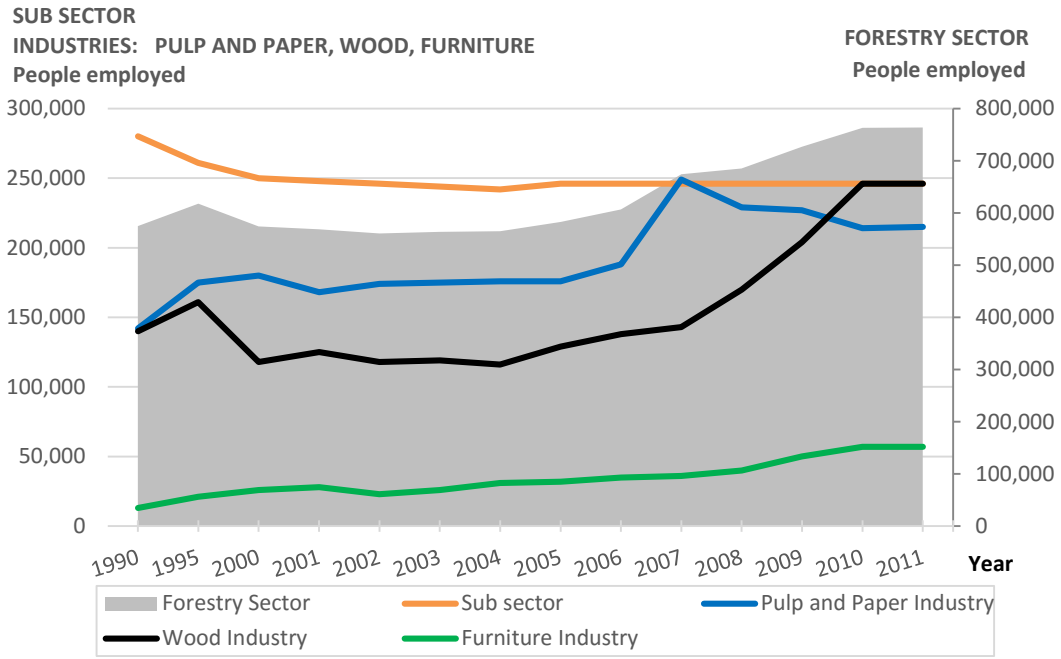

Figure L: Forestry contribution to employment in India, people employed, 1990-2011.
Source: Lebedys 2014.
Notes: Forestry Sector includes Sub-sector and the Wood, Pulp and Paper, and Furniture industries; Sub-sector includes forestry and logging; Wood Industry includes the manufactures of wood, of products of wood and cork (except furniture), of articles of straw and plaiting materials; Pulp and Paper Industry includes manufacture of paper and paper products.

6.1.2.3 Housing and Construction

In India, construction is the largest consumer sector for wood and wood products and housing is the sub-sector with the highest use of wood. In the country, housing provides security and shelter but also shows a great diversity, which reflects the socio-economic status of its population. Over the past decade, the Indian housing market has shown a strong growth and after agriculture, the housing has become the second largest employment generator in the country. Additionally, housing contributes with about 6 per cent to India's GDP. According to data obtained from the National Housing Bank (2012), the total housing stock has increased from 186 million units in 2001 to 245 million units in 2011, which is about 25 per cent in a decade (see Fig. M). Thus, considering that most of housing units are in rural areas,

for year 2012 was estimated a shortage of 18.78 million and 43.67 million housing units for both urban and rural areas, respectively.

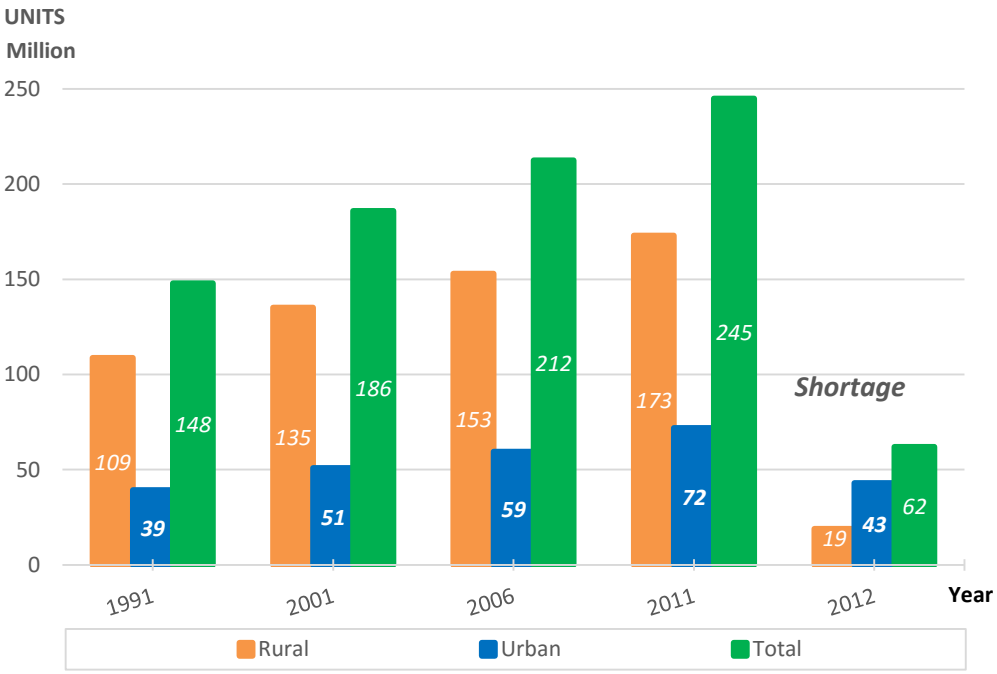

Figure M: Total housing stock in India (rural and urban), million units, 1991-2012.
Source: National Housing Bank 2012.

The main reason for the considerable change in the housing market is due to the higher purchasing power of Indian citizens, which according to the McKinsey Global Institute (Ablett et al. 2007), in 2025 it is expected quadruple from USD 1,822 in 2005 to USD 5,511. In addition to this, major investments in socio-economic infrastructures try satisfy the rapid urbanization caused by migration of people from rural areas and continuous increment of the population. Hence, home ownership is becoming a trend and it raises the demand for construction.

India is known for its wood-culture. Locals appreciate good-quality wood in their homes. Furthermore, the constant growing middle-class population in the country is being exposed to influences in wood decorations from the western-style (e.g. doors and windows, among others). Thus, in terms of wood structure and properties, the preference are tropical hardwood species due to high resistance against termites as well as to climatic conditions of heat and humidity (Rawat 2004). Softwoods are not considered for housing purposes due to there is a lack of knowledge about their use. However, softwood are used for shuttering and formwork due to good nailing

properties as well as lighter weight but above all, low cost. Additionally, in terms of quality, it is considered low and to be used only for short-life and low value applications (Leslie 2014). In addition to this, some Indian manufacturers such as high-tech door companies only use imported softwood sawnwood due its quality and reliability in terms of size, dry and grades. Such characteristics cannot be obtained from the local sawmills. (Leslie 2015). Consequently, the perceptions of Indian consumers are currently changing due to the deficit in the supply of tropical hardwoods. Meanwhile, other hardwoods and softwoods start to be considered as alternatives.

Today, standard constructions in India are based on bricks and cement. Constructions have been diminishing the use of wood for residential and commercial purposes. This is due to the shortage of raw materials available in the market, governmental restrictions and the more use of substitutes products such as glass, steel or aluminum for windows frames and doors. Thus, in housing constructions, the use of wood has been confined specially to both flooring and roof structures in wooden housing. Additionally, wood is also used in interior finishes such as doors and door frames, windows and window frames, stairs, furniture and joinery as well as for exterior and interior walls but its use is insignificant. (Agarwal 2013, BMTPC 2014). Then, in commercial constructions, wood is used for cabinetry and desks. Meanwhile in infrastructure and industrial constructions, the use of wood is focused on railway sleepers, warehousing and rolling stock structures, among others (Dun and Bradstreet 2015).

It is important to highlight some drawbacks that must be taken into account regarding the use of wood in the construction sector. The most important are the high cost of maintenance and price, as well as the wood is susceptible to fires, some insects (e.g. termites) and weather, so it loses its value and strength over time. Additionally, the use of softwoods for construction requires a market development to demonstrate properties and applications. For these reasons, today wood buildings in India have been replaced by stone and brick and the use of wood remains for special purposes such as interior decoration and furniture.

6.1.3 India's forest sector and wood products markets

6.1.3.1 India's forest sector

According to the Forest Survey of India (FSI), in 2011 the total forest area and tree cover in the country was about 782,871 km^2, representing 23.81 per cent of the geographical area in the country and 0.08 ha of the per capita availability of forest land, which is one of the lowest in the world. For this reason, since 1996, the indiscriminate clearing and illegal logging of forest in India have been banned. The government only allows strictly limited harvesting of wood based on authorized forest management plans. Most of the forests are state owned and only about 10 per cent are private owned (Ganguli and Eastin 2007). Moreover, generally forest are classified as tropical (about 95 per cent), with a low productivity due to soil degradation (Midgley et al. 2007). The total amount of growing stock of forest and trees outside forests is estimated in about 6,047.15 million m^3, divided in 4,498.73 and 1,548.42 million m^3, respectively (FSI 2011), and only 40 per cent is used for commercialization. Finally, in terms of use of wood, both rural and urban populations (80 per cent and 48 per cent, respectively) consume fuelwood and therefore the country is considered as the largest consumer of fuelwood in the world (Ganguli and Eastin 2007).

Despite fuelwood is important in India due to provides close to 40 per cent of the energy in the country (households and industries use around 70 and 30 per cent, respectively), non-wood forest products (NWFPs) are also important but mainly for the rural sector. Thus, 60 per cent of NWFP is consumed for the domestic market and its commercialization represents almost half of the total incomes from the forest sector. (ITTO 2004).

Considering the importance of use of wood and NWFP in different sectors in India, there is a need to establish forest plantations in the country due to its wood-deficiency and because current Indian native forests are on the limits of available supply. In such a way, the main purposes for forest plantations are degraded-forest

restoration and wood-balance. However, the country lacks adequate budget to carry out reforestation projects nor effective forest management programs. Additionally, there are high demands, on one side, for land caused by the steady increase population, and for another side, on raw materials supply for manufacturers and wood processors. Thus, based on the Indian Paper Manufactures Association (2014) estimations, the need for wood by Indian wood-based industries will grow from 5.2 to 13.2 million tons in 2020 Midgley et al. (2007).

6.1.3.2 India's wood products markets

The wood-based industry in India is characterized by low-technology manufacturing sectors that operate under a market without regulations for product standards. Since the economic reform in year 2000, India enabled to remove quantitative restrictions in import tariffs within the forestry sector. In addition to this, only exports of logs are banned but not wood-based wood products. As a result, the wood and wood product market in the country has increased considerably its commercialization at both domestic and international level.

Despite that imports duties were lowered, these are still high due to that the high import duties on other forest products than logs (e.g. 17.3 per cent on sawnwood) are used to protect the Indian domestic wood-based industry. On one hand, imports of logs represent over 74 per cent of the total imports of forest products in the country (USDA 2014). Some of the reasons for importing logs in India are due to large number of low cost, small and simple mills, besides the cheap labor. On the other hand, wood products are imported in small and insignificant amounts, as are the cases of sawnwood (around 6.5 million m^3), and veneer and plywood (around 0.5 million m^3), respectively (see Fig. N based on data extracted from Table 26 in Annex 3). However, the figure shows signs on increasing imports of sawnwood during the recent years. Thus, it is expected a rise on imports of wood but gradually with a less participation of logs and tropical woods in favor of sawnwood and softwood, respectively. According to DGCIS (2013), in 2010, the top five major exporters of wood and wood products into India were Malaysia, Myanmar, New Zealand Papua New Guinea and Ivory Coast. Despite the sawnwood sector is growing fast, it

represents only 3 per cent of the total imports of wood in India. Meanwhile, the downward trend in the plywood sector is due that plywood units are produced only in small-scale industries after that large and medium-scale industries have ceased to manufacture. However, the consumptions of sawnwood and plywood are expected to rise along with GDP. It is important to mention that brute force is still used within wood processes and judgment of local operators is required for sawing, grading and size control. All of this influence the end-product performance. (Leslie 2014).

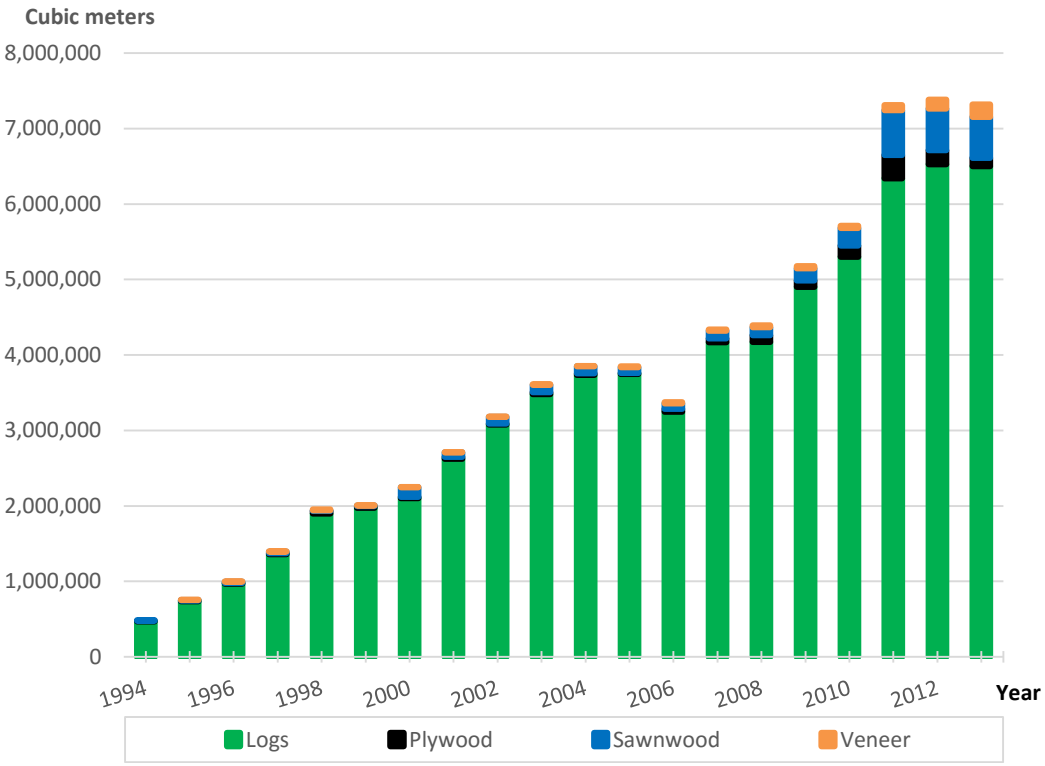

Figure N: Indian imports of logs and main wood products (m^3), 1994-2013.
Data: ITTO 2014.

As it has been explained before, India is definitely a net importer of wood and some wood-based products, which is the result of the increasing commercialization of these products due to a high consumption mainly at domestic level. Thus, consumption of wood and wood products follows the same upward trend than their imports and shows as well that the segment with the higher consumption is logs when compared to wood products (see Fig. O based on data extracted from Table 27 in Annex 3). Consumption is described here by apparent consumption (consumption= production+ imports– exports). The rise in the consumption of wood and wood products is shown that starts right after the economic reform in 2000 and

maintains a small steady growth after 2008 despite the global economic crisis. The only exception occurs in the sawnwood sector, whose consumption in 2006 fell by about 50 per cent and recovered very slowly until after the subsequent economic crisis. One of the reasons is probably due to a decrease for imports of logs that took place in the same period and that caused a drop of half of the domestic production of sawnwood. Note, that there may be also uncertainties in the statistical data.

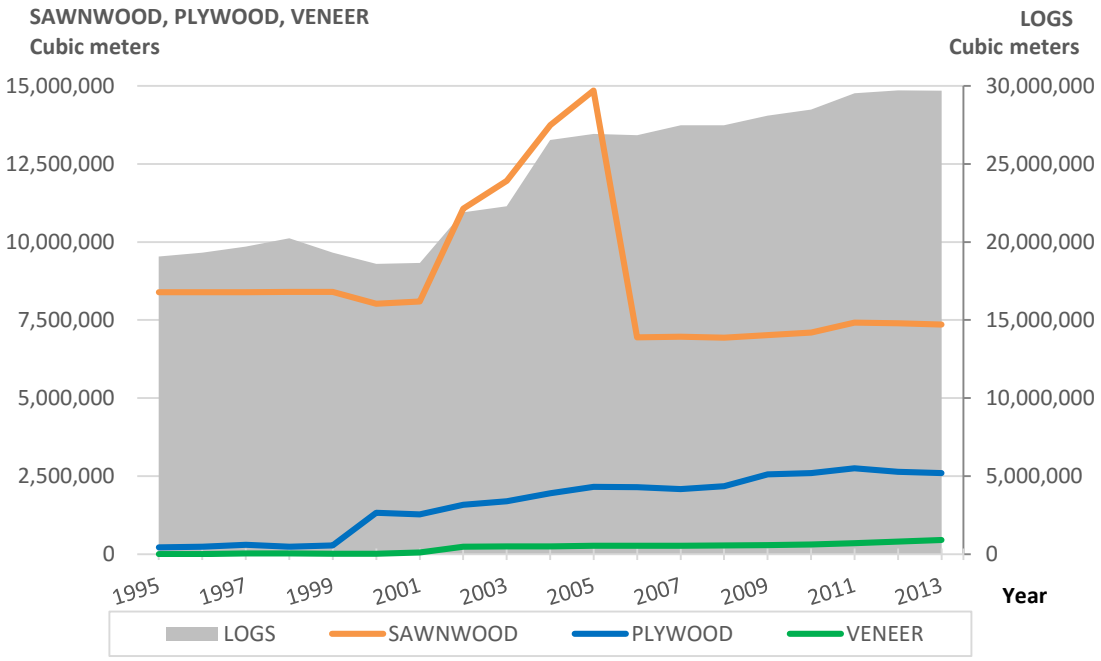

Figure O: Indian consumption of logs and main wood products (m^3), 1995-2013.
Data: ITTO 2014.

The use of wood depends on its structure and properties. As such, most of the wood is used in the construction sector (with around 30 per cent) mainly for interiors in houses (doors, windows and frames); plywood and boards (25.8 per cent); packaging (8.8 per cent) and furniture (6.3 per cent) (APFSOS II 2010). According to Sincavage et al. (2010), in terms of distribution, domestically logs and sawnwood are supplied to both small and medium-sized manufactures by wholesalers, while large manufacturers negotiate directly with local mills and importers. The wood is processed mostly in the unorganized sector, which includes carpenters and small and medium size enterprises. The organizer sector is defined for large or branded manufacturers. Consequently, some advantages of the unorganized sector over the organized sector are that products are cheaper (between 15 to 20 per cent). But, the negative side is, that taxes and duties of the unregistered products are unpaid and the

low cost in the raw material supply is caused by the consumption of illegal wood. On the contrary, the organized sector ensure better quality and high-end products based on major investments in technology.

Today, despite that most of the Indian wood workers are more familiarized and skilled with hardwoods, softwood species start to be used in sectors dominated by hardwoods, such as in construction (for both window and door frame), furniture and packaging sectors (Agarwal 2013). A high consumption of softwood started together with the economic reform in 2000 since high import tariffs maintained low availability of softwood in the country. In this way, India started to import higher volumes of softwood logs mainly from Australia and New Zealand at an annual rate close to 39 per cent (Glass 2013). Since then, New Zealand has been the main exporter of softwood logs into India due to freight rates advantage, less shipment time and low price of logs. In 2007, a reduction in the tariffs (about 15%) allowed to maintain a steadily rise in softwood imports into the country. Thus, from the total amount of sawnwood imported in 2014, around 60 per cent was softwood compared to 44 per cent in 2010 (Dun and Bradstreet 2015).

At present, New Zealand counts with about 80 per cent of the total imports of softwood into India and is followed by Australia, Germany and the Nordic countries. This increasing trend confirms the acceptance by local consumers towards the use of softwoods as an alternative to hardwoods despite that the country is still immature regarding the consumption of softwoods (see Fig. P based on data extracted from Table 28 in Annex 3).

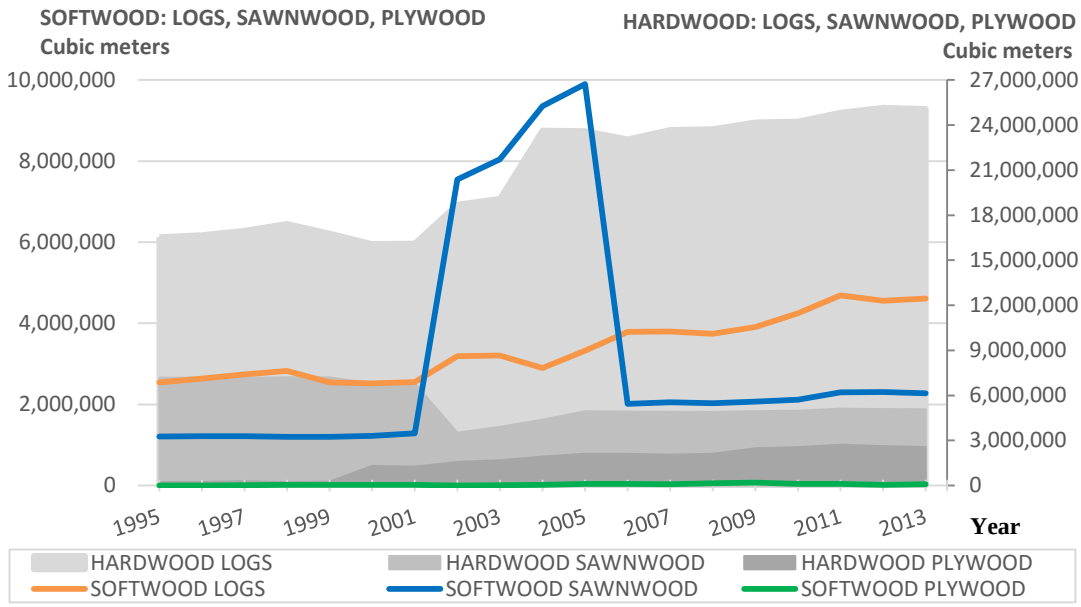

Figure P: Indian consumption of logs and wood products by group species (m^3), 1995-2013. Data: ITTO 2014.

6.1.3.2.1 Logs

Wood is culturally, one of the resources that is used by most people in India and is important for the growth of its economy due to generation of incomes and employment, principally in areas with low human development. In terms of wood, India is along with China one of the main users of this resource in the Asia-Pacific region (Pandey and Rangaraju 2008).

According to Fig. Q (based on Table 29 in Annex 3), the domestic production of logs in India during 2013 was estimated in around 23,192 million m^3 with a growth rate less than 2 per cent. The trend grew strongly since year 2000, right after the economic reform that allow sawmills to use logs to manufacture sawnwood. Then, four years later, the trend has been stable due mainly to government restrictions on harvesting in local forests without previous authorization. Moreover, a similar situation occurs with the trend of Indian imports of logs, which has been growing steadily for around 20 years. Some reasons that have contributed to this continuous increment are the rising purchasing power within the population and the continuous real estate development that have increased the demand for imported wood varieties, destined for the use in housing construction as interior decorating and furniture.

Thus, in 2013 India's import of logs were estimated in 6.5 million m^3 but it is expected that this amount might decrease in the following years in favor of an increment of imports of sawnwood. The reason is that since 2014, exports of teak logs have been banned in Myanmar (the largest teak exporter to India) dropping Myanmar's share of India's hardwood imports from 32 to 1 per cent. This provides an opportunity to import teak sawnwood into India as an alternative (Leslie 2015). In India, a similar situation occurs with exports of logs, which are also banned. This has led to no clear trend during the time. Hence, despite that exports grew rapidly after the Indian economic reform in 2000, the trend has shown ups and downs over time with a drastic decline six years later and in 2013. Consequently, the steady rise in the trend of both imports and production as well as the uncertain trend in exports has let a continuous increasing trend in the consumption of logs since the economic reform was established until today (from 18 million m^3 in 2000 to about 30 million m^3 in 2013).

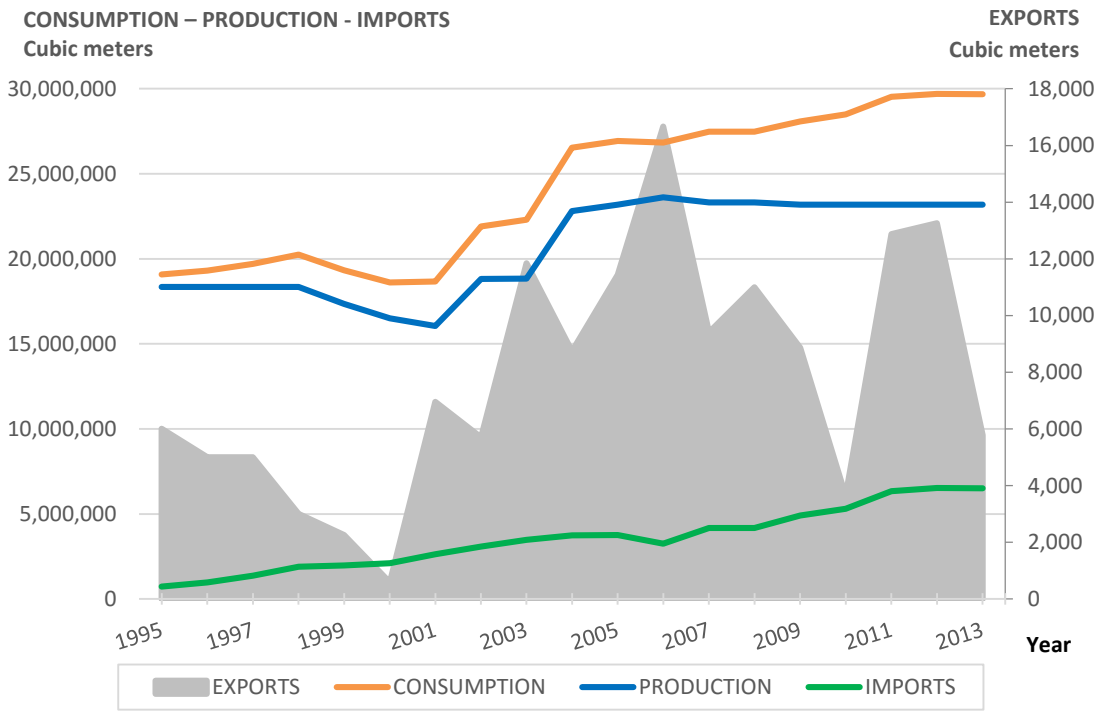

Figure Q: India's exports, imports, consumption and production of logs (m^3), 1995-2013. Data: ITTO 2014.

In terms of wood species, the International Tropical Timber Organization (ITTO) estimated that in 2013 the production of hardwoods in India was around 20 million m^3 compared with only about 3 million m^3 of softwoods. The same situation has

remained since 2005 until today and the pattern is followed by the consumption of logs in the country, where hardwoods are in turn more appreciated than softwoods (about 25 million m^3 and 5 million m^3, respectively). Moreover, India's local consumption of hardwoods is higher than the production due to imports of hardwoods have about 5 million m^3 in contrast to the low quantity exported (less than 5 thousand m^3) in 2013 (see Fig. R based on Table 30 and 31 in Annex 3).

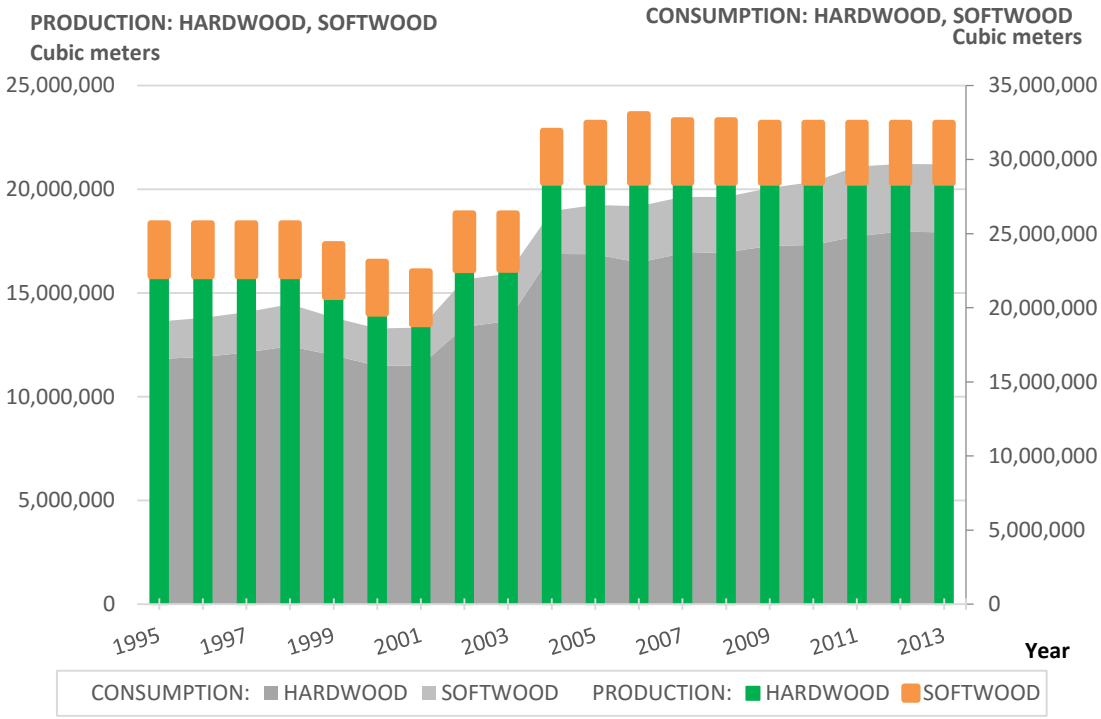

Figure R: India's production and consumption of logs by group species (m^3), 1995-2013. Data: ITTO 2014.

Within hardwoods, tropical hardwoods are commonly used for the production of logs due to durability and termite resistance properties (Leslie 2014). For this reason, most of the manufacture of tropical hardwood logs results in sawnwood that later is consumed by industries such as construction (mainly housing), pulp and paper, furniture, Infrastructure and Engineered wood products (veneer and plywood). Meanwhile, the manufacture of softwood species is demanded mainly for paper production (Dun and Bradstreet 2015). Thus, major exporters of tropical hardwood logs into India are countries from South-East Asia; in the case of other hardwood logs, these are mainly imported from Germany and Panama; while New Zealand and the United States (EEUU) are the largest exporters of softwood logs (see Table 4). The advantages of these countries over other global exporters are freight and low

prices as well as free trade agreements such as the ASEAN –India Free Trade Area (AIFTA) where Malaysia and Myanmar are part. On the contrary, global exporters such as Canada accounts only 0.05 per cent of the total amount of logs imported in India (FAOSTAT 2014).

Table 4: Top five log exporters to India by group species in 2013.

TOP 5	EXPORTER	SOFTWOOD (m^3)	EXPORTER	TROPICAL HARDWOOD (m^3)	EXPORTER	OTHER HARDWOOD (m^3)
1	New Zealand	1,061,000	Malaysia	1,914,000	Germany	93,000
2	United States	509,000	Myanmar	1,547,000	Panama	75,644
3	Germany	67,000	Papua New Guinea	319,000	United States	35,000
4	Myanmar	50,046	Ghana	281,000	Ecuador	21,908
5	Australia	49,000	Cameroon	108,000	Romania	14,968

Data: FAOSTAT 2014.

In India, the local demand of wood (around 95 million m^3) is not satisfied by import of logs, despite that the current tariff for log imports is low (9.25 per cent). Previous studies (Pandey and Rangaraju 2008, Manoharan 2013) estimate that more than three-quarters of the logs produced at domestic level are obtained from local plantations and forests (see Table 5). This is due to that based on the total annual consumption of logs, only about 6 per cent of the logs (mainly tropical hardwood) are imported into the country.

Table 5: India's demand supply scenario of industrial wood, million m^3, 1995-2010.

YEAR	QUANTITY DEMANDED	SUPPLY FROM:		DEFICIT	IMPORTS	ILLEGAL FELLING
	Industrial Wood	Forest	Plantations			
2010	95	23	55	**17**	6	11
2005	74	12	45	**17**	3	14
2000	58	12	32	**14**	2	12
1995	50	12	27	**11**	1	10

Source: Pandey and Rangaraju 2008, FSI 2011, DGCIS 2013, FAO 2013, Manoharan, 2013.

Notwithstanding these factors, there is still a deficit in the log supply (about 11 million m^3) that should be satisfied. For this reason, the Indian forests suffer from illegal harvesting that includes cuts of small logs and stumps to produce sawnwood. Additionally, India is an important importer of illegal wood (around 17 per cent of its

imports) that is not even reported in customs (Dun and Bradstreet 2015). Hence, according to Khanduri and Mandal (2005), it is expected by 2020 that the wood supply deficit will exceed 90 million m^3. India's demand of wood was around 95 m^3 in 2010. This demand is expected to rise up to 153 million m^3 in 2020 (see Table 6).

Table 6: Growth pattern of future quantity demanded of wood in India, million m^3, 2000-2020.

YEAR	WOOD-BASED PANELS	WOOD-BASED PULP	DURABLE WOOD-BASED PRODUCTS	TOTAL DEMAND	GROWTH RATE %
2020	30.53	45.86	76.61	153	4.88
2015	23.96	34.67	64.37	123	5.89
2010	18.82	21.92	54.26	95	5.68
2005	14.69	14.32	44.99	74	5.52
2000	11.55	8.76	37.69	58	-

Source: Khanduri and Mandal 2005, Pandey and Rangaraju 2008, Manoharan 2013.

6.1.3.2.2 Sawnwood

Since India's independence in 1947, the sawmill industry has grown rapidly but with a small technological development. Although it is a competitive industry, local sawmills are archaic and labor intensive. In addition, handsaws are still in use and represent a large part of the sawing, which is done in the place of felling by many small sawmills. Hence, Indian sawmills are homogeneous, since there is no differentiation among them. Some sawmills are located close to ports and count with seasoning and treatment operations, while others are close to consumption markets or forest fringes and produce small and customized units. Production is characterized by not following international standards, and therefore there is a wide variety of dimensions in the unit produced. Local consumers prefer wide and long units due to there are more opportunities for final applications, which in India are usually unpredictable. These situations cause local sawmills lack of negotiating power with trade partners, which obtain the sawnwood at a low price. (Ganguli and Eastin 2007).

The production of sawnwood in India depends mainly on logs supply. However, even though local sawmills receive most of the logs available in the market, there is scarcity of raw materials in the country. Thus, local sawmills have been forced to use small logs and stumps to produce sawnwood. In addition to this, problems such as

warp and sawing variations are common in the sawnwood sector caused by poor manufacturing practices and low level of automation among domestic sawmills in the country. For these reasons, the capacity utilization of the about 56,000 sawmills in the country, is estimated in 50 per cent. In consequence of the production wastage, in 2010, there were a total of 18.5 million m^3 of sawnwood from almost 23 million m^3 of logs supplied to local sawmills. (Dun and Bradstreet 2015). Nevertheless, despite the different problems faced by local sawmills, sawnwood has been so far the largest category among the three different sectors of wood-based industries. One of the reasons is due the use of sawnwood in small volumes in different industries.

According to Fig. S (based on Table 32 in Annex 3) the domestic production of sawnwood in India started to picking up in 2001, right after the economic reform, due to sawmills were allowed to use logs for the manufacture of sawnwood, and kept a steady growing until 2006. One year later, the production decelerated dramatically to 6.9 million m^3 and has remained about this volume until today. However, this quantity is still lower than the volume produced in 2000 (near 8 million m^3) perhaps due to current high import tariff of sawnwood. The same trend is followed in the Indian apparent consumption (consumption= production+ imports- exports) of sawnwood due to the very small import and export quantities. The only difference is a slight increase in the consumption of sawnwood since 2009 caused by increased imports of this product during the same period. Nevertheless, consumption of sawnwood started to be a bit higher than production right after the economic reform in India. The reason is partly due to rising purchasing power within the population and major real estate development. Thus, Pandey and Rangaraju (2008) estimate that about 70 per cent of the sawnwood in the country is used within the construction sector, basically, for housing (around 62 per cent). In addition, sawnwood is used for decoration and interior applications such as doors, windows, floors, walls and furniture. The rest is consumed for packing, railroad sleepers and vehicle industries, among others.

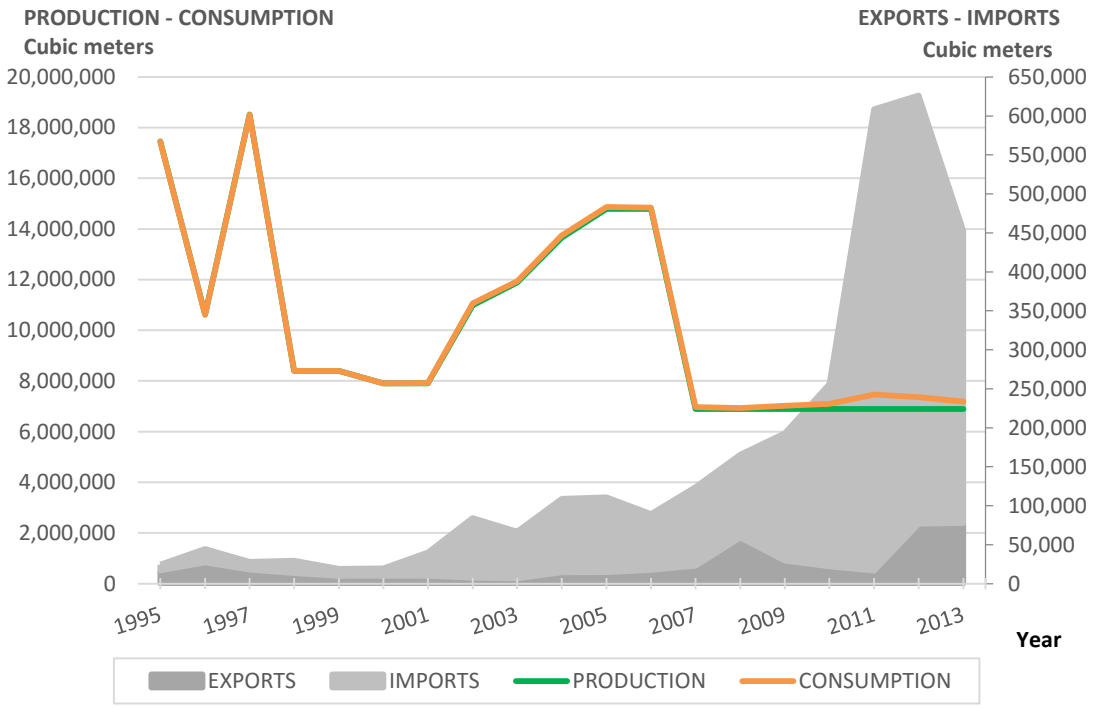

Figure S: India's exports, imports, consumption and production of sawnwood (m^3), 1995-2013. Data: FAOSTAT 2014.

As regards trade of sawnwood (see exports and imports in figure above), on one hand, the volume of sawnwood that India exports has been lower than imports right after the economic reform and its trend has shown ups and downs, as well. Some factors that led to obtain high picks during some years were that in addition to the normal exports, India also exported sawnwood to Iraq due to the post-war reconstruction, and Vietnam, as a new trade partner (Ganguli and Eastin 2007). On the other hand, imports of sawnwood are not yet required to satisfy the domestic demand even though it is expected to increase in the following years. Until then, imports of sawnwood might be required to meet the increased local demand.

Although in 2012 India imported more than five times the amount of sawnwood imported in 2008 (549 and 106 thousand m^3, respectively), this quantity only represents 2 per cent of the total imports of wood and wood products in the country (DGCIS 2013). Some reasons that can explain the rise in sawnwood imports are the gradual reduction of import tariffs, which has lowered the import price even more than the cost of sawnwood production at local level (Adams 2009), and the rupee appreciation against other currencies and its fairly stable exchange rate with USD and Euro. Hence, these situations have opened an opportunity to import hardwoods

and softwoods from large exporting countries at competitive prices and to maintain the purchasing power in Indian buyers (Leslie 2015).

From 2008 to 2013, on one hand, the major exporters of softwood sawnwood to India have been Germany, the United States (EEUU), Canada, the United Republic of Tanzania and Brazil, in this order. It is interesting to note that during the period 1999 to 2004 (not in the Figure), New Zealand, Australia and Canada used to be the largest exporters of softwood sawnwood to India (Ganguli and Eastin 2007). One of the advantages of New Zealand and Australia over European and American countries was due to more convenient imports as a result of lower cost in logistics. However, the volumes imported from these countries in 2013 have excluded them from the group of major exporters. Today, Germany shares about 19 per cent of the total imports of softwood sawnwood in India (see Fig. T based on Table 33 in Annex 3).

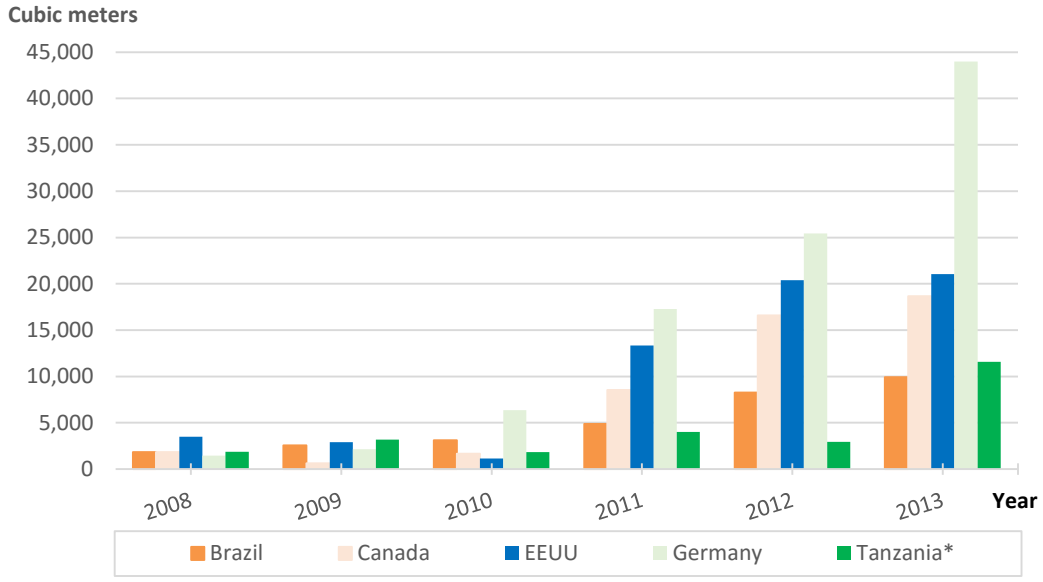

Figure T: Top five exporters of softwood sawnwood to India (m^3), 2008-2013.
Data: FAOSTAT 2014.
Note: * United Republic of Tanzania

On the other hand, currently the largest exporter of hardwood sawnwood to India is Germany, while during 1999 to 2004 (not in the Figure), the largest exporter was the United Kingdom (Ganguli and Eastin 2007). In 2013, Germany shared near to 29 per cent of the total imports of hardwood sawnwood in India and it is followed by Brazil, the United Kingdom (UK), the United Republic of Tanzania and Panama, respectively (see Fig. U based on Table 34 in Annex 3). Consequently, in terms of

countries exporting sawnwood into India, the largest exporter of both hardwood and softwood in the last years has been Germany, which has overtaken the United Kingdom (the largest exporter of sawnwood from 1999 to 2004), according to Ganguli and Eastin (2007). Thus, in 2013 Germany shared about 23 per cent of the total imports of sawnwood to India with 87 thousand m^3 and is followed by far for Brazil and the United Republic of Tanzania with total exports of sawnwood in India around 37 and 21 thousand m^3, respectively. It is important to mention that since 1999, Germany has been among the major exporters of sawnwood into India (Ganguli and Eastin 2007).

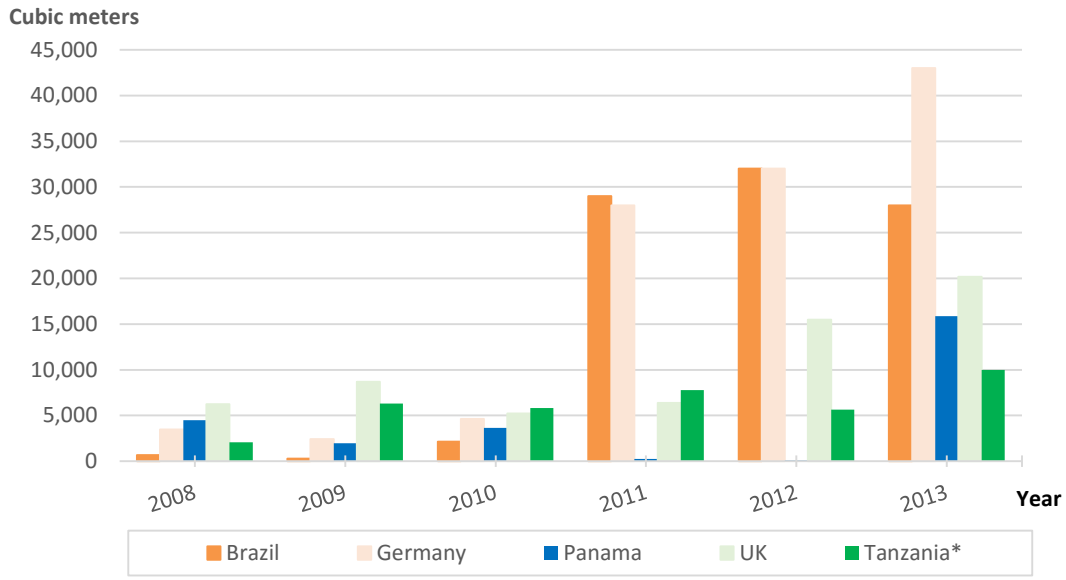

Figure U: Top five exporters of hardwood sawnwood to India (m^3), 2008-2013.
Data: FAOSTAT 2014.
Note: * United Republic of Tanzania

In terms of wood species, the trend of imports of hardwoods and softwoods sawnwood into India have shown ups and downs in the last 20 years. However, as is shown in Figure V (based on Table 35 in Annex 3), this trend can be divided in three different stages depending on the species group. As such, higher imports of softwood sawnwood (about 70 per cent of the total imports of sawnwood) were reported during the period before the economic reform in India (from 1995 to 1999). The same situation occurred during the years after the global economic recession (from 2010 to 2013), where the share of softwood sawnwood imported has been around more than 55 per cent of the total imports of sawnwood, particularly in the last years. On the contrary, during the period from 2000 to 2009, imports of hardwood sawnwood were higher than the imports of softwood sawnwood, with an approximate share of 75 per

cent of the total imports of sawnwood, mainly in the beginning of the period. Thus, the most representative tree species imported into India are on one hand, Teak and Meranti, in the case of hardwoods due to high wood value and ease growth. On the other hand, Radiata Pine, on the side of softwoods due to its properties make it excellent for use with different machines such as for drilling, turning and cross cutting, among others. Additionally, softwoods such as Douglas fir, larch, yellow cedar and western red cedar could be accepted if the wood receives prior treatment such as Borate treatments. In consequence, today Indian consumers prefer softwood due to excellent results in end-use applications and the competitive price in the market. Moreover, it is expected to surpass 400 thousand m^3 of imports of softwood sawnwood in India, for the first time (Leslie 2015).

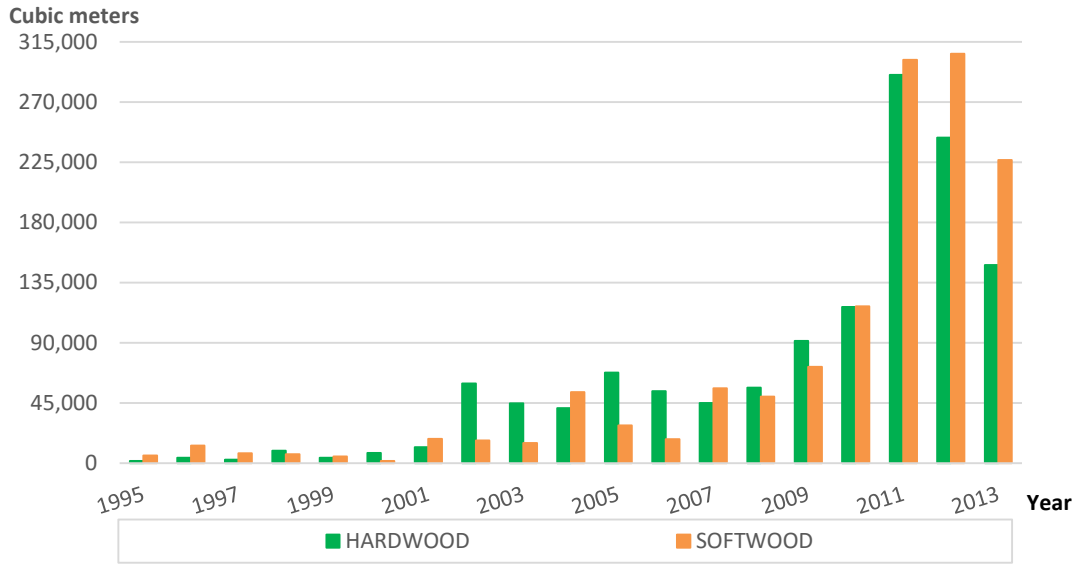

Figure V: India's imports of sawnwood by group species (m^3), 1995-2013.
Data: FAOSTAT 2014.

With concern to exports, India exports mostly hardwoods but not in large volumes. Softwoods, on the contrary are produced in the country, but they are not important for exports. Thus, similarly as occurs with logs, hardwood species are mostly used for the production of sawnwood in comparison to the use of softwood species. As such, before the economic reform in India, around 86 per cent of the hardwoods were used for both production and consumption. The situation changed in 2002 and during the next four years, when around 70 per cent of both total production and consumption of sawnwood was softwoods. The situation was caused by the entry of Australia, Canada and New Zealand in the sawnwood market in India, the new

largest exporters of softwood sawnwood into the country. After that short period until today, hardwoods have returned to dominate the sawnwood market in India with shares close to 71 and 69 per cent in both total production and consumption of sawnwood, respectively. The reason was probably caused by the recent global economic recession that influenced in the decline of the global market share of softwood sawnwood of Europe and North America (see Fig. W based on Table 36 in Annex 3).

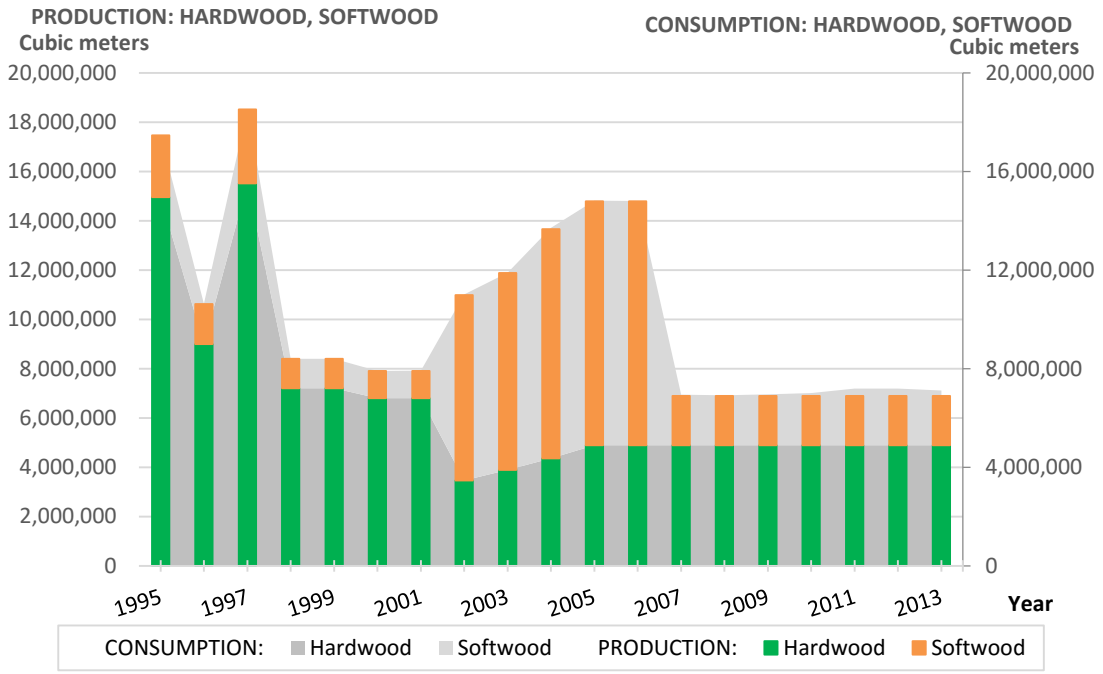

Figure W: India's production and consumption of hardwood and softwood (m^3), 1995-2013. Data: FAOSTAT 2014.

6.1.3.2.3 Plywood

Among the different types of wood-based panel products, plywood is the segment most produced in India. As such, in 2009 plywood accounted for 83 per cent (about 2.5 million m^3) of the total production of wood-based panels in the country (FAOSTAT 2014). As reported by Patel (2012), today the plywood industry has been growing from ten to twenty per cent annually and is focused on international markets due to major demand in both domestic sectors, furniture and wooden furnishing. Thus, in accordance with the Federation of Indian Plywood and Panel Industry (FIPPI), the production of plywood in India is used in three different segments such as commercialization, decoration and block board and flush door. Among them, most

of the plywood is used for commercial purposes in about 90 per cent (Ganguli and Eastin 2007). In the case of high-end constructions, plywood is used to smooth the surface finish to the concrete slabs upon setting, contributing to minimize finishing costs. The use of plywood is considered to replace traditional wood products due to shortage of wood. In addition, plywood products are easy to install, flexible and resistant to moisture. As such, hardwood plywood is oriented to produce cabinets, panels and wood works required for architecture. Meanwhile softwoods are used for the production of containers and furniture frames as well as substitutes for hardwood for interior cladding applications (Ganguli and Eastin 2007).

In India, in order to satisfy the domestic demand of plywood, the country mostly depends on domestic production. In this way, the manufacturing structure of plywood in India is based on around 3,500 units in the small-scale sector. These plywood mills depend mainly (about 93 per cent) on forest plantations of tropical hardwood species for the supply of raw material. However, as well as occurs in the sawnwood sector, plywood mills suffer on raw material availability due to the rule that bans illegal logging of wood from natural forests in the country. For this reason, the reduction in the import tariff on logs has contributed to diminish this pressure. Thus, taking into consideration that local plywood mills use either hardwood or softwood species for the manufacture of plywood, the annual consumption of plywood requires only about 4 to 7 per cent of imports of both hardwoods and softwoods, but generally with major volumes of hardwoods. As such, only around 7 per cent of the domestic production of plywood corresponds to imports of softwoods. Hence, in terms of exports, the country can be considered exclusively as an exporter of hardwood plywood but in small volumes. (Ganguli and Eastin 2007, Dun and Bradstreet 2015).

Finally, following Fig. X (based on Table 37 in Annex 3) in 2000 the domestic production of plywood in India jumped to around four times the volume produced in 1999 (from 315 thousand m3 to more than 1.3 million m3) and remained higher than the domestic consumption of plywood until 2007. This was due to higher exports than imports within the trade of this product. However, local plywood manufacturers have faced serious difficulties for obtaining the necessary volume of logs that can

ensure local production. One year later, the global economic recession impacted India's imports and export levels of plywood until today, in fact exports have declined more than imports so trade balances have benefited the domestic consumption of plywood. Imports kept growing due to the boost in housing demand in both rural and urban sides of the country.

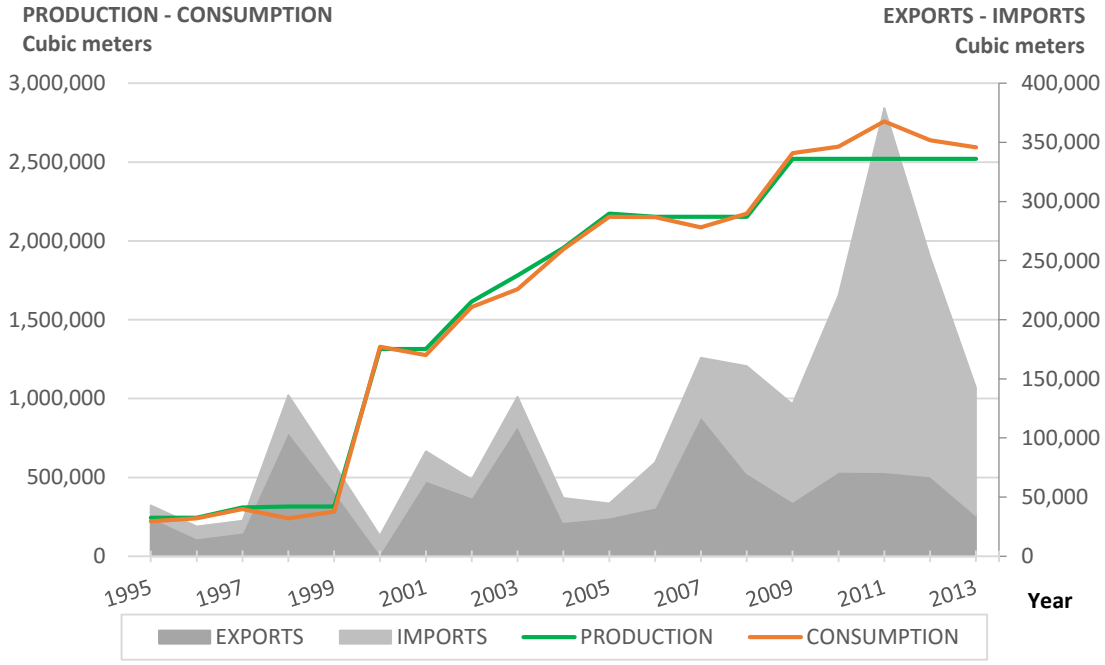

Figure X: India's exports, imports, consumption and production of plywood (m^3), 1995-2013. Data: ITTO 2014.

6.1.4 Finnish participation in the Indian Market of Wood Products

Forests are an essential part of the Finnish culture and both have gone hand in hand for centuries. Nearly three fourths of the land area are covered by forests. Thus, Finnish forests are also macroeconomically important since forest activities such as wood processing and pulp and paper contribute to Finland's GDP (about 5 per cent in 2010). Despite the recent economic downturn, the Finnish forest industry has shown a stable but slower growing than previous years due to lower demand for forest industry products in certain markets. (LUKE 2015a).

It was at the end of 1980s when due to internationalization, Finland set up huge companies based on forest industry. These companies such as the Stora Enso Group

(Stora Enso) and UPM-Kymmene Corporation (UPM) are considered among the largest globally in terms of production of forest industry products, while the Metsä Group (Metsäliitto) it is in Europe. (Lehtinen 2002). Thus, taking into account that Finland is considered as one of the world's leaders in terms of wood industry production, the country concentrates most of its exports of forest products to European Union countries (around 60 per cent). Also, other European countries are considered good destinations for Finnish forest products (10 per cent) and finally about 30 per cent concerns to countries from other regions in the world (Finnish Forest Sector Economic Outlook 2015-2016).

Based on Table 7, at national level the Finnish forest industry products represented 20 per cent of the value of the total exports in the country during 2014. On one hand, most of this share (about 77 per cent) was obtained by the exports of paper, board, pulp and converted products. From this group of products, more than 90 per cent of the local production of high-quality printing and writing paper, paperboard and converted products was exported. On the contrary, only 40 per cent of the local production of chemical pulp was exported. On the other hand, exports of wood products and furniture represented about 23 per cent of the value of the total exports in the country during the same year. (Finnish Forest Industries Federation 2014).

Table 7: Finnish forestry industry products production and exports, 2014.

MAIN FORESTRY PRODUCT	PRODUCTION PLANTS (units)	PRODUCTION	% OF PRODUCTION EXPORTED	EXPORT	CATEGORY	VALUE OF EXPORTS (Billion EUR)	% OF EXPORTS
Paper (1000 tons)	22	7,450	94 %	7,000	Pulp, paper, board and converted products	8,700	77 %
Paperboard (1000 tons)	13	2,950	95 %	2,800			
Chemical pulp (1000 tons)	14	7,000	40 %	2,800			
Sawnwood (1000 m3)	130	10,900	69 %	7,500	Wood products* and furniture	2,600	23 %
Plywood (1000 m3)	8	1,160	87 %	1,010			
Forestry industry total							11,300
Share of total Finnish exports							20.20 %

Source: Finnish Forest Industries Federation 2015.
Note: *Wood products such as sawnwood and plywood including veneer sheers and fiberboard.

The situation changed a bit during the first quarter of 2015 when at national level the Finnish forest industry products increased the share of the value of the total exports in the country for 22 per cent. Thus, among the forest industry products paper was the most significant with 40 per cent of the value of forestry products exports, followed by paperboard and chemical pulp with 20 and 16 per cent, respectively. In the case of wood-products, sawnwood represented the highest share with 13 per cent. The remaining 11 per cent corresponded to other wood products and furniture (LUKE 2015c).

In terms of sawnwood, the consumption of this product in the Finnish market is in a low level due to a decline in the local residential construction activity. The same problem occurs in Europe and Asia, which has impacted the Finnish exports of sawnwood. According to Fig. Y (based on data extracted from Table 38 in Annex 3), during 2014 Finnish sawnwood was mainly exported to key market areas in Europe, Asia and Africa.

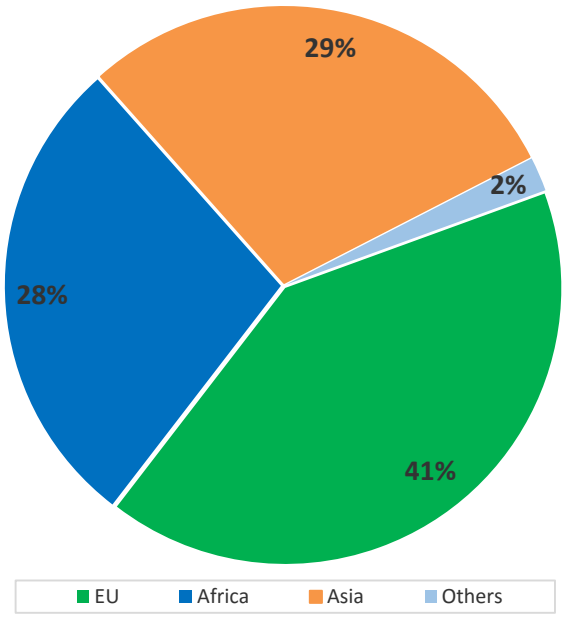

Figure Y: Finnish exports of sawnwood, quantity shares by regions (%), 2014.
Data: The Finnish Forest Industries Federation 2014 and the Finnish Board of Customs 2015.

In comparison to the previous year, although export prices of sawnwood increased during 2014, exports of this product were higher in Europe and North Africa due to reactivation of demand in these markets, but lower in Asia due to a decreasing demand in Japan for this product. Thus, Finnish exporters of sawnwood have great

expectations in exporting to North Africa due to major constructions and renovations of buildings as well as enhancements in infrastructure are expected in the coming years. In this way, Egypt maintained the highest level of imports of Finnish sawnwood in North Africa and China increased its share of imports of this product in Asia. (Finnish Forest Sector Economic Outlook 2014-2015).

Currently in 2015, Finnish exports of sawnwood have decreased in comparison to the previous year due to weaker demand in important markets such as France and Germany, lower demand of wood for construction, and a more intense competition mainly from Sweden and Russia, both countries benefited from the weaker exchange rate against the euro. On the contrary, exports to Asia and North Africa have grown due to major demand from China as well as from Egypt and Morocco, respectively. Nevertheless, the amount of exports of sawnwood is expected to remain at last year's level but export unit prices to fall. In terms of softwood sawnwood, Africa and Asia represent about one-third of the Finnish exports of this product. (Finnish Forest Sector Economic Outlook 2015-2016).

Regarding India, Finnish exports to this country are clearly dominated by new technologies and high-tech products that are necessary to develop the local industries. These commodities account over 70 per cent of total Finnish exports to that country (Bhide et al. 2006). Meanwhile in terms of forest products, newsprint represents about 99 per cent of the Finnish exports to India with 18,000 tons. The remaining 1 per cent corresponds to plywood, sawnwood and other forest products such as logs, particle board and veneer sheets (see Fig. Z based on data extracted from Table 39 in Annex 3). Despite Finnish exports of forest products to India are still modest, the promising Indian economy, the constant growth of consumers with higher disposable incomes that ensure housing demand and the high use of wood in home construction provide opportunities for other forest products different than newsprint. Thus, considering the increasing trend in imports of sawnwood in India since 2007 and the high use of this wood product within the construction sector (70 per cent) as well as the trends of Finnish exports of forest products into India, sawnwood (with the highest pick in 2009) and plywood (with the highest pick in 2013) are the most promising alternatives. However, it is only a matter of time that

India will change their perceptions of the local market, due to changes in its economy and tastes of local consumers. Therefore, it is expected that opportunities to increase current exports of wood products from Finland to India will happen in the coming years.

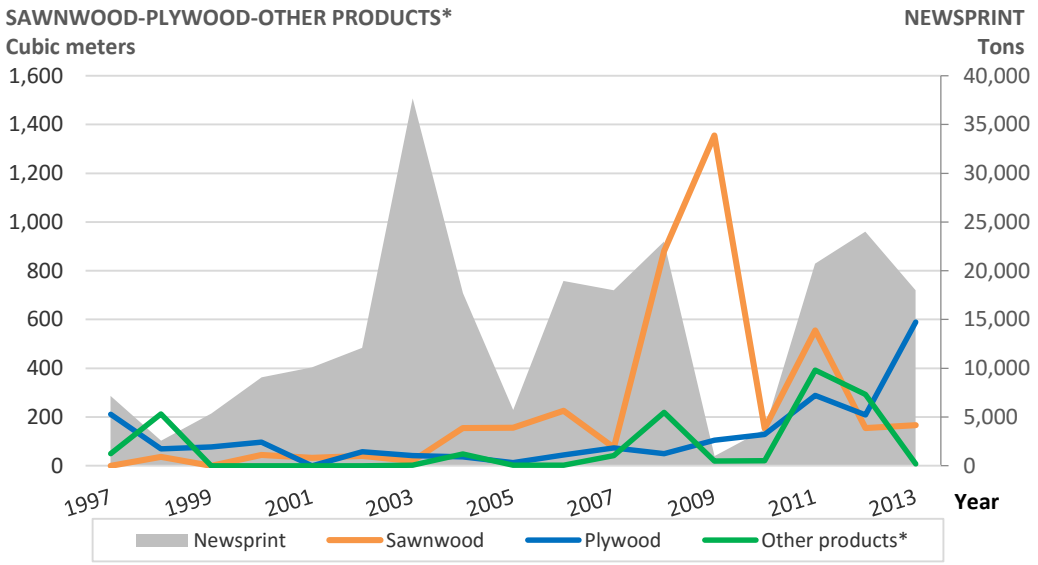

Figure Z: Finnish exports of forests industry products to India (m3, Tons), 1997-2013.
Data: FAOSTAT 2014.
Note: *Other products such as logs, particle board and veneer sheets.

In addition to the above information, due to the annual demand growth of the Indian pulp and paper market is 6 per cent, one of the fastest in the world, then there is a clear opportunity for investors to participate in this market (Johnson et al. 2011). Hence based on expertise in paper technology, Finland has invested in the pulp and paper sector in India aiming to increase the competitiveness of the local industries through automatization. Thus, on one hand, some of the largest paper companies in the world such as Metso, Stora Enso and UPM have established manufacturing services in India. Metso has been present in India since 1992 and counts with several service centers in different cities such as Mumbai, Chennai, Kolkata, Vadodara Panipat and Paradeep. However, since the beginning of 2015, the company's process automation systems business has been acquired by Valmet Corporation, a global developer and supplier of services and technologies for the pulp and paper industries, among others. In 2013, with an annual sales around EUR 300 million, the firm aims to enhance process efficiency in the pulp and paper industries in India through automation solutions based on cutting-edge technology. (Valmet 2015). Thus, large and small local paper mills together with larger fiber lines rely on Metso's

information management, runability monitoring and advanced process controls, among others, to reduce manufacturing costs while adding value to their products. Stora Enso subsidiary, Stora Enso Inpac Delta India Private Limited (SEIDI), was incorporated to the firm in 2005. Since then, the consumer packaging segment in the Asian market has been the main strategic goal with annual sales of EUR 10 million. SEIDI counts with two units located in the city of Chennai, India. One of the unit designs, plans and works exclusively to Nokia and the second unit counts with heavy machinery and it is related mostly with production activities. This unit aims to satisfy high-end customers from several segments by manufacturing refined paper packaging. Such customers are related to foot-wear, cosmetics, electronics and food as well as to healthcare and pharmaceuticals industries but mostly to telecommunications. (Finnwatch and Swedwatch 2013). UPM, is represented in India by UPM-Raflatac, a global supplier of self-adhesive label stock. The firm aims to satisfy the Indian paper label stock market, which has the highest growth in the Asia-Pacific region (15-20 per cent annually). Indian Pharmaceutical industries and personal care products are among their main customers. Since 2007, the firm has opened two servicing terminals in the country, one in Mumbai and the other in Bengaluru. Both terminals supply high-quality film and paper label stock to satisfy the demand in the local market. (UPM 2015).

On the other hand, there are other Finnish companies operating in India that are small globally but have found an excellent opportunity in the Indian market in diverse segments. These are Andritz Oy, Huhtamäki and Eltete. In the case of Andritz Oy, an important supplier of machinery and services for the pulp and paper industries in the world, the company is focused on enhancing and building paper machines in the Indian market. Moreover, Huhtamäki by acquiring the local company The Paper Products Ltd, the firm became the leader in flexible packaging converter in India counting with 10 per cent of the local market share and annual sales around USD 380 million. Currently, the company counts with factories located in Thane and Nagpur. Finally, Eltete, after receiving funds from Finnfund, the company operates in India with production facility in Gujarat. (Grundström and Lahti 2005).

6.2 Statistical Modeling of Indian Sawnwood Demand

6.2.1 Time Series Properties of Variables

Econometric methods are applied directly to different types of economic data sets. One of them is a time-series data set, which consists of a collection of observations on one of numerous variables obtained through repeated measurements over time (Asteriou and Hall 2007). The analysis of the properties of time-series data sets, such as normality and stationarity, are necessary in order to specify an appropriate econometric model. Thus, Figures AA to HH in Annex 4 illustrate the behaviour over time of the logarithmic transformations of the level series and their respective first differences, as well as their correlograms up to 12 lags; then, Table 8 brings statistics information regarding the normality of the data series based on JB tests; and Table 9 presents the results of ADF unit root tests that show when to use differenced time-series data or cointregration specifications.

According to Table 8, all series from 1992 to 2013 are distributed normally due to all *p*-values from the JB tests are greater than the 0.05 level of significance. Moreover, most of the series are positively skewed with exception of Indian Unemployment and Indian Population Density, which distributions count with an asymmetric tail extending toward more negative values. The positive kurtosis indicates a relatively peaked distribution in all the series.

Table 8: JB tests for normality of logarithmic transformations of the levels series 1992-2013.

VARIABLE	NORMALITY	*P*-VALUES	SKEWNESS	KURTOSIS
LIMP, Indian Imports of Sawnwood	1.443	0.486	0.178	1.797
LGDPC, Indian Gross Domestic Product per Capita	2.143	0.342	0.375	1.667
LDPS, Indian Import Price of Sawnwood	0.797	0.671	0.133	2.106
UE, Indian Unemployment	1.527	0.466	-0.301	1.859
EO, Indian Economic Openness	2.403	0.301	0.302	1.498
LPOPD, Indian Population Density	1.396	0.497	-0.177	1.818
LDPP, Indian Import Price of Plywood	1.089	0.580	0.294	2.083
LDPPC, Indian Import Price of Portland Cement	0.386	0.825	0.234	2.551

Note: Jarque-Bera Test refers to normality and the H_0 suggests that the variable is distributed normally.

Based on Table 9 results, all time-series variables from 1992 to 2013 are non-stationary in levels with exception of the logarithm of the Indian Import Price of Portland Cement (LDPPC). Thus, for all the series data, the lag length *p* considered was estimated by the Aikaike's information criterion and shows that the correct lag length for the 22 observations was 4. Also, half of the series data show to have a significant linear time trend in the ADF test option. The exceptions are the data series of Indian Unemployment (UE) and the logarithm of the data series of Indian Import Price of Sawnwood (LDPS), and Indian Import Price of Plywood (LDPP), which show to have only a significant intercept. Another exception is the logarithm of the data series of Indian Population Density (LPOPD), which show no significant linear time trend or trend. Furthermore, almost all the series data become stationary in the first difference and half of them show none intercept nor trend. The exceptions to this, are the series data that corresponds to the first difference of the Indian Gross Domestic Product per Capita D(LGDPC) and the first difference of the Indian Economic Openness D(EO), whose intercepts are significant, and the first difference of the Indian Population Density, which trend and intercept are both significant. The only series data that become stationary until the second difference are the data series of the Indian Economic Openness (EO) and the logarithm of the data series of Indian Population Density (LPOPD), which show no significant linear time trend or trend, and significant intercept, respectively.

Table 9: ADF Unit Root Tests for the variables in Levels, 1st and 2nd Differences, 1992-2013.

Levels

Variable	Lag	Determination	*t*-ADF	Significance Level	Decision
LIMP, Indian Imports of Sawnwood	4	Trend and intercept	-2.418	0.359	I(1)
LGDPC, Indian Gross Domestic Product per Capita	4	Trend and intercept	-1.884	0.627	I(1)
LDPS, Indian Import Price of Sawnwood	4	Intercept	-2.953	0.056	I(1)
UE, Indian Unemployment	4	Intercept	-2.562	0.116	I(1)
EO, Indian Economic Openness	4	Trend and intercept	-2.393	0.372	I(1)
LPOPD, Indian Population Density	4	None	-1.311	0.168	I(1)
LDPP, Indian Import Price of Plywood	4	Intercept	-2.367	0.162	I(1)
LDPPC, Indian Import Price of Portland Cement	4	Trend and intercept	-4.501	0.009	I(0)

1st Differences

Variable	Lag	Determination	*t*-ADF	Significance Level	Decision
LIMP, Indian Imports of Sawnwood	4	None	-4.275	0.000	I(0)
LGDPC, Indian Gross Domestic Product per Capita	4	Intercept	-4.266	0.004	I(0)
LDPS, Indian Import Price of Sawnwood	4	None	-5.851	0.000	I(0)
UE, Indian Unemployment	4	None	-6.111	0.000	I(0)
EO, Indian Economic Openness	4	Intercept	-2.638	0.106	I(1)
LPOPD, Indian Population Density	4	Trend and intercept	-2.869	0.195	I(1)
LDPP, Indian Import Price of Plywood	4	None	-4.345	0.000	I(0)

2nd Differences

Variable	Lag	Determination	*t*-ADF	Significance Level	Decision
EO, Indian Economic Openness	4	None	-3.073	0.005	I(0)
LPOPD, Indian Population Density	4	Intercept	-5.872	0.000	I(0)

Notes:
Level Critical Values with none determination: 1%= -2,69; 5%= -1,96; 10%= -1,61
Level Critical Values with intercept determination: 1%= -3,79; 5%= -3,01; 10%= -2,65
Level Critical Values with trend and intercept determination: 1%= -4,47; 5%= -3,64; 10%= -3,26
1st Differences Critical Values with none determination: 1%= -2,69; 5%= -1,96; 10%= -1,61
1st Differences Critical Values with intercept determination: 1%= -3,81; 5%= -3,02; 10%= -2,65
1st Differences Critical Values with trend and intercept determination: 1%= -4,62; 5%= -3,71; 10%= -3,29
2nd Differences Critical Values with none determination: 1%= -2,73; 5%= -1,97; 10%= -1,60
2nd Differences Critical Values with intercept determination: 1%= -3,86; 5%= -3,04; 10%= -2,66
I(1): There is one unit root which means non-stationary series
I(0): There is no unit root which means stationary series

6.2.2 Time Series Correlograms for the Indian Sawnwood Demand Model

Correlograms are useful tools that contribute to verify when the evaluated series are stationary. Thus, the correlograms in Figures AA to HH in Annex 4, indicate that the statistical modeling of the Indian Sawnwood demand based on time-series variables from 1992 to 2013, have problems in trend if non-stationarity is not taken into account.

For the demand model, Figures AA to HH in Annex 4 present a graph for each of the logarithmic and difference time-series with their respective correlograms. The correlograms in Figures AA to CC correspond to the explanatory variables that are part of the conventional demand model of Indian Sawnwood, whereas the correlograms in Figures DD to HH correspond to the explanatory variables that are tested by the ad hoc model.

The correlograms corresponding to the explanatory variables of the conventional demand model indicate that the time-series of the Indian Imports of Sawnwood (LIMP), the Indian Gross Domestic Product per Capita (LGDPC) and the Indian Import Price of Sawnwood (LDPS) seem non-stationary in their levels, but seem to be stationary in their respective first differences. However, the sudden and deep drop in observations from 2001 to 2004 indicate problems in the estimation during the period from 1992 to 2013. There seems to be two separate time periods.

Regarding the correlograms that correspond to the explanatory variables that are tested by the ad hoc model, the graphs indicate that the time-series of the Indian Unemployment (UE), the Indian Economic Openness (EO), the Indian Import Price of Plywood (LDPP), the Indian Import Price of Portland Cement (LDPPC) and the Indian Population Density (LPOPD) are non-stationary in their levels, but seem to be stationary in their respective first differences. However, also at least some of these series indicate problems in the estimation. The time series of the import price of plywood (LDPP) seem to have two separate periods: one is the declining trend between 1992 and 2009 and the other is the increasing trend between 2009 and 2013. The growth trend from 2009 to 2013 is evidently due to the economic reform. The two separate time periods can be seen in sawnwood imports (LIMP), gross domestic product per capita (GDPC), import price of sawnwood (LDPS), unemployment (UE), economic openness (EO), import price of Portland cement (LDPPC) and population density (POPD). If more data were available, the conventional model and the ad hoc model could be estimated for two time periods separately to get more reliable estimates. In general, severe problems here are related to the statistical data that cannot be kept very reliable due to the deficiencies in the Indian statistical system.

6.2.3 Results for Indian Sawnwood Demand Model

Generally, most of the economic variables are non-stationary. The economic theory considers that certain non-stationary variables have equilibrium relationships among each other based on the combination of the variables to become stationary. Thus, when a stationary equilibrium relationship exists then there is cointegration among the variables. Non-stationarity of the variables should be considered when choosing estimation method. In the following, we use the Engle-Granger (Engle and Granger 1987) error correction method in two steps when estimating the conventional import demand model. In addition also Johansen's cointegration method is applied.

Based on Engle and Granger (1987), the estimation for the Indian Sawnwood Demand Model follows the recommended two-step estimation procedure for error correction model. Thus, in the first stage, the long-run coefficients of the static relationship between the variables of the Indian Sawnwood Demand Model are obtained by ordinary least squares (OLS). In the second stage, the residuals obtained from the long-run regression are used to estimate the short-run ECM-model. The ECM model combines the information from the long-run relationship to short run dynamic factors.

6.2.3.1 Level Model

The level model estimates the long-run equilibrium equation. Based on the double-logarithmic formula (Eq. 4.2.1.A), there is a simple linear regression model where LIMP (Indian imports of sawnwood) is the dependent variable, and GDPC (Indian gross domestic product per capita) and DPS (Indian import price of sawnwood) are the independent or explanatory variables. The equation for the demand is static and it is estimated in EViews by OLS. Moreover, the time series model includes 22 annual observations, which correspond to the period from 1992 to 2013. The results are shown in Table 40: Level Model (in Annex 3). In addition, for this model the estimated coefficients together with the t-values (in parentheses) are shown in the following equation with logarithmic variables:

$$LIMP_t = \underset{}{0.139} + \underset{(0.061)}{2.464\ LGDPC_t} - \underset{(13.196)}{0.934\ LDPS_t} + \underset{(-2.885)}{u_t} \qquad \textbf{(Eq. 6.2.3.1.A)}$$

Thus, based on the equation above, both coefficients LGDPC and LDPS count with the expected signs suggested by the consumer theory (Varian 2010). Considering the values for both coefficients, 2.464 > 1 for LGDPC and -0.934 (in absolute value) < 1 for LDPS, Indian sawnwood demand shows to be income elastic and with respect to price, the elasticity is close to unitary in the long-term. However, taking into account the *p*-values of t-statistics is possible to verify this result. Consequently, Indian imports of sawnwood show to be highly dependent on both consumer income (LGDPC) and price effect (LDPS), based on their *p*-values (0.000 and 0.009, respectively) and 1% of significance level. For this reason, is possible to reject the null hypothesis of a zero coefficient. However, it must be borne in mind, that in the presence of non-stationary variables, the significance of the above long-run coefficients cannot be interpreted as usual.

Another important characteristic of the model is its goodness of fit. For instance, this could be explained by the 90% (adjusted R-squared = 0.899) of the variance of the imports of sawnwood series. The Durbin-Watson statistic (DW = 1.04), indicates serial correlation problems. However, considering that all the *p*-values that correspond to the Jarque-Bera Histogram-Normality test, Heteroscedasticity test and Breusch-Godfrey serial correlation LM test for the residual are greater than 0.05, therefore we assume that there is no problem in the model with non-normality, heteroscedasticity and serial correlation in the residual series, respectively.

Finally, as shown in Table 40: Level Model (in Annex 3), the results of the unit root test indicate that the residuals series for the model become stationary at the level. The lag length *p* considered was estimated by the Aikaike's information criterion and shows that the correct lag length for the 22 observations was 4. Furthermore, the residuals series show none intercept nor trend. Thus, the test results indicate that the null hypothesis is rejected considering that the value of t-statistic (-3.927) is higher than the level critical values at 1, 5 and 10 per cent (-2,678, -1,958 and -1,607, respectively). Therefore, we assume that the residuals of the model are stationary and all the variables of the long-run model are cointegrated.

Notwithstanding the above results, MacKinnon critical values, designed for cointegration testing, were also formed to test further the stationarity of the residuals from the level model for three variables. Thus, based on Table 42 in Annex 3, MacKinnon critical values indicate that the null hypothesis is rejected only at 10 % level. Consequently, the MacKinnon test results are somewhat contradictory compared to the results presented in Table 40. So, the final interpretation on the existence of cointegration remains very uncertain. However, we proceed to the second stage in modelling.

6.2.3.2 Error Correction Model

In spite of the uncertainties of the cointegration test results obtained for the long-run Level Model including three variables (LIMP, LGDPC and LDPS) we proceed to the second stage in modelling. The ECM model combines the information from the long-run relationship to short run dynamic factors. The Error Correction Model (ECM) is based on the residuals obtained from the equilibrium regression equation (Eq. 6.2.3.1.A). Thus, the short-run ECM includes the first differences of the variables (regressors and regressands) and the lagged Error Correction Term (ECTt-1). This new variable is obtained from the long-run equilibrium relationship. Hence, the ECM combines both the long-run and short-run properties built in it. Additionally, all the variables in ECM are stationary and consequently, we may assume that there should be no spurious regression problem on it.

Considering that, the two parts of the relationship in the ECM involve the differenced variables and the lagged Error Correction Term, then the short-run equation is formulated from the long-run equation as:

$$\Delta LIMP_t = a + b\,\Delta LGDPC_t + c\,\Delta LDPS_t + d\,ECT_{t-1} + \varepsilon_t \qquad \textbf{(Eq. 6.2.3.2.A)}$$

$$+ \qquad - \qquad -$$

Where ΔLIMP is the first difference of the Indian imports of sawnwood, ΔLGDPC is the first difference of India's GDP per capita and ΔLDPS is the first difference of the Indian import price of sawnwood; coefficient *a* is the constant term, coefficient *b* is

the income elasticity and coefficient *c* is the price elasticity; *d* is the coefficient of the ECT and ε is the error term. The value of the coefficient *d* must be negative, statistically significant and denote the speed of correction of the response variable to its long-run value. The signs under the other coefficients show the signs for the income and price coefficients expected for the short-run. The results are presented in Table 41: Error Correction Model (in Annex 3). In addition for this model the estimated coefficients together with the t-values (in parentheses) are shown in the following equation:

$$\Delta LIMP_t = 0.068 + 0.856\ \Delta LGDPC_t - 0.800\ \Delta LDPS_t - 0.732\ ECT_{t-1} \quad \textbf{(Eq. 6.2.3.2.B)}$$
$$(0.655)\ \ (0.871) \qquad (-3.584) \qquad (-4.120)$$

On one hand, as shown in the equation above, both of the coefficients for the first differences of LGDP and LDPS appear with the expected signs also in the short-run. The value for the coefficient of the lagged ECT counts with the characteristics expected since it is negative and highly significant statistically. Moreover, its value of -0.732 indicates that the Indian imports of sawnwood adjust on 73% in a year. On the other hand, the adjusted R-squared (0.594) obtained in the ECM shows a lower value than in the level model.

In terms of F-statistic, its *p*-value (0.0003) is highly significant and indicates that all the regression coefficients are also significant. However, the Durbin-Watson (DW) statistic (1.32) indicates autocorrelation problems, i.e. that the null hypothesis of no autocorrelation can be rejected. The *p*-values that correspond to the Jarque-Bera Histogram-Normality test and Heteroscedasticity test for the model residual are greater than 0.05, therefore there we assume no problem in the model with non-normality and heteroscedasticity, respectively. However, the value obtained for the Breusch-Godfrey serial correlation LM test is lower than 0.05, which indicates serial correlation in the residual series.

Finally, as shown in Table 41: Error Correction Model (in Annex 3), the results of the unit root test show that the residuals series for the model become stationary at the level. The lag length *p* considered was estimated by the Aikaike's information

criterion and shows that the correct lag length for the 21 observations after adjustments was 4. Furthermore, the residuals series show none intercept nor trend. Thus, the test results indicate that the null hypothesis is rejected considering that the value of t-statistic (-3.213) is higher than the level critical values at 1, 5 and 10 per cent (-2,686, -1,959 and -1,607, respectively). This indicates that there is no unit root in the residuals series of the model. Because of the uncertainties in the cointegration test results in the long run model, MacKinnon critical values for cointegration are tested also for the error correction model for three variables. Thus, based on Table 42 in Annex 3, MacKinnon critical values indicate that the null hypothesis cannot be rejected in any significance level. Hence, because of the uncertainties of the all above results, the Johansen cointegration technique is also tested to re-estimate the conventional model.

The system-based, Johansen Cointegration Test (Johansen 1995), is acknowledged theoretically superior than the two-step procedure for cointegration analysis (single-equation-based) proposed by Engle and Granger. The advantage is that the Johansen Cointegration method can estimate more than one cointegration relationship from data with two or more time series. In our case, the advantage is, that this method can be used to model non-stationary time series. For this reason the conventional model for Indian sawnwood demand is estimated using the Johansen method. Thus, the estimated long-run cointegration coefficients can be compared to the results of the long-run single-equation level model.

Based on the results obtained from the Johansen Cointegration Test (see Table 43, in Annex 3), there is one cointegration relationship between all the three variables of the model of Indian sawnwood demand. In other words, there is a long-run relationship among all these three variables. This is due to both rank test methods, Trace and Maximum Eigenvalue cointegration rank tests, confirm that the null hypothesis of one cointegration vector cannot be rejected. In both cases, the *p*-value (at most 1) is higher than 5 per cent (0.32 and 0.35, respectively). Thus, the cointegrated Johansen equation for LIMP that takes into account long and short term effects in the model estimation of Indian sawnwood demand, when explained by

income and price (LGDPC and LDPS, respectively). Consequently, the normalized cointegrating coefficients (standard error in parentheses) are described as follow:

LIMP	LGDPC	LDPS
1.000	-3.078	3.664
	(0.178)	(0.418)

Then for the purposes of this study, the long-run model, where LIMP is explained by the other variables is shown as:

$$LIMP = 3.078\ LGDPC - 3.664\ LDPS \qquad \textbf{(Eq. 6.2.3.2.C)}$$

Compared to the results of the level model (Eq. 6.2.3.1.A), the above cointegration coefficients are somewhat larger. For LGDPC the coefficient was 2.464 and for LDPS -0.934. The difference is large especially between the coefficients obtained for the price (LDPS). All these estimation results indicate the need for further modelling that is left for future research in this area.

6.2.4 Results for Ad hoc Model

Table 44 and 45, in Annex 3, shows the results for the estimated ad hoc models. Table 44 presents the long-run models for the Indian demand for sawnwood explained by income (LGDPC) and other variables describing economic activity, such as unemployment (UE), economic openness (EO) and population density (LPOPD). In addition to these models, various model alternatives were tested, where explanatory price variables were added to the models. Selected results from the various estimations are presented in Tables 43 and 44. The main criteria for selection was that the signs of the estimated coefficients follow economic theory.

The main interest in the estimation results is related to the magnitudes of the estimated elasticities and variations of the coefficients depending on the model. The income elasticity of Indian sawnwood imports varies between 2.31 and 3.08, from which the highest coefficient is obtained from the Johansen estimation (Eq.

6.2.3.2.C). The unemployment (UE) seem also to have a quite large, but negative impact on sawnwood imports (-2.98). The economic openness has a small positive effect (0.10). The coefficient of population density (LPOPD) is the largest (from 12.43 to 15.80) depending on the model. This indicates that a 1 percent increase in population density induces nearly 16 per cent growth in sawnwood imports.

According to the OLS-estimation results the elasticity of sawnwood imports with respect to its price (LDPS) is between -0.92 and -3.66, from which the larger value is obtained from the Johansen estimation (Eq. 6.2.3.2.C). The price elasticity estimated from the conventional level model (Eq. 6.2.3.1.A) was -0.93 indicating that, for example 1 percent rise in price reduces sawnwood imports to India by almost 1 per cent. For the Johansen estimate, a 1 per cent increase in price reduces imports by 3.66 per cent. So, there is a large difference between the estimates indicating the need for further modelling. .

Also price relations between sawnwood price and plywood price (DPS/DPP) as well as sawnwood price and Portland cement price (DPS/DPPC) were tested in the models (see Table 45). The estimated cross price elasticities can be interpreted as elasticities of complement due to the negative sign. Thus, with respect of plywood, both of the estimated cross elasticities are quite large (-5.28 and -5.50), indicating that sawnwood and plywood are quite close complements goods in imports. Similarly, there is a high complementary relationship between sawnwood and Portland cement with cross elasticities of -1.94 and -2.44.

In the tested models, import price of plywood (DPP) and import price of Portland cement (DPPC) were not statistically significant or showed the opposite sign suggested by the consumer theory (Varian 2010).

Among the estimated coefficients of the variables, LPOPD, UE and LGDPC appear to be the most significant (based on *p*-values of t-statistics) and elastic (in absolute value), in this order. The same situation is showed for LPOPD and LGDPC in the models, where price relations DPS/DPP and DPS/DPPC are included.

In almost all the models, the goodness of fit is explained above 85 per cent of the variance of IMP (R-squared > 0.85). The only exception is UE, with an R-squared value of 0.35. Thus, it can be explained that most of the models fit quite well the data series. In terms of autocorrelation, on one hand, the DW statistic indicates positive high serial correlation (values < 2) in all the models. This would be caused by omitted variables, misspecification or simple systematic errors in measurements. In the presence of serial correlation the statistical significance of the coefficients cannot be interpreted, the estimates are inefficient, but the OLS estimators are stated as unbiased. On the other hand, the Breusch-Godfrey Serial Correlation LM Test shows no serial correlation in almost all the variables of the ad hoc model due to *p*-values greater than 0.05, with exception of UE (*p*-value = 0.0049). Finally, since the *p*-values obtained from the Heteroscedasticity test and JB test are all higher than 0.05, it can be assumed that the ad hoc model does not suffer from heteroscedasticity nor non-normality in the residual series. Additionally, considering the results of unit root test for each variable in the ad hoc model, most of the t-statistics are greater than the corresponding critical values at the 1%, 5% and 10% level (with exception of UE, which happened in the first difference).

6.3 Summary of the Results

India is a country that occupies about 3.29 million km^2 (around ten times Finland's land mass) with an approximate population of 1.21 billion (more than 200 times Finland's population). Moreover, the cultural and linguistic diversity is immense within the vast territory. Today, India's economy is along with China one of the largest and the second fastest growing economy in the world and it is expected to be the third largest economy in the next fifteen years. Its success is based on a high growth rate of gross domestic product (GDP) and greater macroeconomic stability. Hence the country is gradually transforming from an agriculture based economy into a service-oriented economy. The cause was due to economic liberalization policies focused on trade, which were adopted by the government since 1991 and have been supported by gradual reductions in domestic tariffs and the elimination of most quantitative trade restrictions. As a result, India has increased both imports and exports as well as growing incomes and spending among consuming classes. In

addition, rising number of consumers has increased ownership of homes and the demand in the domestic urban market for wood products. These factors accelerated the uncontrolled use of local resources that has caused a wood deficit in the country and a strong dependence on imports of raw material. Notwithstanding and despite the raw material shortages faced by the Indian wood base industry, this transition turned India into a potential player in the global economy and attracted the interest of foreign exporters to set up promotional and marketing agencies in the country in terms of wood and wood products. Such are the cases of New Zealand with NZ Wood, Australia with Forest & Wood Products Australia Limited- FWPA and EEUU with Software Export Council- SEC (Dun and Bradstreet 2015).

India's participation in the global market of wood products accentuates the importance to explore both the Indian market demand for wood and primary wood products as well as the different opportunities available for investment and sales on the part of foreign manufacturers and investors. Thus, providing a better understanding on the facts that impact the consumption and imports of a determined industry in India (e.g. sawnwood) is an appropriate platform for industry stakeholders and policy makers that are searching for information on possible market prospects and challenges for new export businesses outside their frontiers.

On the basis of the above, some global wood product manufacturers and local governmental institutions in India have initiated studies, desiring to enter the Indian market of wood products and to develop the local market. Thus, on one hand, a previous Indian research conducted by Yadav and Basera (2013), intended to understand the situation in the production and trade of forest products in India and their role in the global, national and regional economy. On the other hand, the interest of British Columbia and the United States, among others larger manufacturers, is to explore both sawnwood market and wood products industry in India, in order to ensure potential opportunities for investments and sales in the Indian market. Hence, from the Canadian side, Rattan (1999) concluded that in India there is a lack of knowledge in terms of Canadian softwood for both sawnwood and wood products but there is a high demand for finished wood products for trade. Whereas, Agarwal and Shang (2004), revealed a great potential for good quality

Canadian softwood due to depleted wood supplies and high prices for high quality hardwood in the Indian domestic market. Meanwhile from the American side, Ganguli and Eastin (2007) confirmed that in India there is less consumption of tropical hardwood (e.g. teak) due to its high price and low quality of imported, and more use of high end furniture. However, data regarding analysis of most of the Indian wood primary products is scarce and unreliable. Therefore, the purpose of this research is to contribute to a better understanding on the Indian wood products market through the description and analysis of the potential drivers that determine the Indian demand of wood products, focusing on sawnwood.

In furtherance of the purposes, different methods were used for the description and analysis of secondary data collected. Thus, the descriptive method is used to analyze background information and data related to Indian situation in both global and local markets. Meanwhile a statistical method is used to analyze data for empirical modelling. In this case, the analysis is based on the impact that changes in one or more variables cause in Indian sawnwood demand. Then, seeing that most of the sources vary among themselves and due to a lack of an efficient data collection system in India, only the most reliable and accurate sources have been considered for gathering data. Hence, for this purpose, annual data over the period of 1992 to 2013 that corresponds to variables related to Indian consumer income and price of sawnwood in India are mainly collected from international sources such as the World Bank Development Indicator Database, the Food and Agriculture Organization of the United Nations Statistical Database (FAOSTAT) and the United Nations Commodity Trade Statistics Database (UN Comtrade). Other sources such as the International Tropical Timber Organization (ITTO) and the Directorate General of Commercial Intelligence and Statistics (DGCIS) were used to complement gaps in the information and to confirm the veracity of the data collected.

In terms of the descriptive method, the analysis of background information and secondary data is used to answer three research questions of the study. The first two questions are related to the current state of India's economic development and woodworking sector markets (focused on sawnwood), respectively, as well as their possible future prospects. The third question is focused on the market opportunities

and challenges that the Indian wood product market features for foreign and Finnish wood-based industry companies and shareholders.

6.3.1 What is the current state of India's general economic development and possible future prospects?

To answer the first question, India's current economic development is the result of an economic reform that has renovated the recent local economic structure and turned the country into the second fastest-growing economy in the world with great opportunities for trade of good and services with foreign markets. These changes accelerated the consumption in the domestic market by increasing the GDP due mainly to the growth of the service sector. In this way, the service-oriented economic growth contributed to diversify the industry and its operations, but above all, to transform agriculture (including forestry) into a self-sufficient sector. Moreover, India's market liberalization is one of the causes of the increase in the number of educated workers and incomes in the country, due to higher salaries and more sources of employment (mainly found in the agriculture-forestry sector). Hence, India has been positioned as the third world-largest economy by high purchasing power parity.

Today, India is one the few countries in the world that has recovered earlier from the recent global financial crisis. In addition, the country contributes with 7.7 per cent of world GDP and its GDP is expected to steadily increase in the coming years. Then, under this trend it is forecasted that the Indian market will become the fifth largest consumer market in the world by 2025. All these changes in the Indian economy have increased the attraction for Foreign Direct Investments from companies interested in establishing operations in the domestic market due mainly to India's return on investment is considered as one of the highest in the world. However, the Indian economy is still complex and despite its progress, the fiscal deficit and government debt should be addressed, as well as developing infrastructure and reducing the large number of people surviving under the poverty line. Furthermore, the country still depends on subsistence agriculture and high technology for developing its economy.

6.3.2 What is the current state of India's woodworking sector markets especially focusing on sawnwood and how is going to be in the future?

India is an important manufacturer and consumer of wood and primary wood products in the world. As such, the demand for wood and primary wood products has increased in the construction sector as well as in different industries such as paper, furniture and wood panel among others. Hence, the Indian wood-based industry sector is a net importer of raw materials, such as tropical hardwood logs, that are required to satisfy its domestic demand of wood.

One of the reasons for India to import raw materials is due to the scarce availability of wood in the country caused by the limited per capita forest resources. Apart from this, forests and the domestic wood-based industry are protected by government regulatory policies such as banning both illegal logging within Indian forests and exports of logs, and by high import duties on other forest products than logs, respectively. Other factor that increase the quantity demanded on raw materials is the high consumption of fuelwood, which is considered as the highest in the world, in both rural and urban populations. However, the wood-based industry is characterized by low-technology manufacturing sectors of value-added wood products, which operate without regulations for product standards, at low-cost and with cheap labor that still uses brute force within wood processes.

Despite these factors, the Indian wood and wood product market sector has increased its commercialization at both domestic and international level and together with the agriculture sector are the highest generators of sources of employment in the country. Moreover, considering the continued growth in both the population and the middle-class segment with higher purchasing power, the quantity demanded for wood and wood products are expected to increase in the near future due to major investments in socio-economic infrastructures and housing that requires of logs, sawnwood and furniture among others.

In the case of sawnwood, this sector is growing fast and represents a competitive industry but it still remains a small segment within the entire wood market in India.

Despite of that, sawnwood has been so far the largest sector among the different wood-based industries in the country due to this product is used in small volumes in different industries but mostly in housing. Moreover, the technological development in the sawnwood sector is low, counts with local sawmills that do not differ from each other and which in turn still are labor intensive. The production is characterized by not following international standards due to the fact that local consumers prefer wide and long units for final applications that in India are usually unpredictable. Additionally, poor manufacturing practices are common in local sawmills causing problems such as warp and sawing variations. In consequence, final prices of sawnwood are low, which is an advantage for trade partners.

Production of sawnwood depends on logs supply and imports of sawnwood are not required to satisfy the domestic demand even though it is expected to increase in the following years. With respect to sawnwood consumption, this is primarily domestically produced, but exceeds the production of sawnwood due to rising purchasing power within the population and major real estate development. In this way, the volumes of sawnwood exported are insignificant and still lower than the volumes imported.

Finally, in terms of wood species, both Indian production and consumption of tropical hardwood sawnwood are among the five highest in the world. In consequence, most of the tropical hardwood species available in the country are transformed into sawnwood and therefore, the sawnwood sector is mainly supplied domestically by tropical hardwood species and by a minor percentage of softwood species. However, imports of softwood sawnwood represents a bit more than half of the total imports of sawnwood in the country and the volumes are expected to increase in the following years. The reasons are the gradual reduction of import tariffs for sawnwood, the growing preference of Indian consumers to use softwood instead of hardwood due to excellent results in end-use applications as well as its better competitive price in the market, which in part is due to the rupee appreciation against other currencies and its fairly stable exchange rate with USD and Euro.

6.3.3 What are the market opportunities and challenges that the Indian wood product market features for foreign and Finnish wood-based industry companies and shareholders?

About the last question of the descriptive method, there are at least six different opportunities that the Indian wood product market features for both foreign and Finnish wood-based industry companies and investors. First and foremost, the already large consumer market in India is projected to become the fifth largest in the world by 2025 due to continued population and economic growth. This brings a wide range of business prospects for foreign exporters and investors to explore different sectors in India, such as wood industry, housing, packaging and furniture. In the case of Finnish wood-based industry companies (e.g. Metso, Stora Enso and UPM), they have already started to build business operations in India specifically in the pulp and paper sector. As such, the existence knowledge about the Indian market facilitates developing new strategies to introduce other wood products in India (e.g. sawnwood).

A second opportunity is focused on supply of raw materials into the country. India relies on imports due to availability and shortage of wood resources in the country caused by government regulatory policies, limited per capita wood resources and high consumption of fuelwood. In this case, the opportunity is open to wood-based industry companies with strong and low cost in logistics, wood sources and above all price-competitive supply due to India is a price-sensitive market. In other words, the demand of wood products in India changes accordingly to lower or higher prices.

Third, a significant opportunity for both Finnish and foreign wood-based industry companies, is the introduction of softwood sawnwood into the Indian market even though the country is a major importer of logs, has a long tradition in using hardwoods and lacks of knowledge on the use of softwood. Today, the demand for sawnwood is growing rapidly due to different factors. One of them is the rising purchasing power among the population that in consequence has increased the real estate development. Another factor is the gradual reduction of tariffs on imports of sawnwood, which has lowered the import price even more than the cost of

sawnwood production at domestic level. In addition to this, there is a growing acceptance for softwood sawnwood in India due to the use of softwoods is considered as an alternative to replace hardwoods in different applications in sectors such as housing, packaging and furniture. The reasons are that softwoods are easy to work and show excellent results in end-use applications, besides that some tropical hardwoods imported from African and South American countries have high prices and low quality.

Fourth, the supply of specialty/value-added wood products and engineered wood products for furniture, joinery and high-end applications in housing and commercial constructions. These high-quality finished wood products can be supplied to the rapidly growing middle-class population as well as the wealthier Indian market, which are continually exposed to western-style influences. Thus, there is a significant opportunity to those wood product companies ready to get established in the Indian market at an early stage, thereby avoiding competition in the market.

Fifth, taking into account the absence of industry standards and that the end user determines species, grading and dimensions in India, there is an opportunity to those exporters able to adapt production to custom orders. In the case of Finnish companies, it is important that exporters work together with importers and traders in order to understand end-user needs, as well as to recommend and educate them about suitable products for certain applications.

Finally, since the World Bank confirmed that doing business with India is becoming easier, a sixth opportunity is oriented towards negotiating potential Free Trade Agreements (FTAs) with India. FTAs maximize the economic benefits between trade partners and for both foreign and Finnish wood companies can enhance the competitiveness on wood exports into India. Moreover, FTAs encourage investments and the free flow of goods and services due to the reduction of trade barriers and other issues (e.g. sanitary and phytosanitary disputes) can be addressed.

As well as with opportunities, the Indian wood products market shows at least six different challenges that foreign and Finnish wood-based industry companies and

investors should be aware when entering this emerging market. First of all, the most important barrier that wood-based industry companies has to face is the consumer perception in the use of wood. In India, consumers perceive hardwoods as stronger, with better appearance and more resistant to fire and termites. For these reasons, there is a need of an awareness campaign on softwood attributes and applications in order to foster commercial trials and increase its availability in the market. Hence, the limited knowledge regarding softwood species and products, as well as about their suppliers, is a significant challenge to entry for foreign and Finnish exporters.

Third, the difficulty of building market intelligence is another challenge when entering India's wood product market. India lacks of efficient statistical systems to collect and disseminate data related to production and trade of wood and wood products. The data available is incomplete and contradictory, therefore is unreliable and makes even more difficult that suppliers prepare strategies and take advantage of the opportunities provided by India's demand for wood and wood products.

Fourth, currency fluctuations impact the import demand of wood and wood products. As such, rupee devaluation presents a challenge for countries with overvalue currencies, which is shown in the decrease of their exports to India. Therefore, it is important for such countries to track the rupee and learn to manage currency risks.

Fifth, establishing sustainable distribution channels is a challenge when entering the Indian wood product market. India possess an underdeveloped and fragmented domestic distribution system for most wood and wood products. This distribution channel consist of importers, distributors, wholesalers and retailers, each of them with rigid margins, which impact economically foreign suppliers within the Indian market. Additionally, there are no loyalties with suppliers but high risks of replacement by other competitors. Hence, it is necessary to diminish the number of intermediation points in the trade channels in order to allow customers to recognize the origin of wood products.

Finally, the sixth challenge is bureaucracy, which can impact business decisions. Therefore suppliers require assistance from reliable Indian firms about tax, payment and transparency issues as well as a complete understanding of the local culture.

6.3.4 What factors explain sawnwood demand in India?

In the statistical phase of the study, an explanatory analysis tries to model the Indian demand for sawnwood and answer the research question related to the factors that impact such demand. Thus, an econometric time-series model is used to estimate elasticities for the demand of Indian sawnwood for annual data over the period 1992 to 2013. The explanatory analysis assesses whether the conventional demand model including income and price variables or an ad hoc model with several explanatory variables, are able to explain the Indian demand for imports of sawnwood. Because of non-stationarity of the data, the Engle and Granger (1987) estimation was used for modelling. Due to the uncertainties related to the results of the cointegration testing, also Johansen method (1995) was applied. For the purpose of this study, only long-term elasticities are used to answer the research question related to the statistical phase of the study. Notwithstanding, in this study short-term elasticities for the conventional demand model were all smaller than long-term elasticities, thus according to previous studies about sawnwood consumption, e.g. Hurmekoski et al. (2015). Moreover, the long-term elasticities obtained in the estimations of both models, conventional and ad hoc, were statistically significant in all the cases and their significance varies from one variable to another. However, the interpretation of the significance of coefficients is not straightforward. It must be remembered that there were much uncertainties in the results of the cointegration testing.

Based on the results of the conventional demand model, the imports of sawnwood in India are related to income and price. In the long-term, the Indian demand for import of sawnwood appears to be elastic in both income and price. Thus, the rise in Indian consumer income (i.e., Indian GDP per capita) might have a strong impact in the growth of imports of sawnwood in India due to major use in the construction sector, basically for housing. However, with respect to import price of sawnwood, the high elasticity value confirms that India is a price-sensitive market where over time,

Indian consumers have more time to adjust their habits when price changes. As such, in the very competitive Indian market of sawnwood, consumers would switch to possible substitutes such as the import of softwood sawnwood instead of hardwood sawnwood, the import of sawnwood from countries with more favorable tariffs or the import of logs for local production of sawnwood. Moreover, sawnwood seems to be a luxury product when the final use is destined to furniture or interior decoration. Therefore, the price effect seems to play a key role to determine the demand for imports of sawnwood in India.

With respect to the ad hoc model, the results of the Indian demand for imports of sawnwood show the long-term elasticities for the income, price and other variables describing economic activity. In terms of income and economic activity variables, except for economic openness (EO), all the long-term elasticities shows to be greater than one or elastic and statistically significant. As such, the elasticities for these variables could determine that a rise in Indian consumer income (GDP per capita) and a higher population density in India would result to be determinants of absolute growth in the quantity demanded for imports of sawnwood in India probably due to a major use of sawnwood caused by housing within the construction sector. In the case of unemployment (UE), an increase in the rate of this variable is expected to cause a strong impact in demand for sawnwood by diminishing the level of imports of this product in India. On the contrary, the trade openness rises would have a minor impact on total demand for imports of sawnwood.

In relation to price, the long-term elasticities appear to be inelastic for the import price of sawnwood (DPS), which is contrary to the results obtained in the conventional demand model, but elastic and statistically significant for the price relations between sawnwood price and plywood price (DPS/DPP) as well as for sawnwood price and Portland cement (DPS/DPPC). Nevertheless, the price elasticity shows to be higher with DPS/DPP than with DPS/DPPC or DPS. All cross-price elasticities show negative sign and therefore, such products complement to each other. Furthermore, only the income variable GDP per capita and Population Density (POPD), among the economic activity variables, appear to be highly significant with cross-price variables. However, the elasticity shows to be higher with POPD than

with GDP per capita. In consequence, the results in the ad hoc model suggest that the demand for imports of sawnwood has a slight drop when import prices of sawnwood rise or is insensitive to price changes. This probably occurs due to a small range of substitute products to replace the use sawnwood e.g. in the construction sector or for furniture or interior decoration. In addition to this, although the strongest impact in the demand for imports of sawnwood is due to e.g. the increase level of residential construction caused by population density, the smallest negative price effect occurs when DPPC increases with respect to DPS.

7 DISCUSSION

This study aimed at analyzing the Indian sawnwood market by using both descriptive and statistical research methods. The main contributions of this study were to provide a broader understanding on the importance of the sawnwood demand in the Indian wood products market as well as to explain the economic factors that impact the Indian demand for imports of sawnwood. Such economic factors were addressed by estimating a conventional demand model and an ad hoc model based on some previous research (e.g. Wan 2011, Hurmekoski et al. 2015). Thus, information regarding the Indian wood market is available but, on the contrary, there is a lack of econometric-based studies. The reason may be due to historical time-series data are unreliable and scarce.

Regarding the conventional demand model, in the long-term, the Indian sawnwood demand (softwood and hardwood) shows to be elastic in both income and price (+3.08 and -3.66, based on Johansen Cointegration Test results). These results vary compared to the cointegration coefficients obtained in the level mode for income and price (+2.464 and -0.934, respectively) and to previous studies related to sawnwood. For example, on one hand, estimates of the long-term income elasticity of import demand for sawnwood vary from +0.50 and +0.70 for hardwood and softwood, respectively (Buongiorno, 1979) to +2.20 for softwood (Hurmekoski et al., 2015) and +2.71 (Turner and Buongiorno, 2004). On the other hand, estimates regarding the long-term price elasticity of import demand for sawnwood vary from -0.20

(Buongiorno, 1979) to -0.49 (Turner and Buongiorno, 2004) and -2.62 for softwood in Nordic countries and Austria (Hurmekoski et al., 2015). The results obtained in previous studies are challenging to compare due to different reasons such as definition of sawnwood (softwood or hardwood), data sources, and period of study as well as model and estimation method. Thus, Turner and Buongiorno (2004) estimated income and price elasticities with panel data from 64 countries from 1970 to 1987 by Arellano-Bond method. Hurmekoski et al. (2015), estimated the sawnwood consumption per capita with respect to GDP per capita and import price of sawnwood with panel data from 17 European countries from 1980 to 1996 by OLS and two-stage least squares method. Buongiorno (1979), used yearly data from 43 countries over the period from 1963 to 1973 to estimate income and price elasticities of demand for sawnwood by analysis of covariance and OLS. Hence, in this study, both income and price elasticities of India's demand for imports of sawnwood are higher than expected. In addition to this, the price effect seems to play a key role to determine import demand of sawnwood. In other words, a sudden rise of 1 per cent in the import price of sawnwood in India would cause a 3.6 per cent increase in the demand for imports of sawnwood. Consequently, Indian imports of sawnwood show to be highly dependent on both consumer income and price effect. That is, the rise in Indian sawnwood demand is caused by the increase in Indian consumer income (GDPC), whereas a higher increase in Indian imports of sawnwood is caused when the import price of sawnwood (DPS) increases.

With respect to the ad hoc model, the results for the Indian sawnwood demand show only the long-term elasticities for the variables that describe income, price and economic activity and when some of them are estimated together with cross-price variables. Thus, in terms of income and economic activity variables, in the long-term the Indian sawnwood demand shows to be elastic for gross domestic product per capita (GDPC= +2.51), unemployment (UE= -2.98) and population density (POPD= +13.47) but inelastic for economic openness (EO= +0.10). The variable EO is highly significant at 99 per cent level and its magnitude and sign are in range according to previous studies (e.g. Nasreen and Anwar 2014 and +0.92 in Hurmekoski et al. 2015) and theoretical expectations, respectively. However, except for POPD, all the variables show the correct sign according to theoretical expectations and previous

studies e.g. Haripriya and Parikh (1998), Varian (2010) and Hurmekoski et al. (2015). For the purpose of this study a positive sign was expected for POPD variable due to its high value impact positively the quantity demanded for sawnwood in the country.

Regarding the magnitude of these elasticities, only UE seems to be high, while both GDPC and EO show to be in the range when are compared to Hurmekoski's ad hoc model estimations (-0.65, +2.08 and +0.92, respectively). The variable UE, which is an opposite indicator to GDPC, suggest that an increase in its rate would cause a decrease in the level of demand for imports of sawnwood. In the case of POPD, its magnitude is the highest among the long-term elasticities tested in this study. However, this variable was excluded in Hurmekoski's research due to overlap and endogeneity. In addition, the variable is highly significant at 99 per cent level and its impact suggest that a rise of 1 per cent in India's population density would cause a 13.47 per cent increase in the demand for imports of sawnwood.

The ad hoc model also shows that the imports of sawnwood in India are related to price. However, contrary to the conventional demand model, in the long-term the variable import price of sawnwood (DPS) appears to be inelastic (-0.92), significant at 90 per cent confidence level and its sign is also correct according to theoretical expectations. Additionally, its magnitude is too low compared to the results obtained in the conventional level model and the Johansen Cointegration Test as well as to Hurmekoski's results (e.g. -2.62 for softwood in Nordic countries and Austria). Thus, when the import price of sawnwood increases in 1 per cent, the demand for imports of sawnwood would be slightly reduced in 0.92 per cent.

Continuing with the ad hoc model, it was also possible to estimate the relationships between explanatory variables and cross-price variables. In terms of cross-price variables, import price of sawnwood only shows to be significant when it is related to both import price of plywood (DPS/DPP) and import price of Portland cement (DPS/DPPC). Thus, from all the explanatory variables, only GDP per capita and Population Density (POPD) appear to be highly significant (i.e. at 99 per cent confidence level) with cross-price variables. For both variables, the highest

elasticities are shown when are compared to DPS/DPPC (+2.83 and +15.80). Although POPD shows higher elasticity than GDPC, its magnitude cannot be compared to Hurmeskoski's results due to the author excluded the POPD variable owing to overlap and endogeneity. Additionally, the sign shown for POPD is against the economic theory. Meanwhile, the magnitude and sign for GDPC are according to the range (e.g. +2.08, Hurmekoski et al., 2015) and theoretical expectations, respectively.

Between the cross-price variables, despite the highest significance (at 95 per cent confidence level) appears when DPS/DPPC is related to POPD, in terms of magnitudes, DPS/DPPC is smaller when is compared to DPS/DPP (-2.44 and -5.28, respectively). Furthermore, regarding the magnitudes of these cross-price variables, there are no previous studies related to sawnwood or other forest product that can be used for comparison. For the cross-price variable DPS/DPP, the highest magnitude is shown when is related to GDPC (-5.50), therefore, the price effect shows to be stronger when an increase in the price of DPP leads to a rise in DPS.

The ad hoc model shows that all long-term elasticities are elastic and statistically significant. In addition, the negative sign shown in the cross-price elasticities determine that such products are complement to each other. In consequence, a rise of 1 per cent in the Indian population density causes a strong positive impact in the demand for imports of sawnwood increasing the quantity demanded by 15.80 per cent. As such, the effect of rising the population density translates into higher social capital that leads to a rise in the quantity demanded for imports of sawnwood to supply the construction sector. Meanwhile, the negative price effect caused in the quantity demanded for imports of sawnwood is also strong due to the rise of 1 per cent in the import price of plywood complemented with the rise in the import price of sawnwood will reduce in 5.28 per cent the quantity demanded of sawnwood in India.

Econometrically, it is hard to estimate forest products demand equations due to the lack of suitable and accurate data that, in some cases, has to be manipulated based on the variable of interest. In this study, even though the limited short time-series available (22 observations), it was possible to generate different models to obtain the

long-term income and price elasticities that explain the demand for imports of sawnwood in India. Moreover, despite that econometric parameters tend to differ from study to study, the results obtained from the empirical and statistical models are considered satisfactory based on their similarities with previous research (e.g. Hurmekoski et al., 2015) and theoretical expectations. However, considering some differences in the results of this study as well as uncertainties related to the model results, there is a need for further modelling that is left for future research in this area.

8 CONCLUSIONS

This study has analyzed India as a potential market for sawnwood by determining the factors that influence the demand for imports of this product (hardwood and softwood) in the country. The results obtained from the demand model that estimates the relationship between socioeconomic variables and the demand for sawnwood in India, demonstrate that the demand model can be applied to developing countries where statistics are scarce and it can be used for different forests-wood products, other than sawnwood.

The results shown for the conventional demand model and ad hoc model suggest that the demand for imports of sawnwood is related to income and prices and depends on other factors such as population density, unemployment and economic openness (in this order). In the case of India, the growth in population leads to a rise in the labor force participation represented mainly by an also growing middle-class segment with higher purchasing power (i.e. consumer income). However, in terms of income and price, the results of this study suggest that a rise in gross domestic product (GDP) per capita induces a smaller positive change in the quantity demanded for imports of sawnwood in India than a corresponding change in the price variable. Hence, there is a strong impact in sawnwood importer's decisions due to changes in the import price of this product as well as in the import price of plywood, which according to the results both products complement each other. This confirms that in the long-term India is a price-sensitive market.

The research highlights the strong impact caused by Indian GDP per capita and import price of sawnwood in the quantity demanded for imports of this product. With respect of GDP per capita, the reason might be due to that consumer income increases along with increasing the economic activity level (e.g. in the construction sector for housing and socioeconomic infrastructures) and consequently, the use of sawnwood is more required for different purposes such as interior decoration or furniture due mainly to cultural reasons. In the case of import price of sawnwood, changes in price cause adjustments in Indian consumer's habits over time. As such, there is a probability to replace traditional wood products made from hardwoods with softwoods. Furthermore, importers might search for more economically-favorable suppliers of sawnwood (hardwood or softwood) or, when that is not possible, logs as a raw material for local production of this product.

It is expected that the information obtained in this study can contribute as a valuable reference source for those major foreign and Finnish wood-based industries searching for possible market prospects and challenges to export their products (especially sawnwood), outside their frontiers as well as in regard to their investment decisions. However, the results raise several questions (e.g. response of imports of softwood sawnwood to income and price variations as well as to construction activity), which can be only answered with further research and the refinement of methodologies and models that allow to estimate, with more accuracy, the effect of other potential explanatory variables. Finally, it should be noted that, in order to achieve more satisfactory results, it is important to consider increasing both the time period for the study or the number of observations (e.g. monthly data) with more accurate data if possible.

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ANNEXES

Annex 1

Table 10: Global production of hardwood and softwood sawnwood (m^3), 1990-2013.

YEAR	PRODUCTION		
	Hardwood	Softwood	SAWNWOOD TOTAL
2013	119,499,981	301,396,609	420,896,590
2012	114,516,568	287,971,934	402,488,502
2011	106,953,441	281,403,514	388,356,955
2010	105,883,310	270,805,341	376,688,651
2009	95,225,753	249,129,993	344,355,746
2008	109,229,546	277,692,898	386,922,444
2007	116,686,007	317,604,007	434,290,014
2006	114,689,612	331,477,717	446,167,329
2005	111,307,545	326,487,935	437,795,480
2004	106,987,036	318,332,426	425,319,462
2003	99,646,237	300,034,763	399,681,000
2002	99,422,883	292,976,707	392,399,590
2001	101,045,974	277,993,572	379,039,546
2000	105,465,912	279,376,979	384,842,891
1999	109,483,683	278,982,897	388,466,580
1998	111,675,426	266,548,175	378,223,601
1997	121,224,030	272,296,943	393,520,973
1996	119,390,530	267,352,368	386,742,898
1995	122,694,030	268,058,391	390,752,421
1994	124,669,050	271,227,787	395,896,837
1993	128,501,220	265,956,832	394,458,052
1992	130,871,280	272,388,249	403,259,529
1991	130,892,148	287,347,920	418,240,068
1990	133,512,180	329,496,637	463,008,817

Data: FAOSTAT 2014.

Table 11: Global export and import of hardwood and softwood sawnwood (m^3), 1990-2013.

YEAR	EXPORT			IMPORT		
	Hardwood	Softwood	Sawnwood Total	Hardwood	Softwood	Sawnwood Total
2013	19,568,690	104,922,501	124,491,191	20,070,120	101,684,203	121,754,323
2012	19,833,346	98,625,368	118,458,714	19,669,095	93,927,702	113,596,797
2011	20,286,299	97,812,690	118,098,989	20,570,315	95,819,101	116,389,416
2010	19,576,057	92,540,043	112,116,100	18,582,800	88,957,011	107,539,811
2009	15,993,050	84,542,976	100,536,026	15,090,573	79,495,472	94,586,045
2008	19,986,889	97,414,289	117,401,178	19,719,024	92,097,875	111,816,899
2007	22,429,761	109,796,519	132,226,280	23,538,542	110,599,787	134,138,329
2006	22,681,682	113,217,235	135,898,917	23,893,332	110,228,278	134,121,610
2005	23,987,935	113,127,803	137,115,738	25,657,279	109,434,983	135,092,262
2004	26,303,816	108,811,908	135,115,724	26,607,907	107,671,672	134,279,579
2003	24,220,959	101,373,476	125,594,435	23,806,631	97,117,074	120,923,705
2002	23,051,221	97,044,809	120,096,030	24,943,664	92,628,764	117,572,428
2001	21,093,501	91,659,985	112,753,486	23,409,608	89,182,004	112,591,612
2000	20,818,069	92,782,047	113,600,116	23,975,602	91,657,137	115,632,739
1999	18,406,014	87,771,142	106,177,156	20,671,288	88,324,854	108,996,142
1998	15,487,521	82,525,042	98,012,563	18,673,986	83,266,669	101,940,655
1997	16,308,993	82,759,033	99,068,026	20,493,440	84,877,288	105,370,728
1996	16,418,319	80,450,042	96,868,361	19,043,632	78,240,983	97,284,615
1995	17,346,296	79,556,135	96,902,431	19,443,857	76,543,112	95,986,969
1994	16,335,481	76,101,948	92,437,429	18,705,597	78,787,256	97,492,853
1993	16,982,184	70,929,018	87,911,202	17,596,986	70,934,048	88,531,034
1992	17,127,833	65,730,250	82,858,083	18,014,057	66,034,764	84,048,821
1991	15,091,149	60,413,397	75,504,546	15,456,290	62,048,501	77,504,791
1990	15,185,349	62,442,335	77,627,684	16,099,092	68,372,369	84,471,461

Data: FAOSTAT 2014.

Table 12: Global consumption of hardwood and softwood sawnwood (m^3), 1990-2013.

YEAR	HARDWOOD	SOFTWOOD	SAWNWOOD TOTAL
2013	120,001,411	298,158,311	418,159,722
2012	114,352,317	283,274,268	397,626,585
2011	107,237,457	279,409,925	386,647,382
2010	104,890,053	267,222,309	372,112,362
2009	94,323,276	244,082,489	338,405,765
2008	108,961,681	272,376,484	381,338,165
2007	117,794,788	318,407,275	436,202,063
2006	115,901,262	328,488,760	444,390,022
2005	112,976,889	322,795,115	435,772,004
2004	107,291,127	317,192,190	424,483,317
2003	99,231,909	295,778,361	395,010,270
2002	101,315,326	288,560,662	389,875,988
2001	103,362,081	275,515,591	378,877,672
2000	108,623,445	278,252,069	386,875,514
1999	111,748,957	279,536,609	391,285,566
1998	114,861,891	267,289,802	382,151,693
1997	125,408,477	274,415,198	399,823,675
1996	122,015,843	265,143,309	387,159,152
1995	124,791,591	265,045,368	389,836,959
1994	127,039,166	273,913,095	400,952,261
1993	129,116,022	265,961,862	395,077,884
1992	131,757,504	272,692,763	404,450,267
1991	131,257,289	288,983,024	420,240,313
1990	134,425,923	335,426,671	469,852,594

Data: FAOSTAT 2014.

Table 13: Consumption of hardwood and softwood sawnwood by regions (m^3), 1990-2013.

YEAR	ASIA	EUROPE	LAC	NORTH AMERICA	WORLD TOTAL
2013	158,456,537	102,982,720	33,239,610	99,015,613	418,159,722
2012	146,238,834	103,293,121	32,571,588	93,050,447	397,626,585
2011	136,428,961	108,014,290	31,417,918	88,386,348	386,647,382
2010	118,905,122	108,717,658	32,664,151	89,350,143	372,112,362
2009	104,784,267	99,819,914	30,876,367	81,085,441	338,405,765
2008	100,685,981	109,717,144	35,234,138	110,406,180	381,338,165
2007	103,018,019	134,068,106	41,491,982	134,160,248	436,202,063
2006	107,175,508	125,511,885	41,453,934	149,687,229	444,390,022
2005	99,893,838	121,099,240	39,398,844	157,383,934	435,772,004
2004	95,956,488	118,885,803	38,952,569	154,656,352	424,483,317
2003	87,263,727	115,959,515	35,949,485	140,141,040	395,010,270
2002	81,696,379	114,265,047	35,418,516	144,160,337	389,875,988
2001	75,338,779	116,824,858	35,224,716	135,489,402	378,877,672
2000	77,640,726	120,674,979	34,686,847	136,088,225	386,875,514
1999	84,824,294	116,327,376	34,283,862	137,120,674	391,285,566
1998	83,119,600	116,382,336	34,221,560	130,522,905	382,151,693
1997	108,574,355	112,231,131	33,315,151	128,587,799	399,823,675
1996	111,508,153	104,293,920	32,656,078	123,540,279	387,159,152
1995	114,021,525	109,229,914	29,554,088	120,265,981	389,836,959
1994	114,950,853	119,436,540	29,045,265	122,749,206	400,952,261
1993	119,007,428	120,893,656	27,469,706	116,842,865	395,077,884
1992	112,134,076	139,697,729	27,491,751	113,843,062	404,450,267
1991	112,850,832	163,678,508	26,341,078	105,561,851	420,240,313
1990	116,923,573	201,757,908	24,916,054	114,013,267	469,852,594

Data: FAOSTAT 2014.
Note: LAC = Latin America and Caribbean.

Table 14: Major softwood sawnwood producers (m^3), 1995-2013.

YEAR	CANADA	CHINA	GERMANY	INDIA	EEUU	WORLD
2013	39,416,977	22,318,000	20,032,253	2,000,000	50,000,000	39,416,977
2012	39,416,977	22,318,000	20,032,253	2,000,000	48,745,800	39,416,977
2011	37,408,781	17,918,000	21,632,500	2,000,000	45,481,800	37,408,781
2010	37,712,000	14,911,000	21,161,278	2,000,000	42,163,400	37,712,000
2009	32,006,531	13,552,000	19,656,678	2,000,000	39,576,000	32,006,531
2008	40,436,922	11,920,000	18,093,000	2,000,000	49,415,600	40,436,922
2007	50,883,430	11,882,000	23,922,000	2000 000	59,768,600	50,883,430
2006	57,067,210	10,441,000	23,242,000	2,000,000	65,548,600	57,067,210
2005	58,469,630	7,576,000	20,803,000	9,900,000	69,186,600	58,469,630
2004	59,135,910	6,495,000	18,449,000	9,300,000	66,427,500	59,135,910
2003	55,131,760	6,850,000	16,525,000	7,990,000	61,189,800	55,131,760
2002	56,750,280	5,182,000	15,979,000	7,520,000	60,912,700	56,750,280
2001	52,613,593	4,923,000	14,889,000	1,236,670	58,780,900	52,613,593
2000	49,381,607	3,930,000	15,020,000	1,100,000	61,144,000	49,381,607
1999	49,360,671	9,565,000	14,537,000	1,200,000	62,342,685	49,360,671
1998	46,158,265	10,775,000	13,807,000	1,200,000	58,948,000	46,158,265
1997	46,048,059	12,346,000	13,682,000	1,200,000	81,453,000	46,048,059
1996	45,191,622	16,613,000	13,188,000	1,200,000	80,299,000	45,191,622
1995	43,354,857	15,501,000	11,215,000	1,200,000	76,975,000	43,354,857

Data: ITTO 2014.

Table 15: Major tropical hardwood sawnwood producers (m^3), 1995-2013.

YEAR	BRAZIL	INDIA	INDONESIA	MALAYSIA	VIETNAM	WORLD
2013	16,110,000	4,889,000	4,169,000	3,681,000	6,000,000	16,110,000
2012	16,110,000	4,889,000	4,169,000	3,829,000	6,000,000	16,110,000
2011	16,110,000	4,889,000	4,169,000	3,991,000	5,800,000	16,110,000
2010	16,110,000	4,889,000	4,169,000	4,301,000	5,000,000	16,110,000
2009	16,110,000	4,889,000	4,169,000	3,855,000	5,000,000	16,110,000
2008	16,110,000	4,889,000	4,169,000	4,466,000	4,500,000	16,110,000
2007	14,837,000	4,889,000	4,330,000	5,064,000	6,000,000	14,837,000
2006	14,719,000	4,889,000	4,330,000	5,129,000	3,000,000	14,719,000
2005	14,622,000	4,889,000	4,330,000	5,173,000	N/A	14,622,000
2004	14,500,000	4,361,000	4,330,000	4,934,000	N/A	14,500,000
2003	14,430,000	3,890,000	7,620,000	4,769,000	N/A	14,430,000
2002	14,168,000	3,470,000	6,230,000	4,643,000	N/A	14,168,000
2001	14,000,000	6,800,000	3,750,000	4,696,000	N/A	14,000,000
2000	13,800,000	6,800,000	6,500,000	5,589,860	N/A	13,800,000
1999	13,800,000	6,800,000	6,500,000	5,236,700	N/A	13,800,000
1998	13,500,000	7,000,000	7,000,000	5,091,000	N/A	13,500,000
1997	13,700,000	7,000,000	5,570,000	7,176,000	N/A	13,700,000
1996	13,650,000	7,000,000	5,900,000	7,653,000	N/A	13,650,000
1995	13,230,000	7,000,000	6,500,000	8,300,000	N/A	13,230,000

Data: ITTO 2014.
Note: N/A = Not Available.

Table 16: Major tropical hardwood sawnwood consumers (m^3), 1995-2013.

YEAR	BRAZIL	CHINA	INDIA	INDONESIA	VIETNAM	WORLD
2013	15,696,596	6,531,067	4,950,765	3,461,010	6,265,699	15,696,596
2012	15,759,074	6,075,191	4,987,936	3,158,870	6,255,998	15,759,074
2011	15,729,397	5,878,568	4,998,524	3,143,584	6,204,523	15,729,397
2010	15,792,261	4,953,141	4,946,929	3,454,816	5,912,195	15,792,261
2009	15,603,805	3,702,346	4,904,506	3,576,526	5,097,127	15,603,805
2008	15,097,958	3,810,714	4,881,324	3,348,460	5,221,335	15,097,958
2007	13,148,930	3,572,862	4,895,104	3,415,155	4,763,026	13,148,930
2006	13,136,208	3,852,314	4,889,739	2,576,696	3,342,670	13,136,208
2005	12,816,648	3,147,063	4,905,429	2,688,057	N/A	12,816,648
2004	12,512,531	4,018,354	4,366,607	2,402,985	N/A	12,512,531
2003	12,781,175	3,324,999	3,899,176	5,101,134	N/A	12,781,175
2002	12,762,986	2,883,852	3,469,537	3,536,553	N/A	12,762,986
2001	12,988,305	3,543,498	6,806,235	1,521,719	N/A	12,988,305
2000	12,864,139	3,122,554	6,794,905	5,117,295	N/A	12,864,139
1999	13,015,722	2,262,596	6,800,983	5,203,668	N/A	13,015,722
1998	13,118,000	1,599,000	7,005,000	6,426,000	N/A	13,118,000
1997	13,187,000	1,453,000	6,979,000	5,271,000	N/A	13,187,000
1996	13,312,000	787,000	6,977,000	5,501,000	N/A	13,312,000
1995	13,018,000	1,037,000	6,985,000	6,128,000	N/A	13,018,000

Data: ITTO 2014.
Note: N/A = Not Available.

Table 17: Major other hardwood sawnwood consumers (m^3), 1995-2013.

YEAR	CANADA	CHINA	INDIA	ROMANIA	EEUU	WORLD
2013	1,404,288	33,734,073	128,505	1,404,788	13,488,732	1,404,288
2012	1,279,171	33,474,453	104,724	732,128	14,993,852	1,279,171
2011	1,527,159	27,153,443	122,990	844,320	14,309,236	1,527,159
2010	929,684	22,416,084	39,052	944,750	15,712,605	929,684
2009	1,286,822	18,265,500	48,123	870,400	14,921,976	1,286,822
2008	1,649,285	15,686,195	26,806	934,620	21,698,873	1,649,285
2007	1,646,827	16,112,056	20,964	1,286,100	23,600,007	1,646,827
2006	1,569,209	14,104,354	36,280	N/A	25,377,270	1,569,209
2005	1,901,000	11,419,487	39,299	N/A	26,392,560	1,901,000
2004	2,037,280	10,525,819	20,222	N/A	25,652,940	2,037,280
2003	1,481,000	6,490,248	14,842	N/A	23,874,950	1,481,000
2002	1,408,000	5,829,791	52,662	N/A	26,404,290	1,408,000
2001	808,000	2,769,196	5,506	N/A	25,523,624	808,000
2000	811,308	2,784,840	3,160	N/A	28,385,000	811,308
1999	765,700	6,786,146	401,859	N/A	28,741,000	765,700
1998	789,400	7,409,000	201,000	N/A	28,587,000	789,400
1997	1,290,000	8,194,000	201,000	N/A	27,849,000	1,290,000
1996	1,048,000	9,969,000	200,000	N/A	26,577,000	1,048,000
1995	1,269,000	9,563,000	200,000	N/A	27,344,000	1,269,000

Data: FAOSTAT 2014.
Note: N/A = Not Available.

Table 18: Major softwood sawnwood consumers (m^3), 1995-2013.

YEAR	CANADA	CHINA	GERMANY	INDIA	EEUU	WORLD
2013	14,522,934	38,975,516	17,423,209	2,276,976	62,022,483	243,656,867
2012	14,886,082	36,344,862	18,782,447	2,303,368	61,466,078	243,886,553
2011	13,525,444	32,621,676	18,654,259	2,299,023	56,986,654	236,865,742
2010	18,358,476	24,084,221	18,439,904	2,114,775	54,721,973	231,682,653
2009	9,685,491	19,698,276	17,949,848	2,070,218	52,094,994	205,191,026
2008	5,654,356	15,349,212	17,468,191	2,027,875	68,248,638	231,733,551
2007	19,030,320	14,403,886	21,497,518	2,050,890	88,295,141	279,842,340
2006	19,661,310	12,209,401	21,547,571	2,017,123	101,799,736	281,129,726
2005	19,280,990	9,146,772	18,443,000	9,904,300	109,426,720	277,452,850
2004	19,892,520	8,571,019	17,443,000	9,351,949	106,676,910	272,307,592
2003	18,933,800	8,620,667	16,691,000	8,042,939	95,580,980	257,289,656
2002	21,171,060	6,834,738	16,247,000	7,546,215	94,943,500	266,343,225
2001	17,788,528	5,479,678	15,671,000	1,284,912	90,935,478	241,275,327
2000	14,924,445	4,314,269	17,247,000	1,224,645	91,673,823	241,233,894
1999	15,043,418	9,916,408	17,351,000	1,201,442	92,294,167	241,555,353
1998	12,621,530	11,132,000	16,885,000	1,201,000	88,254,000	227,453,314
1997	13,182,281	12,768,000	17,067,000	1,215,000	120,081,000	264,478,719
1996	10,184,482	16,723,000	15,881,000	1,213,000	118,410,000	258,101,548
1995	N/A	15,635,000	14,383,000	1,205,000	112,883,000	235,430,379

Data: ITTO 2014.
Note: N/A = Not Available.

Table 19: India and major tropical hardwood sawnwood importers (m^3), 1995-2013.

YEAR	CHINA	INDIA	THAILAND	EEUU	VIETNAM	WORLD
2013	4,204,542	138,763	693,699	385,973	440,670	8,685,692
2012	3,744,994	138,607	693,699	313,182	440,670	8,307,532
2011	3,990,114	167,405	698,998	428,337	484,459	9,121,761
2010	3,375,279	77,604	642,410	320,584	332,750	8,258,191
2009	2,245,832	43,081	552,440	215,842	209,627	6,411,152
2008	2,031,449	29,607	759,521	377,598	283,431	7,538,628
2007	2,146,958	23,957	660,440	533,289	326,981	8,588,041
2006	2,383,091	17,010	742,590	544,137	394,480	8,981,052
2005	2,643,316	28,429	1,478,000	354,000	N/A	10,040,797
2004	2,979,443	20,502	1,456,551	343,000	N/A	10,451,364
2003	2,854,905	28,050	687,168	258,810	N/A	9,135,480
2002	2,783,158	6,837	631,391	231,570	N/A	9,089,296
2001	2,906,782	7,116	1,000,000	277,317	N/A	9,656,475
2000	2,570,999	472	823,000	330,000	N/A	9,339,783
1999	1,465,000	983	755,000	284,000	N/A	8,123,774
1998	800,000	5,000	845,000	285,000	N/A	6,510,820
1997	661,000	4,000	1,282,000	325,000	N/A	7,535,177
1996	501,000	4,000	2,089,000	321,000	N/A	9,071,000
1995	672,000	2,000	1,950,000	237,000	N/A	10,004,000

Data: ITTO 2014.
Note: N/A = Not Available.

Table 20: Major softwood sawnwood importers (m^3), 1995-2013.

YEAR	CHINA	INDIA	JAPAN	UK	EEUU	WORLD
2013	16,910,216	277,683	6,805,000	5,074,285	16,335,684	82,264,310
2012	14,221,365	306,060	6,289,000	4,755,962	16,551,790	79,823,314
2011	14,925,550	301,524	6,572,744	4,526,202	15,610,151	80,177,142
2010	9,370,718	117,242	6,156,816	5,230,448	15,913,803	76,035,003
2009	6,344,089	72,069	5,347,000	4,858,878	14,898,189	67,303,414
2008	3,645,501	49,704	6,208,000	5,487,000	21,283,409	79,386,232
2007	2,804,379	55,995	6,947,000	7,946,000	30,940,730	96,005,583
2006	2,108,307	17,829	8,060,000	7,400,600	38,483,230	96,244,423
2005	1,841,346	7,045	7,902,000	7,562,780	41,610,310	94,059,927
2004	2,263,664	53,201	8,553,000	7,871,000	41,644,860	93,174,176
2003	1,935,664	53,201	8,077,000	7,943,920	36,017,140	85,513,468
2002	1,751,664	26,536	7,722,000	7,586,160	35,673,590	96,738,246
2001	642,888	48,326	8,027,000	7,221,273	33,801,449	84,707,374
2000	507,907	125,457	8,806,000	7,307,641	32,708,823	85,112,870
1999	393,412	1,717	8,372,000	6,604,323	32,274,482	80,571,473
1998	398,000	2,000	6,639,000	6,490,000	31,385,000	76,373,682
1997	551,000	15,000	10,801,000	6,491,000	42,514,000	88,401,900
1996	179,000	13,000	10,326,000	5,344,000	42,529,000	83,581,000
1995	287,000	5,000	10,011,000	5,010,000	40,600,000	81,457,000

Data: ITTO 2014.

Table 21: Major other hardwood sawnwood importers (m^3), 1995-2013.

YEAR	CANADA	CHINA	EGYPT	INDIA	ITALY	WORLD
2013	576,653	2,901,598	629,323	128,587	573,202	576,653
2012	460,925	2,664,585	783,973	104,751	573,202	460,925
2011	428,589	2,638,950	736,423	123,025	782,816	428,589
2010	481,418	2,009,698	662,724	39,052	706,684	481,418
2009	800,150	1,295,066	604,184	48,207	703,378	800,150
2008	1,018,253	1,414,440	960,141	26,884	813,116	1,018,253
2007	1,047,395	1,551,917	591,151	20,964	1,190,113	1,047,395
2006	994,656	1,575,941	417,829	36,873	1,083,924	994,656
2005	1,509,000	1,445,984	521,448	39,299	1,214,300	1,509,000
2004	1,582,280	2,384,995	311,740	20,553	1,234,450	1,582,280
2003	1,093,000	2,343,533	370,820	16,767	1,414,640	1,093,000
2002	1,063,000	2,379,280	383,920	52,662	1,609,190	1,063,000
2001	1,005,000	484,450	368,732	5,506	1,553,000	1,005,000
2000	1,172,888	589,004	179,000	3,247	1,794,000	1,172,888
1999	1,054,000	861,737	299,700	1,859	1,757,000	1,054,000
1998	940,800	480,000	216,000	2,000	1,790,000	940,800
1997	1,457,000	805,000	307,000	1,000	1,290,000	1,457,000
1996	913,000	277,000	278,000	N/A	1,273,000	913,000
1995	876,000	289,000	310,000	N/A	1,117,000	876,000

Data: ITTO 2014.
Note: N/A = Not Available.

Annex 2

Table 22: Explanatory variables database. India's imports of sawnwood, GDP per capita, import price of sawnwood and unemployment, 1992-2013.

YEAR	IMPORTS OF SAWNWOOD*	GDP PER CAPITA	IMPORT PRICE OF SAWNWOOD	UNEMPLOYMENT
	IMP m^3	GDPC USD	DPS USD/m^3	UE % of TLF
2013	375,001.000	1,497.550	539.575	3.600
2012	549,418.000	1,484.465	288.609	3.600
2011	591,954.000	1,509.239	270.224	3.500
2010	233,898.000	1,417.074	285.761	3.500
2009	163,357.000	1,147.239	231.860	3.900
2008	106,195.000	1,042.084	406.224	4.100
2007	100,916.000	1,068.679	257.254	3.700
2006	71,712.000	830.163	304.816	4.300
2005	96,031.000	740.114	229.353	4.400
2004	94,256.000	649.711	184.954	3.900
2003	59,954.000	565.335	200.003	3.900
2002	76,499.000	486.640	184.904	4.300
2001	30,000.000	466.214	191.867	4.000
2000	9,400.000	457.284	454.149	4.300
1999	9,000.000	455.474	426.333	4.400
1998	15,900.000	425.445	299.245	4.100
1997	10,000.000	427.236	355.600	4.200
1996	17,200.000	410.818	261.977	4.000
1995	7,400.000	383.551	317.973	4.000
1994	6,451.000	354.855	386.917	3.700
1993	7,586.000	308.535	321.645	4.300
1992	17,699.000	324.495	483.417	4.200

Data: Imports of sawnwood, Import price of sawnwood: FAOSTAT 2014; GDP per capita, Unemployment: World Bank 2014.
Note: *Data of sawnwood includes softwood and hardwood.

Table 23: Explanatory variables database. India's economic openness, population density, import price of plywood and import price of Portland cement, 1992-2013.

YEAR	ECONOMIC OPENNESS	POPULATION DENSITY	IMPORT PRICE OF PLYWOOD*	IMPORT PRICE OF PORTLAND CEMENT
	EO % (trade of GDP)	**POPD** inh./km^2	**DPP** USD/m^3	**DPPC** USD/kg
2013	53.000	421.143	610.803	79.430
2012	55.000	415.946	610.803	73.347
2011	54.000	410.723	475.994	78.752
2010	48.000	405.499	515.914	69.265
2009	45.000	400.290	647.056	53.865
2008	52.000	395.085	852.783	81.205
2007	45.000	389.849	609.912	87.105
2006	45.000	384.533	407.795	83.552
2005	41.000	379.102	625.688	135.004
2004	37.000	373.547	430.490	162.948
2003	30.000	367.883	388.877	82.780
2002	29.000	362.138	370.833	263.357
2001	26.000	356.352	370.833	32.210
2000	26.000	350.553	391.500	89.577
1999	24.000	344.753	330.880	100.188
1998	23.000	338.945	352.137	123.793
1997	22.000	333.130	433.291	144.813
1996	22.000	327.308	415.576	199.723
1995	22.000	321.474	487.864	232.146
1994	20.000	315.638	641.390	267.299
1993	19.000	309.804	513.042	276.762
1992	18.000	303.966	669.843	438.901

Data: Economic openness, Population density: World Bank 2014; Import price of plywood: FAOSTAT 2014; Import price of Portland cement: UN Comtrade 2014.
Note: * Data of import price of plywood includes softwood and hardwood.

Annex 3

Table 24: India's population (inh.) and its annual growth rate (%), 1992-2013.

YEAR	POPULATION (inh.)	ANNUAL GROWTH RATE (%)
2013	1,279,498,874	1.3
2012	1,263,589,639	1.3
2011	1,247,446,011	1.3
2010	1,230,984,504	1.4
2009	1,214,182,182	1.4
2008	1,197,070,109	1.5
2007	1,179,685,631	1.5
2006	1,162,088,305	1.5
2005	1,144,326,293	1.6
2004	1,126,419,321	1.6
2003	1,108,369,577	1.7
2002	1,090,189,358	1.7
2001	1,071,888,190	1.7
2000	1,053,481,072	1.8
1999	1,034,976,626	1.8
1998	1,016,402,907	1.8
1997	997,817,250	1.9
1996	979,290,432	1.9
1995	960,874,982	1.9
1994	942,604,211	1.9
1993	924,475,633	2.0
1992	906,461,358	2.0

Data: World Bank 2014.

Table 25: Forestry contribution to employment in India, people employed, 1990-2011.

YEAR	SUB SECTOR	WOOD INDUSTRY	PULP AND PAPER INDUSTRY	FURNITURE INDUSTRY	FORESTRY SECTOR
2011	246,000	246,000	215,000	57,000	764,000
2010	246,000	246,000	214,000	57,000	763,000
2009	246,000	204,000	227,000	50,000	727,000
2008	246,000	170,000	229,000	40,000	685,000
2007	246,000	143,000	249,000	36,000	674,000
2006	246,000	138,000	188,000	35,000	607,000
2005	246,000	129,000	176,000	32,000	583,000
2004	242,000	116,000	176,000	31,000	565,000
2003	244,000	119,000	175,000	26,000	564,000
2002	246,000	118,000	174,000	23,000	561,000
2001	248,000	125,000	168,000	28,000	569,000
2000	250,000	118,000	180,000	26,000	574,000
1995	261,000	161,000	175,000	21,000	618,000
1990	280,000	140,000	142,000	13,000	575,000

Source: Lebedys 2014.

Table 26: Indian imports of logs and main wood products (m^3), 1994-2013.

YEAR	LOGS	SAWNWOOD	PLYWOOD	VENEER
2013	6,500,953	545,033	108,071	164,719
2012	6,527,345	549,418	185,374	118,455
2011	6,341,350	591,954	307,802	70,410
2010	5,299,689	233,898	149,205	28,644
2009	4,902,995	163,357	82,693	26,088
2008	4,171,011	106,195	90,448	24,876
2007	4,168,397	100,916	49,617	17,014
2006	3,247,311	71,712	38,154	15,841
2005	3,749,713	74,773	11,990	14,053
2004	3,735,136	94,256	20,256	4,122
2003	3,482,250	98,018	24,203	7,358
2002	3,077,323	86,035	15,080	4,773
2001	2,622,989	60,947	24,928	3,727
2000	2,103,004	129,175	15,051	2,136
1999	1,976,155	4,559	22,219	3,446
1998	1,900,000	9,000	31,000	12,000
1997	1,362,000	20,000	10,000	6,000
1996	968,000	17,000	10,000	4,000
1995	735,000	7,000	10,000	1,000
1994	469,000	6,000	10,000	N/A

Data: ITTO 2014.
Note: N/A = Not Available.

Table 27: Indian consumption of logs and main wood products (m^3), 1995-2013.

YEAR	LOGS	SAWNWOOD	PLYWOOD	VENEER
2013	29,687,369	7,356,246	2,594,473	455,041
2012	29,706,292	7,396,028	2,638,824	405,391
2011	29,520,678	7,420,537	2,757,652	352,896
2010	28,488,257	7,100,756	2,598,748	316,430
2009	28,086,337	7,022,847	2,557,817	293,843
2008	27,472,809	6,936,005	2,174,226	276,943
2007	27,471,794	6,966,958	2,085,393	274,967
2006	26,843,444	6,943,142	2,151,061	276,293
2005	26,929,274	14,849,028	2,153,272	273,172
2004	26,536,393	13,738,778	1,948,347	255,551
2003	22,298,507	11,956,957	1,694,758	256,043
2002	21,896,323	11,068,414	1,580,202	243,605
2001	18,662,478	8,096,652	1,276,037	57,373
2000	18,602,423	8,022,709	1,327,820	16,513
1999	19,323,905	8,404,284	281,981	15,272
1998	20,247,000	8,407,000	241,000	25,000
1997	19,707,000	8,395,000	300,000	21,000
1996	19,313,000	8,390,000	240,000	9,000
1995	19,079,000	8,390,000	222,000	4,000

Data: ITTO 2014.

Table 28: Indian consumption of logs and wood products by group species (m^3), 1995-2013.

YEAR	CONSUMPTION OF LOGS		CONSUMPTION OF SAWNWOOD		CONSUMPTION OF PLYWOOD	
	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood
2013	4,609,838	25,077,531	2,276,976	5,079,270	30,624	2,563,849
2012	4,552,755	25,153,537	2,303,368	5,092,660	12,980	2,625,844
2011	4,692,560	24,828,118	2,299,023	5,121,514	37,449	2,720,203
2010	4,251,394	24,236,863	2,114,775	4,985,981	40,758	2,557,990
2009	3,905,587	24,180,750	2,070,218	4,952,629	71,937	2,485,880
2008	3,741,629	23,731,180	2,027,875	4,908,130	55,818	2,118,408
2007	3,796,234	23,675,560	2,050,890	4,916,068	30,487	2,054,906
2006	3,791,379	23,052,065	2,017,123	4,926,019	39,434	2,111,627
2005	3,327,769	23,601,504	9,904,300	4,944,728	38,347	2,114,925
2004	2,897,915	23,638,478	9,351,949	4,386,829	17,335	1,931,012
2003	3,209,403	19,089,104	8,042,939	3,914,018	9,777	1,684,981
2002	3,188,300	18,708,023	7,546,215	3,522,199	1,593	1,578,609
2001	2,546,895	16,115,583	1,284,912	6,811,741	17,849	1,258,188
2000	2,522,891	16,079,532	1,224,645	6,798,065	16,370	1,311,450
1999	2,546,194	16,777,711	1,201,443	7,202,842	15,867	266,115
1998	2,828,000	17,419,000	1,201,000	7,206,000	15,000	226,000
1997	2,738,000	16,969,000	1,215,000	7,180,000	10,000	290,000
1996	2,638,000	16,675,000	1,213,000	7,177,000	N/A	240,000
1995	2,539,000	16,540,000	1,205,000	7,185,000	N/A	222,000

Data: ITTO 2014.
Note: N/A = Not Available.

Table 29: India's exports, imports, consumption and production of logs (m^3), 1995-2013.

YEAR	EXPORTS	IMPORTS	PRODUCTION	CONSUMPTION
2013	5,784	6,500,953	23,192,200	29,687,369
2012	13,253	6,527,345	23,192,200	29,706,292
2011	12,872	6,341,350	23,192,200	29,520,678
2010	3,632	5,299,689	23,192,200	28,488,257
2009	8,858	4,902,995	23,192,200	28,086,337
2008	11,002	4,171,011	23,312,800	27,472,809
2007	9,403	4,168,397	23,312,800	27,471,794
2006	16,667	3,247,311	23,612,800	26,843,444
2005	11,440	3,749,713	23,191,000	26,929,274
2004	8,743	3,735,136	22,810,000	26,536,393
2003	11,843	3,482,250	18,828,100	22,298,507
2002	5,700	3,077,323	18,824,700	21,896,323
2001	6,956	2,622,989	16,046,444	18,662,478
2000	581	2,103,004	16,500,000	18,602,423
1999	2,250	1,976,155	17,350,000	19,323,905
1998	3,000	1,900,000	18,350,000	20,247,000
1997	5,000	1,362,000	18,350,000	19,707,000
1996	5,000	968,000	18,350,000	19,313,000
1995	6,000	735,000	18,350,000	19,079,000

Data: ITTO 2014.

Table 30: India's exports and imports of logs by group species (m^3), 1995-2013.

YEAR	EXPORTS		IMPORTS	
	Hardwood	Softwood	Hardwood	Softwood
2013	4,099	1,685	4,768,830	1,732,123
2012	11,423	1,830	4,852,160	1,675,185
2011	12,412	460	4,527,730	1,813,620
2010	3,297	335	3,927,360	1,372,329
2009	7,350	1,508	3,875,300	1,027,695
2008	10,720	282	3,429,100	741,911
2007	9,300	103	3,372,060	796,337
2006	14,621	2,046	2,753,886	493,425
2005	6,588	4,852	3,296,092	453,621
2004	3,406	5,337	3,333,884	401,252
2003	8,846	2,997	2,989,250	493,000
2002	2,700	3,000	2,604,323	473,000
2001	6,941	15	2,622,092	898
2000	536	45	2,080,068	22,936
1999	2,250	0	1,967,961	8,194
1998	3,000	0	1,610,000	290,000
1997	5,000	0	1,162,000	200,000
1996	5,000	0	868,000	100,000
1995	6,000	0	734,000	1,000

Data: ITTO 2014.

Table 31: India's production and consumption of logs by group species (m^3), 1995-2013.

YEAR	PRODUCTION		CONSUMPTION	
	Hardwood	Softwood	Hardwood	Softwood
2013	20,312,800	2,879,400	25,077,531	4,609,838
2012	20,312,800	2,879,400	25,153,537	4,552,755
2011	20,312,800	2,879,400	24,828,118	4,692,560
2010	20,312,800	2,879,400	24,236,863	4,251,394
2009	20,312,800	2,879,400	24,180,750	3,905,587
2008	20,312,800	3,000,000	23,731,180	3,741,629
2007	20,312,800	3,000,000	23,675,560	3,796,234
2006	20,312,800	3,300,000	23,052,065	3,791,379
2005	20,312,000	2,879,000	23,601,504	3,327,769
2004	20,308,000	2,502,000	23,638,478	2,897,915
2003	16,108,700	2,719,400	19,089,104	3,209,403
2002	16,106,400	2,718,300	18,708,023	3,188,300
2001	13,500,432	2,546,012	16,115,583	2,546,895
2000	14,000,000	2,500,000	16,079,532	2,522,891
1999	14,812,000	2,538,000	16,777,711	2,546,194
1998	15,812,000	2,538,000	17,419,000	2,828,000
1997	15,812,000	2,538,000	16,969,000	2,738,000
1996	15,812,000	2,538,000	16,675,000	2,638,000
1995	15,812,000	2,538,000	16,540,000	2,539,000

Data: ITTO 2014.

Table 32: India's exports, imports, consumption and production of sawnwood (m^3), 1995-2013.

YEAR	EXPORTS	IMPORTS	PRODUCTION	CONSUMPTION
2013	77,787	375,001	6,889,000	7,186,214
2012	76,810	549,418	6,889,000	7,361,608
2011	16,643	591,954	6,889,000	7,464,311
2010	22,142	233,898	6,889,000	7,100,756
2009	29,510	163,357	6,889,000	7,022,847
2008	59,190	106,195	6,889,000	6,936,005
2007	22,958	100,916	6,889,000	6,966,958
2006	17,570	71,712	14,789,000	14,843,142
2005	14,745	96,031	14,789,000	14,870,286
2004	14,581	94,256	13,661,000	13,740,675
2003	6,751	59,954	11,880,000	11,933,203
2002	7,621	76,499	10,990,000	11,058,878
2001	10,000	30,000	7,900,000	7,920,000
2000	10,200	9,400	7,900,000	7,899,200
1999	10,000	9,000	8,400,000	8,399,000
1998	13,500	15,900	8,400,000	8,402,400
1997	18,000	10,000	18,520,000	18,512,000
1996	27,200	17,200	10,624,000	10,614,000
1995	17,000	7,400	17,460,000	17,450,400

Data: FAOSTAT 2014.

Table 33: Top five exporters of softwood sawnwood to India (m^3), 2008-2013.

YEAR	SOFTWOOD EXPORTERS				
	Brazil	Canada	EEUU	Germany	Tanzania*
2013	9,911	18,654	21,047	44,000	11,581
2012	8,256	16,579	20,399	25,426	2,927
2011	4,862	8,542	13,327	17,271	4,030
2010	3,100	1,649	1,160	6,352	1,837
2009	2,552	625	2,910	2,142	3,189
2008	1,821	1,842	3,513	1,447	1,869

Data: FAOSTAT 2014.

Table 34: Top five exporters of hardwood sawnwood to India (m^3), 2008-2013.

YEAR	HARDWOOD EXPORTERS				
	Brazil	Germany	Panama	UK	Tanzania*
2013	28,000	43,000	15,875	20,173	9,991
2012	32,000	32,000	68	15,497	5,643
2011	29,000	28,000	238	6,393	7,799
2010	2,161	4,635	3,649	5,220	5,818
2009	280	2,411	1,987	8,684	6,324
2008	663	3,469	4,496	6,248	2,073

Data: FAOSTAT 2014.

Table 35: India's imports of sawnwood by group species (m^3), 1995-2013.

YEAR	HARDWOOD	SOFTWOOD	TOTAL
2013	148,235	226,766	375,001
2012	243,358	306,060	549,418
2011	290,430	301,524	591,954
2010	116,656	117,242	233,898
2009	91,288	72,069	163,357
2008	56,491	49,704	106,195
2007	44,921	55,995	100,916
2006	53,883	17,829	71,712
2005	67,728	28,303	96,031
2004	41,055	53,201	94,256
2003	44,817	15,137	59,954
2002	59,499	17,000	76,499
2001	11,800	18,200	30,000
2000	7,700	1,700	9,400
1999	4,000	5,000	9,000
1998	9,300	6,600	15,900
1997	2,600	7,400	10,000
1996	4,000	13,200	17,200
1995	1,600	5,800	7,400

Data: FAOSTAT 2014.

Table 36: India's production and consumption of hardwood and softwood (m^3), 1995-2013.

YEAR	PRODUCTION		CONSUMPTION	
	Softwood	Hardwood	Softwood	Hardwood
2013	4,889,000	2,000,000	4,889,000	2,226,059
2012	4,889,000	2,000,000	4,889,000	2,302,854
2011	4,889,000	2,000,000	4,889,000	2,299,023
2010	4,889,000	2,000,000	4,889,000	2,114,775
2009	4,889,000	2,000,000	4,889,000	2,070,218
2008	4,889,000	2,000,000	4,889,000	2,027,875
2007	4,889,000	2,000,000	4,889,000	2,050,890
2006	4,889,000	9,900,000	4,889,000	9,917,123
2005	4,889,000	9,900,000	4,889,000	9,925,558
2004	4,361,000	9,300,000	4,361,000	9,351,731
2003	3,890,000	7,990,000	3,890,000	8,004,875
2002	3,470,000	7,520,000	3,470,000	7,536,679
2001	6,800,000	1,100,000	6,800,000	1,118,000
2000	6,800,000	1,100,000	6,800,000	1,101,500
1999	7,200,000	1,200,000	7,200,000	1,205,000
1998	7,200,000	1,200,000	7,200,000	1,203,100
1997	15,520,000	3,000,000	15,520,000	3,005,600
1996	9,000,000	1,624,000	9,000,000	1,636,600
1995	14,960,000	2,500,000	14,960,000	2,505,500

Data: FAOSTAT 2014.

Table 37: India's exports, imports, consumption and production of plywood (m^3), 1995-2013.

YEAR	EXPORTS	IMPORTS	PRODUCTION	CONSUMPTION
2013	34,598	108,071	2,521,000	2,594,473
2012	67,551	185,374	2,521,000	2,638,824
2011	71,150	307,802	2,521,000	2,757,652
2010	71,457	149,205	2,521,000	2,598,748
2009	45,876	82,693	2,521,000	2,557,817
2008	70,222	90,448	2,154,000	2,174,226
2007	118,224	49,617	2,154,000	2,085,393
2006	41,093	38,154	2,154,000	2,151,061
2005	32,718	11,990	2,174,000	2,153,272
2004	28,910	20,256	1,957,000	1,948,347
2003	110,445	24,203	1,781,000	1,694,758
2002	49,878	15,080	1,615,000	1,580,202
2001	63,890	24,928	1,315,000	1,276,037
2000	2,231	15,051	1,315,000	1,327,820
1999	55,238	22,219	315,000	281,981
1998	105,000	31,000	315,000	241,000
1997	20,000	10,000	310,000	300,000
1996	15,000	10,000	245,000	240,000
1995	33,000	10,000	245,000	222,000

Data: FAOSTAT 2014.

Table 38: Finnish exports of sawnwood, quantity shares by regions (%), 2014.

DESTINATION	TOTAL EXPORTS (1000 m3)	% OF EXPORTS
EU	**3055**	**40.8 %**
Africa	**2084**	**27.9 %**
Egypt	*1223*	*16.3 %*
Asia	**2159**	**28.9 %**
Japan	*776*	*10.4 %*
China	*408*	*5.5 %*
North America	**5**	**0.1 %**
Others	**178**	**2.4 %**
Total exports of sawnwood	**7481**	**100.0 %**

Data: The Finnish Forest Industries Federation and the Finnish Board of Customs 2015.

Table 39: Finnish exports of forest industry products to India (m^3, Tons), 1997-2013.

YEAR	SAWNWOOD	NEWSPRINT	PLYWOOD	OTHER PRODUCTS*
2013	167	18,000	590	7
2012	155	24,000	209	292
2011	555	20,743	289	393
2010	154	3,766	129	21
2009	1,355	1,000	105	19
2008	881	23,000	50	219
2007	74	18,000	73	42
2006	226	18,950	44	3
2005	156	5,713	13	3
2004	155	17,709	37	48
2003	20	37,670	42	2
2002	40	12,099	58	N/A
2001	33	10,092	N/A	N/A
2000	44	9,058	97	N/A
1999	0	5,370	77	N/A
1998	36	2,571	69	213
1997	0	7,159	211	50

Data: FAOSTAT 2014, LUKE 2015b.
Note: N/A = Not Available; *Other products such as logs, particle board and veneer sheets.

Table 40: Level Model - Indian sawnwood demand.

Dependent Variable: LIMP
Method: Least Squares
Date: 09/01/15 Time: 18:19
Sample: 1992 2013
Included observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.139558	2.284400	0.061092	0.9519
LGDPC	2.464286	0.186742	13.19617	0.0000
LDPS	-0.934088	0.323732	-2.885374	0.0095

R-squared	0.908882	Mean dependent var	10.76150
Adjusted R-squared	0.899291	S.D. dependent var	1.469802
S.E. of regression	0.466438	Akaike info criterion	1.438740
Sum squared resid	4.133723	Schwarz criterion	1.587519
Log likelihood	-12.82614	Hannan-Quinn criter.	1.473788
F-statistic	94.76034	Durbin-Watson stat	1.040311
Prob(F-statistic)	0.000000		

Histogram-Normality Test	Kurtosis	Skewness	Jarque-Bera	Probability
	3.376	0.862	2.852	0.240
Heteroscedasticity Test: ARCH	F-statistic	Obs*R-squared	Prob. F(1,19)	Prob. Chi-squared(1)
	2.774	2.676	0.112	0.102
Breusch-Godfrey Serial Correlation LM Test	F-statistic	Obs*R-squared	Prob. F(2,17)	Prob. Chi-squared(2)
	0.831	1.959	0.456	0.375
ADF Unit Root Tests on Resid	Lag	Determination	*t*-ADF	Decision: I(0) or I(1)
	4	None	-3.927	I(0)

Notes:
ARCH stands for Autoregressive Conditional Heteroscedasticity
Level Critical Values with none determination: 1%= -2,678; 5%= -1,958; 10%= -1,607
l(1): There is one unit root which means non-stationary series
l(0): There is no unit root which means stationary series

Table 41: Error Correction Model - Indian sawnwood demand.

Dependent Variable: DLIMP
Method: Least Squares
Date: 09/02/15 Time: 20:32
Sample (adjusted): 1993 2013
Included observations: 21 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.067960	0.103803	0.654707	0.5214
DLGDPC	0.856094	0.983013	0.870887	0.3959
DLDPS	-0.800251	0.223289	-3.583925	0.0023
RESIDMODEL(-1)	-0.731753	0.177604	-4.120130	0.0007

R-squared	0.655153	Mean dependent var	0.145401
Adjusted R-squared	0.594297	S.D. dependent var	0.542454
S.E. of regression	0.345515	Akaike info criterion	0.882081
Sum squared resid	2.029468	Schwarz criterion	1.081037
Log likelihood	-5.261848	Hannan-Quinn criter.	0.925259
F-statistic	10.76572	Durbin-Watson stat	1.320042
Prob(F-statistic)	0.000335		

Histogram-Normality Test	Kurtosis	Skewness	Jarque-Bera	Probability
	2.688	0.533	1.079	0.583
Heteroscedasticity Test: ARCH	F-statistic	Obs*R-squared	Prob. F(1,18)	Prob. Chi-squared(1)
	1.983	1.985	0.176	0.159
Breusch-Godfrey Serial Correlation LM Test	F-statistic	Obs*R-squared	Prob. F(2,15)	Prob. Chi-squared(2)
	3.466	6.637	0.058	0.036
ADF Unit Root Tests on Resid	Lag	Determination	*t*-ADF	Decision: I(0) or I(1)
	4	none	-3.213	I(0)

Notes:
ARCH stands for Autoregressive Conditional Heteroscedasticity
Level Critical Values with none determination: 1%= -2,686; 5%= -1,959; 10%= -1,607
l(1): There is one unit root which means non-stationary series
l(0): There is no unit root which means stationary series

Table 42: MacKinnon critical values for cointegration test

Level Model			
Significance Level	**MacKinnon critical value equation**	**Critical Value**	**t-ADF**
1%	$\beta\infty + \beta1 / T + \beta2 / T^2 + \beta3 / T^3$	-5.01402	-3.927
5%		-4.14969	
10%		-3.74233	
Error Correction Model			
Significance Level	**MacKinnon critical value equation**	**Critical Value**	**t-ADF**
1%	$\beta\infty + \beta1 / T + \beta2 / T^2 + \beta3 / T^3$	-5.01402	-3.213
5%		-4.14969	
10%		-3.74233	

Notes:
MacKinnon Critical values for No Trend Case:
at 1%: $\beta\infty$= -4.29374; $\beta1$= -14.4354; $\beta2$= -33.195; $\beta3$= 47.433
at 5%: $\beta\infty$= -3.74066; $\beta1$= -8.5631; $\beta2$= - 10.852; $\beta3$= + 27.982
at 10%: $\beta\infty$= -3.45218; $\beta1$= -6.2143; $\beta2$= -3.718
T: number of observations (22 for level model and 21 for error correction model).

Table 43: Johansen Cointegration Test - Indian sawnwood demand.
Date: 09/05/15 Time: 00:17
Sample (adjusted): 1994 2013
Included observations: 20 after adjustments
Trend assumption: Linear deterministic trend
Series: LIMP LGDPC LDPS
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.658712	30.93196	29.79707	0.0369
At most 1	0.338988	9.431391	15.49471	0.3270
At most 2	0.055959	1.151718	3.841466	0.2832

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.658712	21.50057	21.13162	0.0444
At most 1	0.338988	8.279673	14.26460	0.3510
At most 2	0.055959	1.151718	3.841466	0.2832

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LIMP	LGDPC	LDPS
2.333794	-7.183663	8.551419
4.270451	-11.35233	5.884595
-4.275718	9.023749	-11.29623

Unrestricted Adjustment Coefficients (alpha):

D(LIMP)	0.041537	-0.240736	0.058586
D(LGDPC)	-0.024843	0.019414	0.013243
D(LDPS)	-0.115333	0.095538	-0.051410

1 Cointegrating Equation(s): Log likelihood 31.07326

Normalized cointegrating coefficients (standard error in parentheses)

LIMP	LGDPC	LDPS
1.000000	-3.078105	3.664171
	(0.17849)	(0.41794)

Adjustment coefficients (standard error in parentheses)

D(LIMP)	0.096939
	(0.29099)
D(LGDPC)	-0.057979
	(0.04072)
D(LDPS)	-0.269165
	(0.17155)

2 Cointegrating Equation(s): Log likelihood 35.21310

Normalized cointegrating coefficients (standard error in parentheses)

LIMP	LGDPC	LDPS
1.000000	0.000000	-13.10050
		(4.17901)
0.000000	1.000000	-5.446426
		(1.44698)

Adjustment coefficients (standard error in parentheses)

D(LIMP)	-0.931114	2.434532
	(0.52601)	(1.45206)
D(LGDPC)	0.024927	-0.041926
	(0.08132)	(0.22450)
D(LDPS)	0.138827	-0.256065
	(0.33698)	(0.93024)

Table 44: Results for the Ad hoc Model- Long-term elasticities of Indian imports of sawnwood (GDPC, UE, EO, POPD).

ID	GDPC	UE	EO	POPD
C	-5.45	22.68	7.19	-68.61
GDPC	2.51***			
DPS				
UE		-2.98**		
EO			0.10***	
POPD				13.47***
DPP				
DPPC				
DPS/DPP				
DPS/DPPC				
R-squared	0.87	0.35	0.86	0.85
DW	1.02	0.68	1.18	0.93
JB H-Nt	0.6	0.68	0.72	0.7
Ht	0.91	0.42	0.67	0.55
BG LMt	0.07	0.0049	0.18	0.15
ADFt	-2.96, I(0)	-2.79, I(1)	-3.61, I(0)	-3.66, I(0)

Notes:
***,** and * represent statistical significance of coefficients at the significance levels 1%, 5% and 10%, respectively.
C=constant, GDPC=GDP/capita (USD), DPS=import price of sawnwood (USD/m^3), UE=unemployment (% of TLF), EO=economic openness (% trade of GDP), POPD=Population density (inh/km^2), DPP=import price of plywood (USD/m^3), DPPC=Import price of Portland cement (USD/kg).
DW=Durbin-Watson stat, JB H-Nt=Jarque-Bera Histogram-Normality Test, Ht=Heteroscedasticity Test (ARCH, Autoregressive Conditional Heteroscedasticity, BG LMt=Breusch-Godfrey Serial Correlation LM Test, ADFt=ADF Unit Root Tests on Resid.
I(0): There is no unit root which means stationary series.
I(1): There is one unit root which means nonstationary series. Then, time series become stationary at the first difference.

Table 45: Results for the Ad hoc Model- Long-run elasticities of Indian imports of sawnwood (EO DPS, GDPC DPS/DPP, POPD DPS/DPP, POPD DPS/DPPC)

ID	EO DPS	GDPC DPS/DPP	GDPC DPS/DPPC	POPD DPS/DPP	POPD DPS/DPPC
C	12.47	0.84	-5.2	-57.65	-79.4
GDPC		2.31***	2.83***		
DPS	-0.92*				
UE					
EO	0.10***				
POPD				12.43***	15.80***
DPP					
DPPC					
DPS/DPP		-5.50*		-5.28*	
DPS/DPPC			-1.94*		-2.44**
R-squared	0.9	0.9	0.89	0.88	0.9
DW	0.95	1.04	1.07	0.89	1.11
JB H-Nt	0.51	0.67	0.57	0.05	0.08
Ht	0.45	0.39	0.34	0.73	0.87
BG LMt	0.28	0.16	0.08	0.23	0.44
ADFt	-2.87, I(0)	-3.08, I(0)	-2.98, I(0)	-3.84, I(0)	-4.44, I(0)

Notes:
***,** and * represent statistical significance of coefficients at the significance levels 1%, 5% and 10%, respectively.
C=constant, GDPC=GDP/capita (USD), DPS=import price of sawnwood (USD/m^3), UE=unemployment (% of TLF), EO=economic openness (% trade of GDP), POPD=Population density (inh/km^2), DPP=import price of plywood (USD/m^3), DPPC=Import price of Portland cement (USD/kg).
DW=Durbin-Watson stat, JB H-Nt=Jarque-Bera Histogram-Normality Test, Ht=Heteroscedasticity Test (ARCH, Autoregressive Conditional Heteroscedasticity, BG LMt=Breusch-Godfrey Serial Correlation LM Test, ADFt=ADF Unit Root Tests on Resid.
I(0): There is no unit root which means stationary series.
I(1): There is one unit root which means nonstationary series. Then, time series become stationary at the first difference.

Annex 4

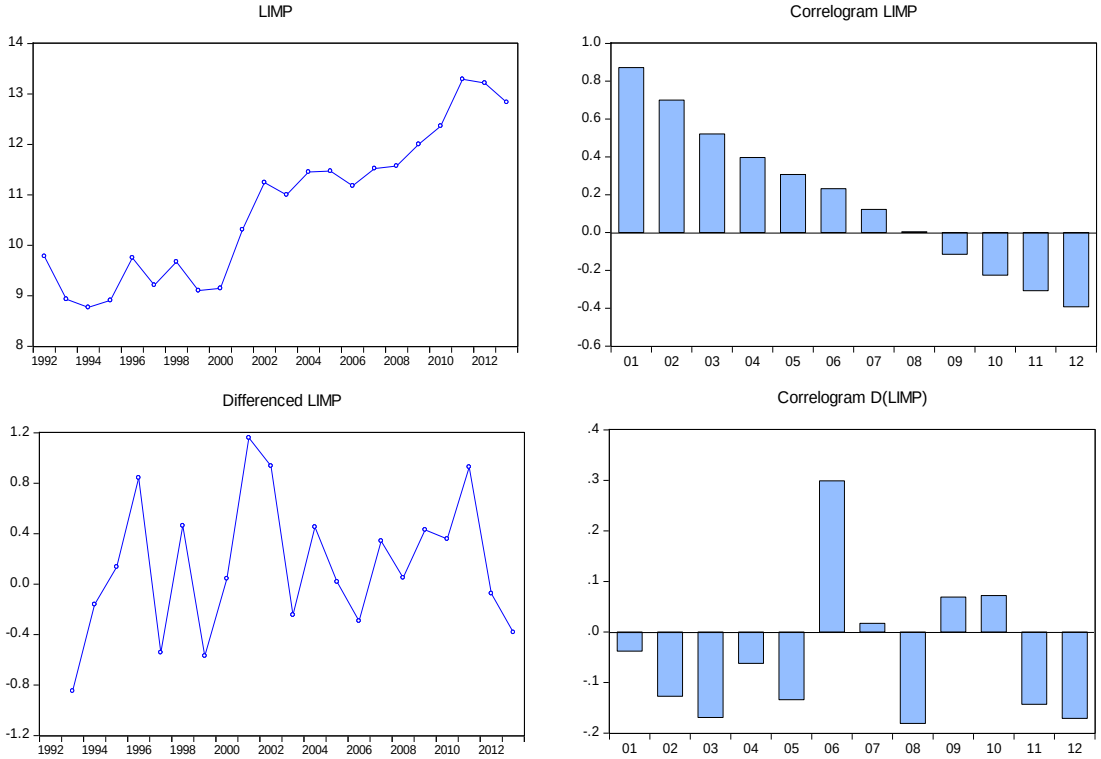

Figure AA: LIMP and the 1st Difference D(LIMP) with the respective Correlograms.

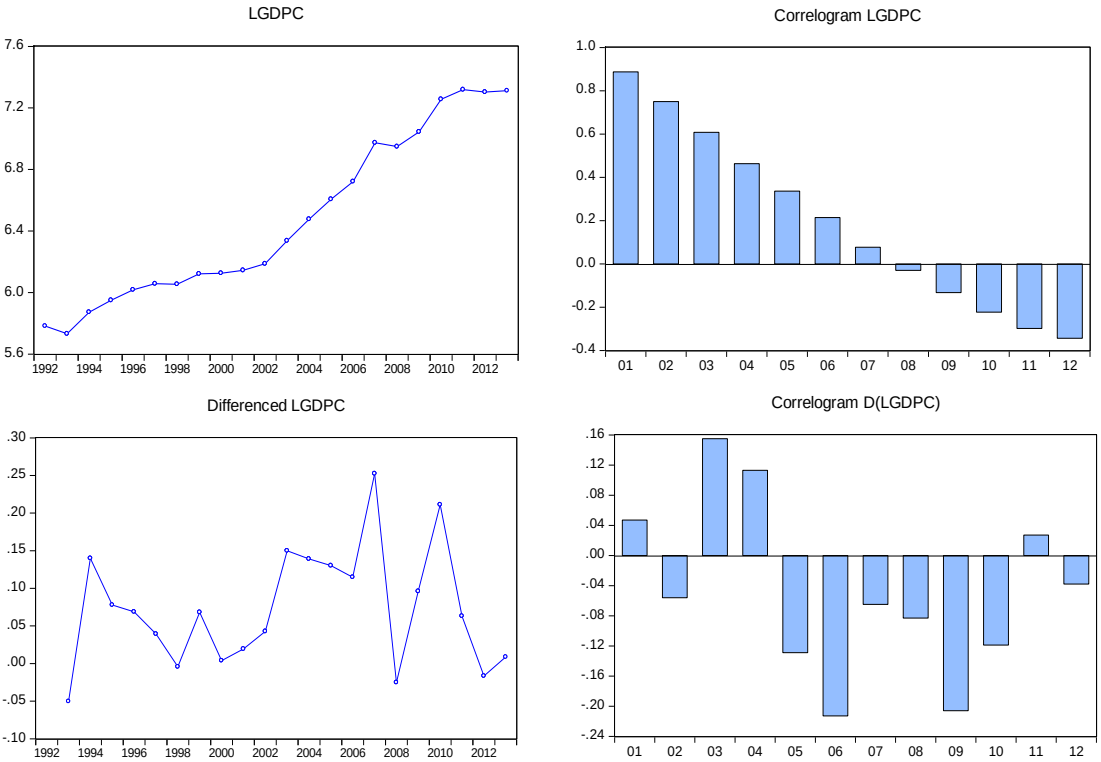

Figure BB: LGDPC and the 1st Difference D(LGDPC) with the respective Correlograms.

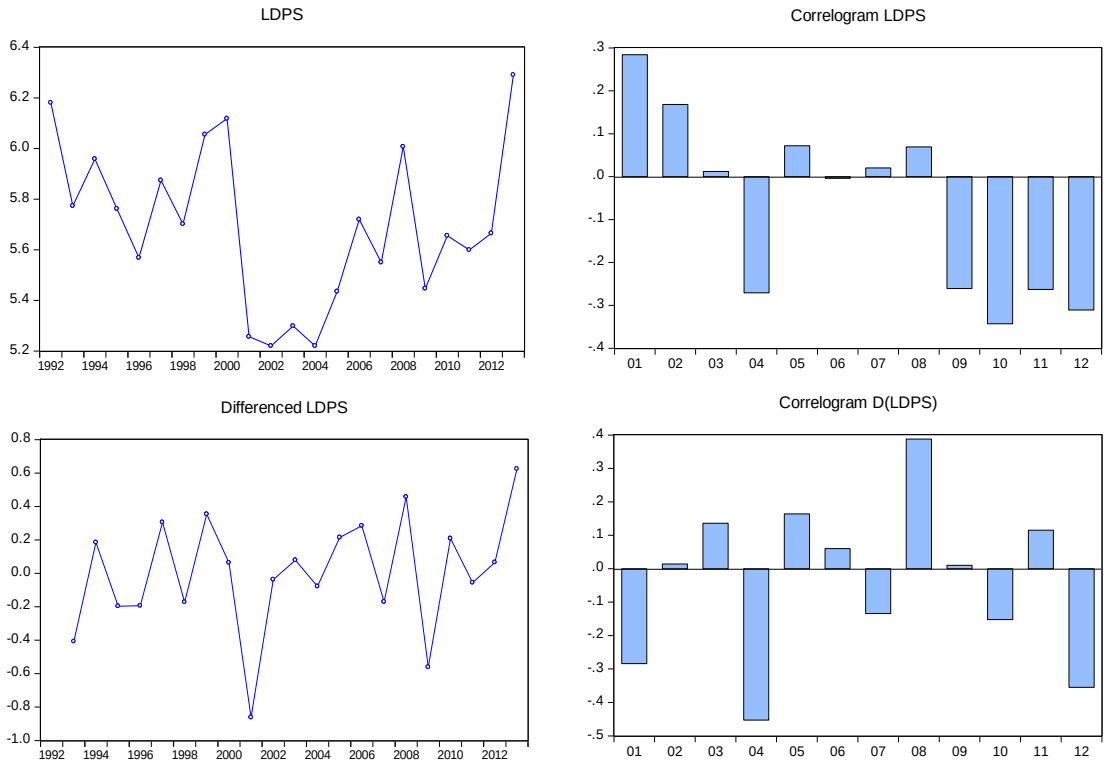

Figure CC: LDPS and the 1st Difference D(LDPS) with the respective Correlograms.

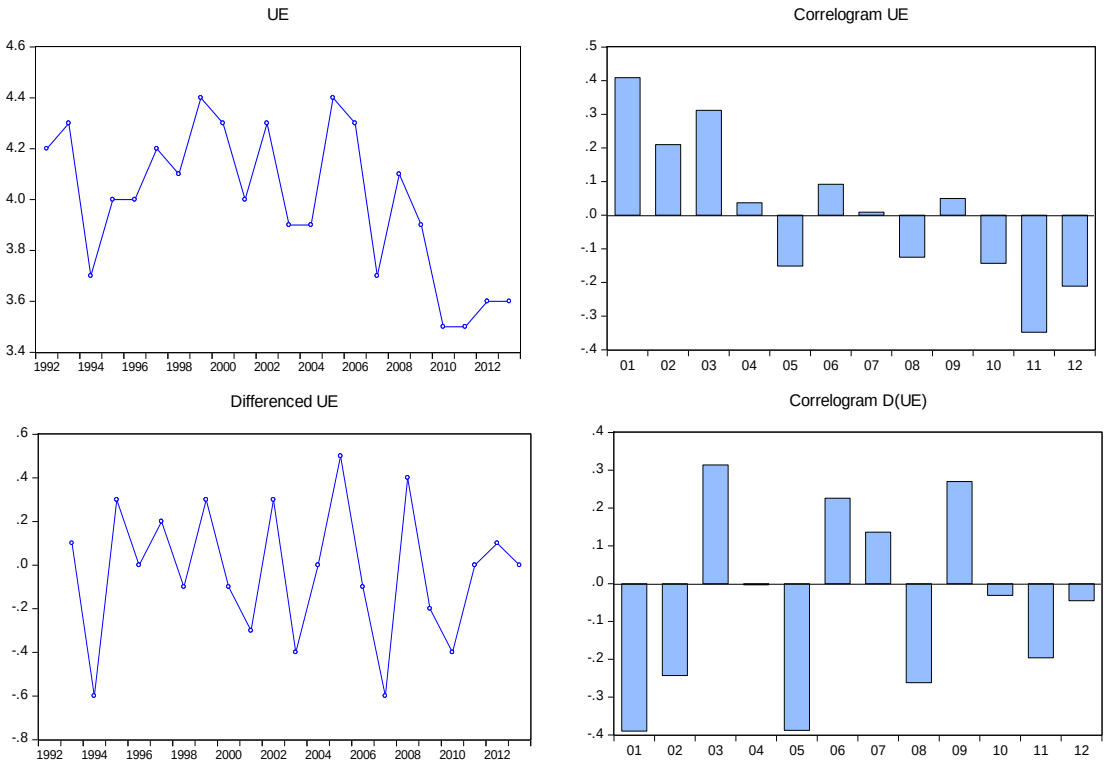

Figure DD: LUE and the 1st Difference D(LUE) with the respective Correlograms.

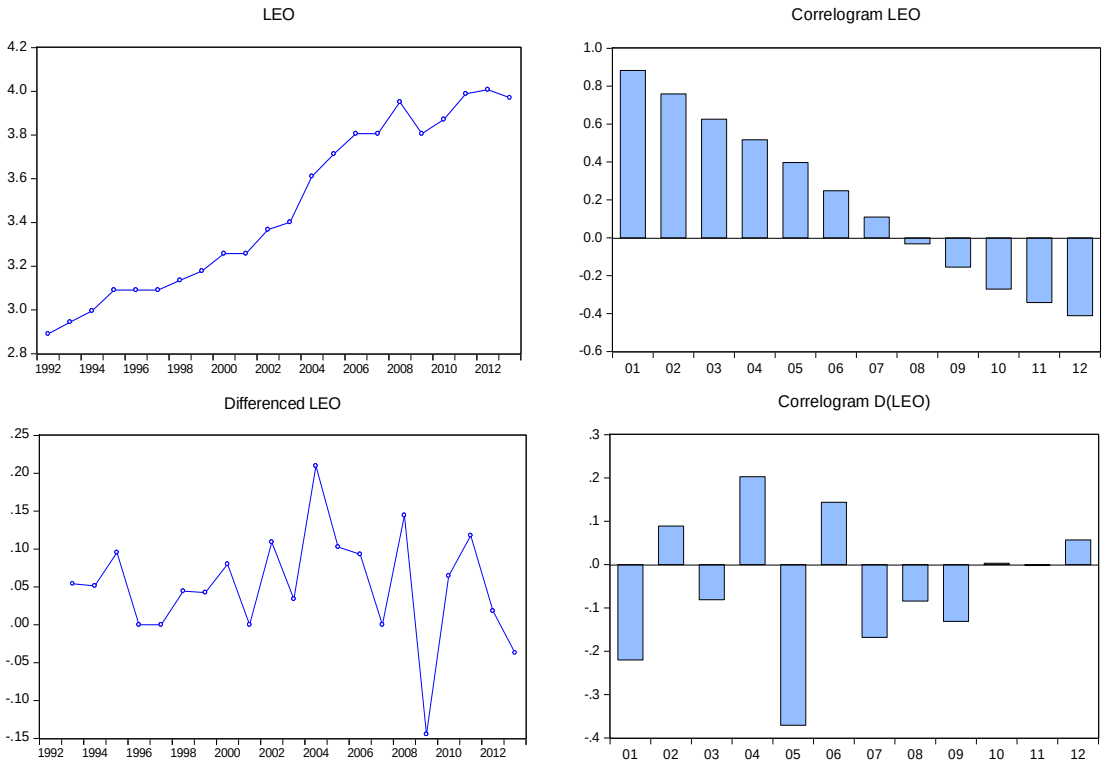

Figure EE: LEO and the 1st Difference D(LEO) with the respective Correlograms.

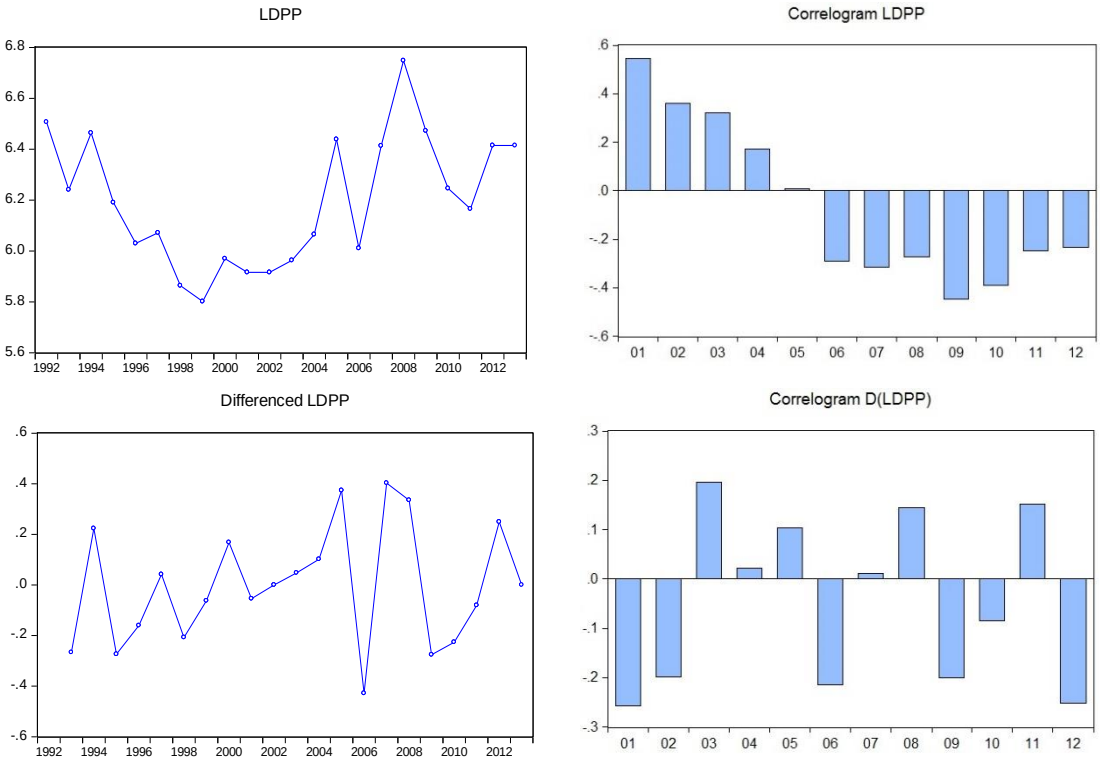

Figure FF: LDPP and the 1st Difference D(LDPP) with the respective Correlograms.

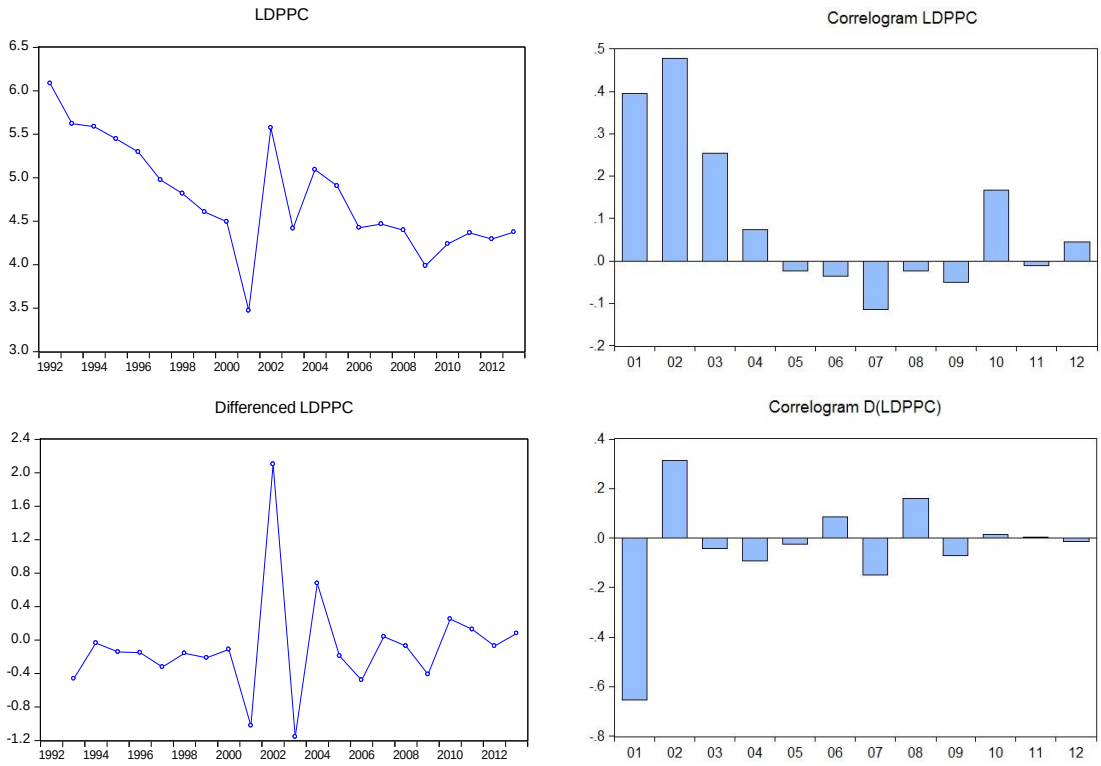

Figure HH: LDPPC and the 1st Difference D(LDPPC) with the respective Correlograms.

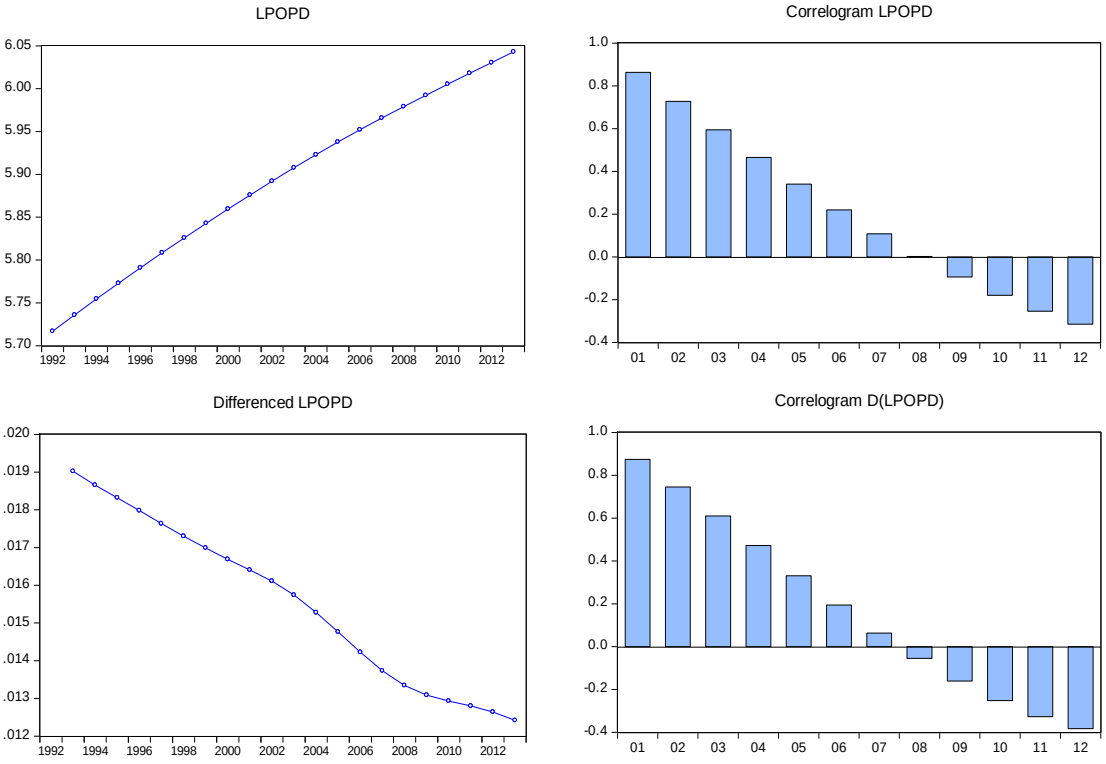

Figure GG: POPD and the 1st Difference D(POPD) with the respective Correlograms.