**ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY II**

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# NATIONAL COMPETITIVENESS INDEX OF THE FOREST PRODUCTS INDUSTRY IN THE ASIA-PACIFIC REGION

**by**

**Daisuke Sasatani**[1]

**FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS**
**REGIONAL OFFICE FOR ASIA AND THE PACIFIC**

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[1] Consultant, FAO FOEP, Rome, Center for International Trade in Forest Products, University of Washington, Seattle.

# Contents

**INFORMATION NOTE ON THE ASIA-PACIFIC FORESTRY SECTOR OUTLOOK STUDY**

The Asia-Pacific Forestry Sector Outlook Study (APFSOS) is a wide-ranging initiative to gather information on, and examine, the evolution of key forestry issues as well as to review important trends in forests and forestry. The main purpose of the study is to provide a better understanding of the changing relationships between society and forests and thus to facilitate timely policy reviews and reforms in national forest sectors. The specific objectives are to:

1. Identify emerging socio-economic changes impacting on forest and forestry
2. Analyze probable scenarios for forestry developments to 2020
3. Identify priorities and strategies to address emerging opportunities and challenges

The first APFSOS was completed in 1998, with an outlook horizon to 2010. During its twenty-first session, held in Dehradun, India, in April 2006, the Asia-Pacific Forestry Commission (APFC) resolved to update the outlook extending the horizon to 2020. The study commenced in October 2006 and is expected to be completed by September 2009.

The study has been coordinated by the Food and Agriculture Organization of the United Nations (FAO), through its regional office in Bangkok and its headquarters in Rome, and implemented in close partnership with APFC member countries with support from a number of international and regional agencies. The Asian Development Bank (ADB), the International Tropical Timber Organization (ITTO), and the United Kingdom's Department for International Development (DFID) provided substantial financial support to implement the study. Partnerships with the Asia-Pacific Association of Forest Research Institutes (APAFRI) and the Secretariat of the Pacific Community (SPC) supported the organizing and implementing of national focal points' workshops and other activities, which have been crucial to the success of this initiative. The contributions of many other individuals and institutions are gratefully acknowledged in the main APFSOS report.

Working papers have been contributed or commissioned on a wide range of topics. These fall under the following categories: country profiles, sub-regional studies and thematic studies. Working papers have been prepared by individual authors or groups of authors and represent their personal views and perspectives; therefore, opinions expressed do not necessarily reflect the views of their employers, the governments of the APFC member countries or of FAO. Material from these working papers has been extracted and combined with information from a wide range of additional sources to produce the main regional outlook report.

In general, working papers are moderately edited for style and clarity and are formatted to provide a measure of uniformity, but otherwise remain the work of the authors. However in this case the contents have been heavily edited; while all care has been taken, some errors may have been introduced as a result of editing and interpretation. Copies of these working papers, as well as more information on the Asia-Pacific Forestry Sector Study, can be obtained from:

Mr. Patrick Durst
Senior Forestry Officer
FAO Regional Office for Asia and the Pacific
39 Phra Atit Road
Bangkok 10200
THAILAND
Ph. (66-2) 697 4000
Fax: (66-2) 697 4445
Email: patrick.durst@fao.org

# 1. INTRODUCTION

## Background to the study

Wood and wood products are increasingly traded regionally and globally and the volume and direction of investments in production and processing are changing depending on how the products could be produced competitively, both in the short and long term. The ability to produce goods and services varies between countries and it is important to understand how this differs between countries. The scope of this paper is the Asia-Pacific Region (APR). The APR includes a variety of nations from technically advanced developed nations, emerging economies to agrarian nations. The APR has been regarded as one of the most dynamic economies in the world recently. The remarkable pace of growth in the APR region has brought immense potential to global prosperity.

Globalization has had a significant impact on wood-processing and the forest product industry in the APR in the last several decades. Globalization has opened up the opportunities for entrepreneurs all over the world. The World Trade Organization (WTO) has liberalized and increased the amount of international trade. Because of the globalization, enterprises have tried to find more inexpensive locations to produce goods than their competitors and to fulfil the profitable market demand anywhere in the world. Firms no longer need to locate near raw material sources or markets if the conditions are not preferable in that country. Some nations which have a preferable environment for entrepreneurs can attract investments in the wood processing and forest products industry, and simultaneously can increase the amount of exports. Competitiveness of the nation is synonymous with the preferable conditions for entrepreneurs and existing firms. In the globalization era, competitiveness became one of the most important factors to understand the international trade flows, the location of production and the inflow and outflow of capital. Therefore, understanding competitiveness of nations is crucial for policy makers. For business, understanding competitiveness of nations and forecasting the changes of competitiveness may bring enormous opportunities and avoid unnecessary risk. In this study, the generalized national competitiveness index of six sectors (wood extraction from natural forest, wood extraction from planted forest, sawnwood industry, plywood industry, fiberboard and particle board industry, and paper and pulp industry) in the next ten years shall be shown. Then, how such competitiveness affects long-term sustainable wealth creation shall be discussed.

## Objective of the study

- Analysis of the factors influencing the competitiveness of production of wood and wood products in the APR in relation to the global situation
- Assess the likely changes in the competitiveness of wood production and processing in different countries in the APR during the next ten years
- Indicate what measures can be taken to improve competitiveness of wood and wood products in the APR

## 2. COMPETITIVENESS: AN OVERVIEW

In general, the cost differentials between nations have been the most important explanatory factor of the economic theory of international trade. However, there are many other important factors, such as natural resource availability, quality of products, technological sophistication and institutions, all affecting a nation's competitiveness. Under free and fair market conditions, firms in a more competitive nation can produce goods and services that meet the test of both domestic and international markets while simultaneously expanding the real income of its citizens. Therefore, if a nation is more competitive than other nations, the nation can produce and then export more goods and attract more direct investments.

**Definition of competitiveness**

Despite its importance, competitiveness of the nation does not have a concrete consensus definition (Dieter and Englert, 2007). Originally, competitiveness is the firm's ability to provide products as or more effectively and efficiently compared to their competitors and to stay in business to have the capacity to exploit existing market opportunities and generate new markets. So, competitive firms can achieve some desired results in terms of profit, price, return, or quality of products. The concept of competitiveness was extended to the national level by Michael Porter (1990). Porter's 'Competitive Advantage of Nations' bridges strategic management of firms and international economics. Porter emphasized that it is firms rather than nations which compete domestically and/or internationally. The role of the nation is how it helps or impedes firms' business activity.

Productivity is treated as the most important variable to see the competitiveness of the nation in the long run. Nations which have higher productivity than others can accumulate wealth in the nation and can even invest to enhance their competitiveness for the future. From that perspective, competitiveness of a nation can be defined as "the degree to which a country can, under free and fair market conditions, produce goods and services which meet the test of international markets, while simultaneously maintaining and expanding the real incomes of its people over the long term" (Garelli, 2006). Porter (1990) believes the traditional comparative advantage of international trade theory is inadequate, and a nation attains a competitive advantage if its firms are competitive. Firms become competitive through innovation. Innovation can include technical improvements to the product or to the production process, which eventually results in lifting up the return.

Although the sustainable competitive advantage of a nation is very useful for the normative perspective and for the long-term perspective, it would be too ideal for the purpose of this study. Since the objective of this study is to analyze the competitiveness outlook of forest sectors in the APR during the next ten years, so the changing of the cost of production must be the most important driver to determine the changes of competitiveness in a nation. Hence, competitiveness of forest product sector in a nation in the next ten years is defined as the firms' ability to produce products cheaper and more efficiently than firms in other nations. This definitely contradicts the long-term competitiveness of nations. Long-term competitiveness can be achieved under free and fair economic conditions. Firms in a nation can produce goods cheaper and more efficiently, so more capital can enter the sector in a nation and accumulated return will eventually benefit its citizens. The reason why I emphasize free and fair economic conditions is the cost advantage from manipulated or unfair economic conditions may temporally spur production and foreign direct investment, but it will eventually harm the wealth of citizens. In the globalized world, arbitrage is happy to exploit those opportunities without considering the long-term wealth creation of a nation. Any subsidies, ignoring social environmental cost, manipulated exchange rate and asset price, and extreme tax benefits will artificially lower production costs in the short term, but will slash

the wealth of its people in the future. Competitiveness of the near future is clearly distinct from the long-term perspective in this study.

**Dynamics of competitiveness**

Factor indicators of competitiveness change all the time. Some factors change predictably, while other factors change unexpectedly. Also, competitiveness is the relative term, so one nation's change affects competitiveness of other nations. Competitiveness is the firm's ability to provide products as or more effectively and efficiently compared to their competitors and to stay in business to have the capacity to exploit existing market opportunities and generate new markets. So, competitive firms can achieve desired results in terms of profit, price, return, or quality of products. It is important to note that firms in nations compete in both home and global markets, but nations by themselves do not compete. Nations' roles are how they can help or hinder firms' activity. However, just helping firms to produce goods inexpensively cannot directly link to the wealth creation of the country. For example, when the nation artificially lowers production cost through subsidies, even though the subsidies can boost the output volume and the number of employment in the sector, subsidies distort the market and usually the nation has to pay a huge cost in the long-run. Hence, how to achieve long-term wealth should be the only interest for the policy makers of the nation in a normative term.

As shown in Figure 1, Porter's competitive advantage of the nation is based on an analysis of four sets of variables; (1) factor conditions, (2) demand conditions, (3) related and supporting industries, and (4) firm strategy, structure and rivalry. Those four sets of variables interdependently influence national competitive advantage. Those four sets of variables are known more commonly as Porter's Diamond of national advantage.

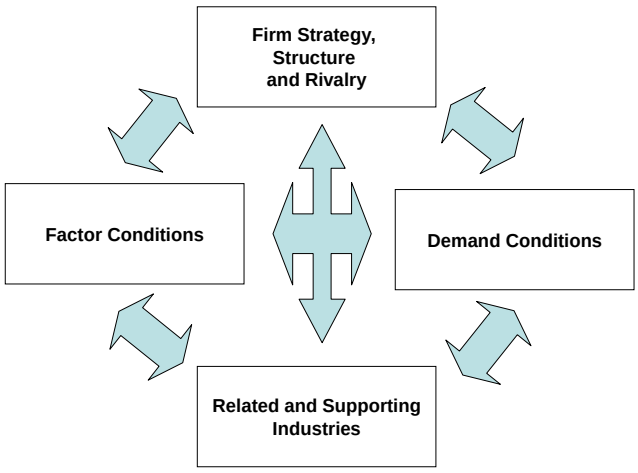



**Figure 1. Four sets of variables for competitive advantage**

Porter took over the factor endowments from international trade theory, but differentiated into basic factors and advanced factors. Basic factors include natural resources, climate, location, and demographics. Advanced factors include communications infrastructure, sophisticated skills and research facilities, which are similar to the idea of intangible resources of an individual firm. Advanced factors are more important than basic endowment factors in terms of national competitiveness. Advanced factors are accumulated through investment by government, individuals and firms. Basic endowment factors can provide some advantages in initial stages, but the nation needs to invest to extend to advanced factors; otherwise it cannot keep the edge of competitive advantage against other nations. Interestingly, disadvantages by basic factor endowment sometimes pressure the nation to invest in advanced factors, and

some countries create the edge of competitive advantage. For example, resource poor nations and regions in East Asian countries became successful industrialized countries because they invested considerably in advanced factors. Porter's challenge was that basic factor endowment is not the single crucial factor. However, intangible advanced factors are not easy to quantify.

Porter emphasizes home demand is crucial for shaping the differentiation attributes of domestically produced products. Usually, firms are more sensitive to domestic customers than foreign customers. Domestic customers' wants will make firms invest in advanced factors and result in sophisticated products. These customers contribute much for the competitiveness of nations. Although foreign-owned companies sometimes do not necessarily target domestic markets, targeted customers would be more important than the domestic customers' sophistication or demand conditions. Porter found the tendency for successful industries within each country to be grouped into clusters of related and supporting industries. If some sectors are competitive in a country, related sectors also gathered in the same regions. Porter also found that rivalry among companies in a country create competitiveness in the country. Since competition between domestic firms is more emotional and firms can get more information on others than competition against foreign competitors, their domestic rivalry is more intense. Intense competition will bring cost reduction, differentiation, and innovation, which eventually result in the competitiveness of the whole sector in the country.

Those four facets interact and create national competitive advantage dynamically. One nation's attempt alters other nations. Any changes make firms change their strategy of business. Under the different types of conditions, firms behave differently to make their profits strategically. Today's success of the sector may bring difficulties for firms in the future. Today's challenge may result in prosperity for firms in the future. The dynamic aspect of competitiveness is critically important to understand.

**Literature review of the competitiveness of wood and wood products**

Competitiveness has been treated as one of the most important key drivers of wealth creation even for wood processing and forest product sectors since the 1990s. Some studies have tried to attempt to integrate the competitiveness of forest sectors among nations. Because of the lack of a clear definition of the competitiveness of a nation, many methodologies have been developed to reflect the competitiveness of a nation. Fundamentally, those studies can be classified into two major groups based on the methodological approach; result-oriented competitiveness analysis and determinant-oriented competitiveness analysis (Dieter and Englert, 2007). Result-oriented study, for example, utilizes the market share indicators and reveals comparative advantages. There are many observable and unobservable factors to determine competitiveness, so the result-oriented approach tries to analyze from results, such as productivity. On the other hand, determinant-oriented studies identify the determinants of competitiveness to compare competitiveness based on the determinants. In the past, studies from different parts of the world and from different sectors of the forest industry indicated the key factors of determinant-oriented indicators that contribute to success in the forest business. In recent years, globalization has emphasized the importance of country-related effects as determinants of performance of firms and sectors in a nation. Resource factor endowments, cost of labor and production inputs, financial and technological infrastructure, accessibility to the markets, and institutional and regulatory frameworks are examples of country-specific factor endowments that affect firms' performance in a nation (Depperu and Cerrato, 2005).

Production cost would be the most popular determinant of the forest sector competitiveness study, no matter how a nation's competitiveness is defined. Most competitiveness studies in forest sectors are focusing on how firms can reduce the cost of production to gain competitiveness. Those studies are usually based on the economic theory of international trade. Based on the cost theory, any factors that reduce the cost of production increase the

amount of productivity and exports. Although, this approach is very straightforward, however, comparing competitiveness by the cost structure of heterogeneous nations might be meaningless since nations are in different levels of development stages. Also, reducing costs through unfair conditions will harm the future wealth of their people, so lower cost structure of nations does not necessarily guarantee the competitiveness of nations in the long-run.

Brown and Ortiz (2001) is the most remarkable study of competitiveness of forest sectors based on the World Competitiveness Yearbook (WCY) by the International Institute for Management Development (IMD). They studied the competitiveness of the forest processing investment environment among New Zealand, Australia, Chile, the Russian Federation, Sweden and the USA. They scored 1) resources, 2) processing development, 3) market development, 4) industry knowledge, 5) investment attractiveness, 6) energy and 7) environment and combined these forestry factors with the base competitiveness index by the WCY and ranked the competitiveness of wood processing sectors among those nations.

**Indices of competitiveness**

Despite the lack of a prominent definition of competitiveness at the national level, economists usually use several indicators that are referred to as measures of national competitiveness. The most popular indicators are the competitiveness index by the World Economic Forum (WEF) and the WCY by the IMD.

The Growth Competitive Index (GCI) is annually reported in the Global Competitiveness Report by the WEF. Competitiveness finds its ultimate expression in the prosperity that countries can sustain over time. Prosperity is sustainable if it is based on the productivity companies can reach given the conditions they face in an economy. While most discussion of competitiveness remains focused on macroeconomic, political, legal and social circumstances that underpin a successful economy, progress in these areas is necessary, but not sufficient.

These indicators represent national overall competitiveness and it may be very different from the competitiveness of forest sectors . The first reason is countries have different amounts of forest resources. For example, Singapore is one of the highest ranked nations in the GCI, but does not have forest resources to explore, so the competitiveness of the wood processing sector is negligible. The second reason is the countries' level of development and investments in forest sectors. Unfortunately, the forest industry is not a fast-growing sector in most countries in the world but there are many growing sectors such as information technology, life science, and aerospace, so these booming sectors can attract much investment, and can grow much faster than general forest product sectors. Since people expect these fast-growing industries to create higher return, countries ranked higher on the existing competitiveness index may focus on these high-tech industries rather than the forest industry. The final reason is contradiction of short-term investment attractiveness and long-term wealth creation. This is a very serious problem especially in the resource extraction sector. Reducing any costs of extraction attracts much investment, but it will harm people in the country in the long-run. So, it is difficult to rely on the general existing overall competitiveness index when we analyze the forest industry. Therefore, it is necessary to create useful indicators to understand the competitiveness of forest sectors at the national level based on the theory.

## Table 1. Global Competitiveness Index (2006) of the APR

| Overall rank | | Total Scores | Basic Scores (2006) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Rank | Basic | Institution | Infra-structure | Macro-economic | Health |
| *5* | Singapore | **5.6** | *2* | **6.1** | 5.9 | 6.2 | 5.7 | 6.8 |
| *7* | Japan | **5.6** | *19* | **5.5** | 5.0 | 6.1 | 4.1 | 7.0 |
| *11* | Hong Kong | **5.5** | *4* | **6.0** | 5.5 | 6.3 | 5.7 | 6.7 |
| *13* | Taiwan | **5.4** | *21* | **5.5** | 4.6 | 5.6 | 5.1 | 6.8 |
| *19* | Australia | **5.3** | *11* | **5.7** | 5.5 | 5.4 | 5.2 | 6.8 |
| *23* | New Zealand | **5.2** | *16* | **5.7** | 5.7 | 4.9 | 5.1 | 6.9 |
| *24* | R. of Korea | **5.1** | *22* | **5.5** | 4.2 | 5.4 | 5.5 | 6.9 |
| *26* | Malaysia | **5.1** | *24* | **5.4** | 5.1 | 5.1 | 5.0 | 6.6 |
| *35* | Thailand | **4.6** | *38* | **5.0** | 4.4 | 4.4 | 5.1 | 6.1 |
| *43* | India | **4.4** | *60* | **4.5** | 4.6 | 3.5 | 4.1 | 5.9 |
| *50* | Indonesia | **4.3** | *68* | **4.4** | 4.0 | 2.7 | 4.5 | 6.4 |
| *54* | China | **4.2** | *44* | **4.8** | 3.5 | 3.5 | 5.7 | 6.4 |
| *71* | Philippines | **4.0** | *84* | **4.2** | 3.4 | 2.7 | 4.5 | 6.2 |
| *77* | Viet Nam | **3.9** | *71* | **4.4** | 3.6 | 2.8 | 4.6 | 6.4 |
| *79* | Sri Lanka | **3.9** | *80* | **4.2** | 3.5 | 3.1 | 3.7 | 6.7 |
| *91* | Pakistan | **3.7** | *93* | **4.0** | 3.5 | 3.4 | 4.2 | 4.8 |
| *92* | Mongolia | **3.6** | *97* | **3.9** | 3.1 | 2.2 | 4.5 | 5.8 |
| *99* | Bangladesh | **3.5** | *96* | **3.9** | 2.9 | 2.0 | 4.7 | 6.0 |
| *103* | Cambodia | **3.4** | *100* | **3.8** | 3.3 | 2.5 | 3.9 | 5.7 |
| *110* | Nepal | **3.3** | *106* | **3.7** | 3.2 | 1.8 | 4.5 | 5.1 |
| *122* | Timor-Leste | **2.9** | *116* | **3.3** | 2.9 | 1.7 | 4.2 | 4.3 |

| | Efficiency Scores (2006) | | | | | Innovation Scores (2006) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rank | Efficiency | Education | Market | Technology | Rank | Innovation | Sophistication | Innovation |
| Singapore | *3* | **5.6** | 5.6 | 5.6 | 5.7 | *15* | **5.1** | 5.2 | 5.0 |
| Japan | *16* | **5.3** | 5.5 | 5.2 | 5.2 | *1* | **6.0** | 6.1 | 5.9 |
| Hong Kong | *11* | **5.4** | 5.1 | 5.7 | 5.4 | *18* | **5.0** | 5.5 | 4.5 |
| Taiwan | *14* | **5.4** | 5.7 | 5.1 | 5.3 | *9* | **5.4** | 5.5 | 5.3 |
| Australia | *10* | **5.4** | 5.6 | 5.2 | 5.5 | *24* | **4.7** | 5.0 | 4.4 |
| NZ | *21* | **5.2** | 5.3 | 5.2 | 4.9 | *25* | **4.7** | 5.1 | 4.2 |
| R. of Korea | *25* | **5.0** | 5.4 | 4.4 | 5.2 | *20* | **5.0** | 5.2 | 4.7 |
| Malaysia | *26* | **4.9** | 4.8 | 5.2 | 4.6 | *22* | **4.9** | 5.3 | 4.5 |
| Thailand | *43* | **4.3** | 4.4 | 4.8 | 3.7 | *36* | **4.2** | 4.6 | 3.7 |
| India | *41* | **4.3** | 4.4 | 5.1 | 3.2 | *26* | **4.6** | 5.1 | 4.1 |
| Indonesia | *50* | **4.1** | 4.3 | 4.9 | 4.9 | *41* | **4.1** | 4.5 | 3.6 |
| China | *71* | **3.7** | 3.7 | 4.2 | 3.1 | *57* | **3.8** | 4.1 | 3.4 |
| Philippines | *63* | **3.9** | 4.0 | 4.2 | 3.3 | *66* | **3.6** | 4.2 | 3.1 |
| Viet Nam | *83* | **3.5** | 3.4 | 4.1 | 2.9 | *81* | **3.3** | 3.6 | 3.1 |
| Sri Lanka | *79* | **3.5** | 3.6 | 4.1 | 2.9 | *67* | **3.6** | 3.9 | 3.3 |
| Pakistan | *91* | **3.3** | 2.8 | 4.2 | 2.8 | *60* | **3.7** | 4.1 | 3.3 |
| Mongolia | *86* | **3.4** | 3.9 | 3.6 | 2.6 | *110* | **2.9** | 3.0 | 2.9 |
| Bangladesh | *108* | **3.0** | 2.7 | 3.9 | 2.4 | *104* | **3.0** | 3.4 | 2.6 |
| Cambodia | *110* | **2.9** | 2.6 | 3.6 | 2.6 | *102* | **3.1** | 3.4 | 2.7 |
| Nepal | *117* | **2.9** | 2.6 | 3.6 | 2.4 | *111* | **2.9** | 3.3 | 2.5 |
| Timor-L. | *122* | **2.6** | 2.6 | 3.0 | 2.2 | *125* | **2.4** | 2.6 | 2.1 |

Source: World Economic Forum (2007).

## 3. METHODOLOGY

Based on the literature review, systematic ways to calculate the current national competitiveness index (NCI) score of each sector are proposed. In this study, the processing wood and wood products industry is divided into six major sectors: 1) wood production from natural forests, 2) wood production from planted forests, 3) sawnwood, 4-a) plywood manufacturing, 4-b) particle board and fiberboard manufacturing and 5) pulp and paper. The current NCI during the next ten years is based on Porter's diamond of each sector, but the price factor is stressed more in my NCI than sustainable competitiveness. So, the current NCI score reflects export volume of products and direct investment inflows to the sector of a nation during the next ten years.

The forest industry ranges from raw material extraction to value-added products. Sectors at different levels of the production chain have different competitiveness drivers. Six sectors hierarchically co-exist in each nation rather than standing independently as shown in Figure 2. The six sectors of the forest product industry lie in these positions of the production chain, and have their own Porter's diamond. Wood extraction sectors heavily rely on natural factor endowments. These wood extraction sectors send raw logs to other value-added sectors. On the other hand, pulp and paper are capital intensive sectors.

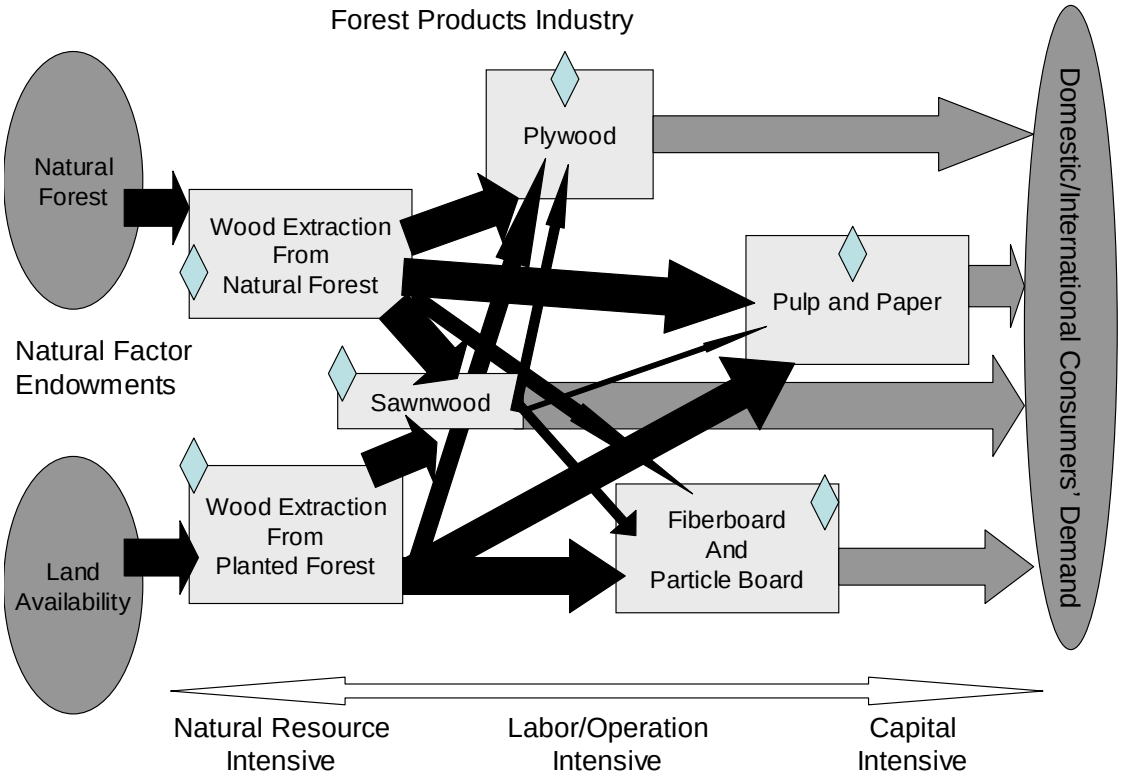



**Figure 2. Position of the six sectors of the forest product industry in the production chain context**

As discussed in the previous chapter, Porter's diamond which influences the competitiveness of nations includes four variables: factor conditions, related and supporting industries, demand conditions and firm strategy, structure and rivalry. It is extremely difficult to get each quantitative score of the four variables of each sector. Even if the quantitative score is estimated for each variable, interactions between those four variables complicate the

interpretation. Therefore, a holistic approach is taken to estimate the NCI in this study. There are many considerable factors which affect the competitiveness of a sector, such as consumption of products, competitiveness of the upstream sector, production of the downstream sector, natural forest, land availability, water availability, country institutions, labor cost, energy cost, infrastructure, efficiencies, technology, innovativeness, capital investment, managerial competencies and current productivity. These factors relate to Porter's four variables as shown in Figure 3. These factors are quite tangible, and it is possible to get a normalized score from available secondary data sources.

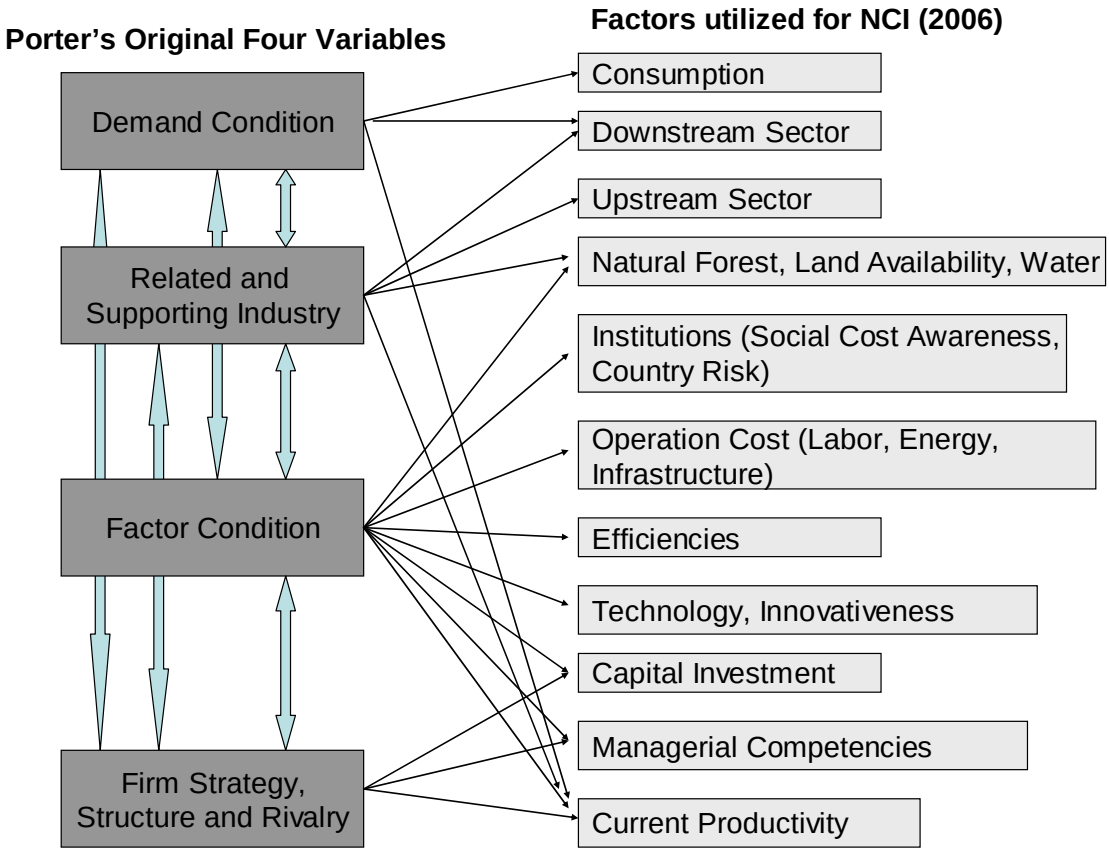



**Figure 3. Porter's diamond and the factors utilized for the NCI**

In order to calculate the current NCI, I initially identified the potential factors which influence the competitiveness of each sector since each sector has different competitiveness drivers. Then, I interviewed several forest products experts in FAO and the academe to determine the appropriate weights of those factors. I assumed factor weightings were constant in each sector over nations. There were many available secondary data sources for these factors, so I collected those figures. There were some missing values, so regression was applied to estimate missing values. The unit of each factor was different, so it was necessary to standardize for comparison. Consequently, a standardized T-score[1] was calculated as factor scores. Finally, the factor scores were systematically summed up with weightings which were based on the experts' opinions to calculate the current NCI. The details regarding procedures and results to calculate the current NCI of each sector are discussed in chapter 4.

A current NCI is useful to understand current competitiveness, but it is not sufficient to forecast future competitiveness. As the industry grows, factors will likely change from the current level. Some factors will change predictably. For example, if a nation attracts more

[1] T score = (z*10)+50, where z = (x – mean of x)/(standard deviation of x). So, T score ~ N(50, 100).

foreign direct investment in wood extraction from natural forest, the nation may suffer from over-logging in the future. However, other factors will change stochastically, and we cannot fully predict them, such as exchange rate and a government's subsidy programme.

Forecasting the competitiveness of each nation with uncertainties is very complex, so exploratory factor analysis was applied to reduce the number of variables of competitiveness and to group similar nations with similar characteristics for convenience. Factor analysis is used to extract the unobservable dimensions which include many variables. It mathematically reduces attribute space from larger correlated variables to smaller numbers of uncorrelated dimensions. Since the factors to estimate the NCI are highly correlated in nature, applying factor analysis can reduce the complexity of data. Two dimensions were extracted in each sector, and correlation between dimensions and factor scores was shown. Since they were latent unobservable dimensions which combined multiple factor scores, it was not always easy to interpret what the dimension meant. Generally, "development of the nation" and "resource richness of a nation" seem to be the two most important dimensions which control national competitiveness. Each nation was plotted on a two-dimensional map based on the results of factor analysis. Neighboring countries have similar characteristics on the map. Nations were grouped into four in each sector based on subjective judgement on the map.

Based on the groups, the outlook for the competitiveness of each sector in 2016 was forecast based on three different scenarios. The outlook for future competitiveness by different scenarios is discussed in chapter 5.

## 4. CURRENT NCI OF THE FOREST PRODUCTS INDUSTRY IN THE APR

In this chapter, the current NCI of six sectors in the forest products industry is shown. The methodology was stated in the previous chapter.

### Wood production from natural forests

Without forest it is not possible to extract wood material commercially. Wood extraction from natural forest (including primary, modified-natural and semi-natural) and productive plantations is quite different in many ways. In general, species and age extraction from natural forests and from plantations is quite different. There are more valuable species in primary, modified-natural and semi-natural forests than in productive plantations. Many AP nations hold rich tropical and temperate rain forests, and they have traditionally practiced logging activities from natural forests.

#### *Wood production from natural forest in the global context*

Natural forest areas are not equally distributed due to the climate and human activities. Wood producing activities in the early stages of development depend on the area of natural forests. The world has 3.5 billion ha of natural forests (1.3 billion ha of primary forest, 1.9 billion ha of modified-natural forest and 260 million ha of semi-natural forests) as categorized by the Forest Resource Assessment (FRA) in 2005. As shown in Figure 4, 19 percent of total natural forest is located in the APR — 670 million ha (120 million ha of primary forests, 420 million ha of modified-natural forests and 130 million ha of semi-natural forests). East Asia, South and South East Asia and Oceania hold 5.7, 7.5 and 5.6 percent of the world's natural forest.

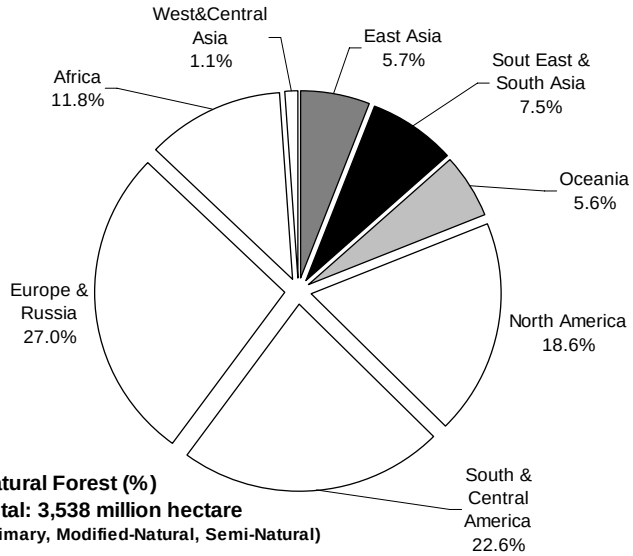



**Figure 4. Natural forest area by world regions**
Source: Global Forest Resource Assessment (FRA) (2005).

As shown in Figure 5, the APR had between 15.8 to 19.9 percent of global industrial roundwood production from 1990 to 2006. It is important to note that this industrial roundwood was not only from natural forests but also from planted forests. In 2006, the region produced 267 million $m^3$ of industrial roundwood, which was 16.1 percent of the total world production. After the Asian financial crisis, the production of roundwood in the APR declined sharply till 2000. North America and Europe (including Russia) produced the majority of industrial roundwood with 631 million (37.9 percent) and 517 million (31 percent) $m^3$ respectively in 2006. After the Soviet Union's collapse, industrial roundwood production in the world sharply declined, but increased gradually after the mid-1990s.

Production recorded 1.71 billion $m^3$ in 2005. However, the global economy has been slowing triggered by the US subprime mortgage problem. Uncertainty in the global economy will challenge global industrial roundwood production in next few years.

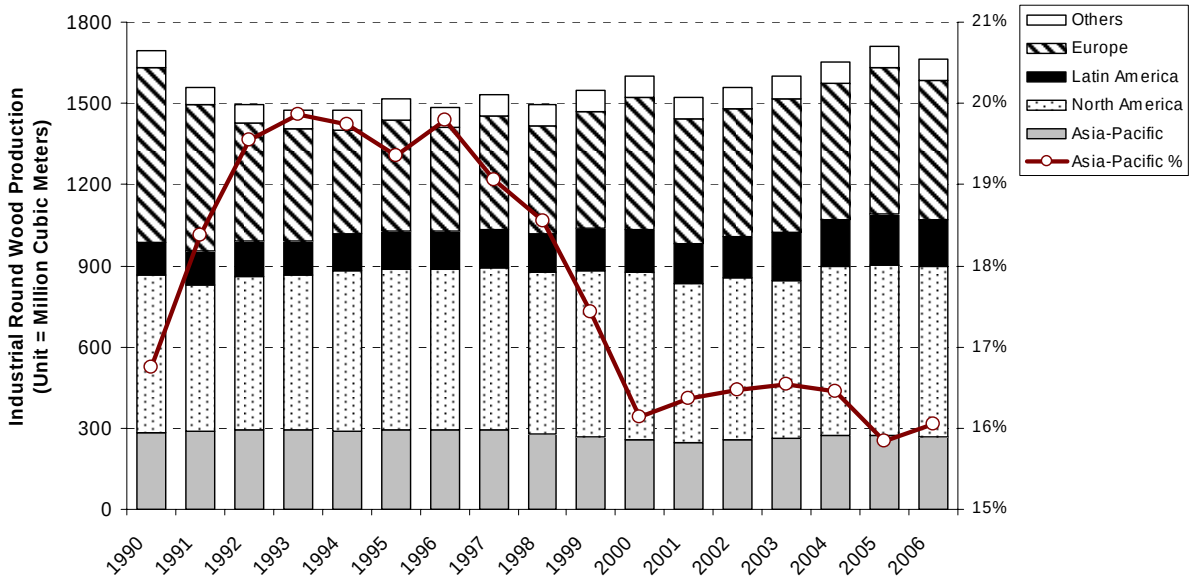



**Figure 5. Industrial roundwood production in the world and the APR's share**
Source: FAOSTAT (2008).

Figure 6 shows the production trend within the APR from 1990 to 2006. China produced 93.2 million $m^3$ of industrial roundwood in 2006, which accounted for 34.9 percent of the APR. Indonesia, Australia, India, Malaysia, New Zealand and Japan followed China, produced 28.1, 26.9, 23.2, 22.5, 19.3, and 16.6 million $m^3$, respectively. In the past 10 years, Indonesia, Malaysia and Japan decreased their production with 38.3, 30.8, and 22.9 percent, respectively. On the other hand, during the same period, Australia and India increased production with 35.9 percent and 21.5 percent, respectively.

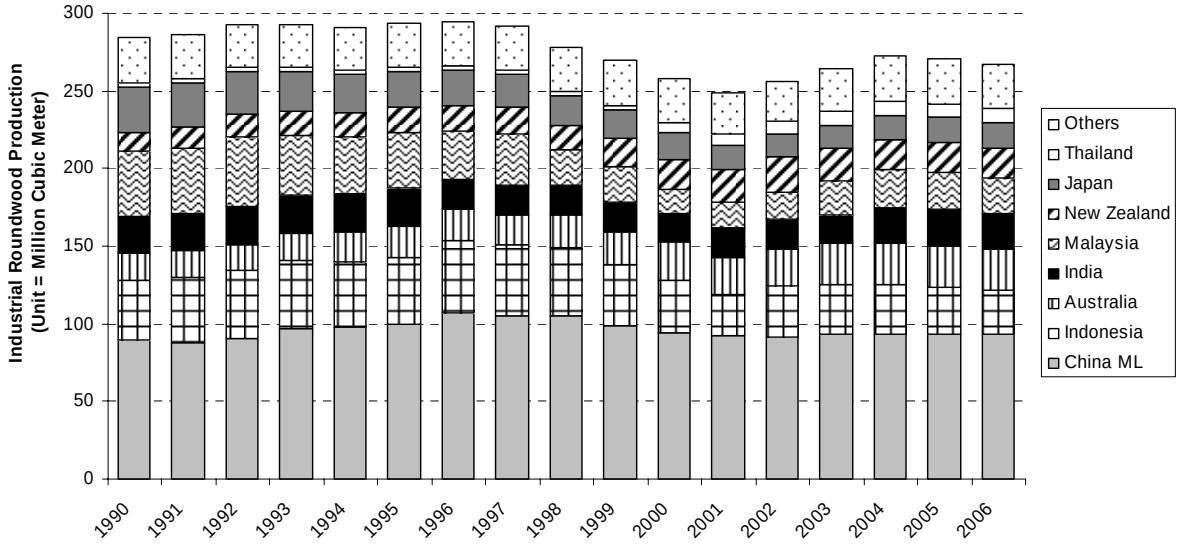



**Figure 6. The share of industrial roundwood production in the APR**
Source: FAOSTAT (2008).

***Key factors concerning competitiveness of wood extraction from natural forests***

From the beginning, the major concern about GCI is that the index does not include resource availability scores at all, so it is not easy to understand the competitiveness of the commodity industry. Hence, natural forest availability is the most important single key factor for wood production sectors, so it is important to include wood resource availability as the primary factor for the competitiveness of wood extraction from natural forests. Even though natural forest resources may be abundant in one nation, many factors hinder logging activities. Accessibility of the natural forest limits the logging activity, which must be an important component of the natural forest availability factor. Second, ease to cut natural forests would be another factor since it is much easier to cut natural forests in some countries than other nations. The fourth factor is operation cost and productivity. Operation cost and productivity vary by nations, which directly results in competitiveness. Finally, the demand condition is the key factor. As the theory of the competitiveness of nations tells, domestic demand primarily sophisticates the industry of the nation.

*Natural forest availability as the factor*

There are four components to estimate the natural forest endowment factor: 1) natural forest area, 2) natural forest area per capita, 3) overall forest stock and 4) accessibility to natural forests. The area of natural forest roughly reflects the size of the forest resource in each country. Then, per capita area of natural forest is also important because the size and population of nations are very different. However, it is also important to note that all forests are not accessible for commercial logging. So, accessibility to natural forest should be considered. If the forest has more stock, there is a tendency to extract more valuable trees from there. So, the overall forest stock is a very important component as well. Those three components directly influence the current competitiveness of wood extraction from natural forests, but overlogging activities will eventually result in the loss of competitiveness in the long run. Vice versa, if the nation extracts fewer trees than those that grow naturally, this will eventually open up more opportunities for the nation in the future. Annual growing stock per hectare will be discussed, and it will be utilized to predict future competitiveness in the next chapter.

In the APR, the FRA categorized 668 million ha as natural forests (either primary, modified-natural and semi-natural forests) in 2005, which is around 23.5 percent of the total land area. As shown in Figure 7, China and Australia hold almost half of the total natural forests in the region with 166 million and 162 million ha, respectively. Tropical and sub-tropical nations, such as Indonesia, India, Myanmar, Papua New Guinea, Malaysia and Laos follow with 85.1, 64.5, 31.4, 29.3, 19.3 and 15.9 million ha, respectively.

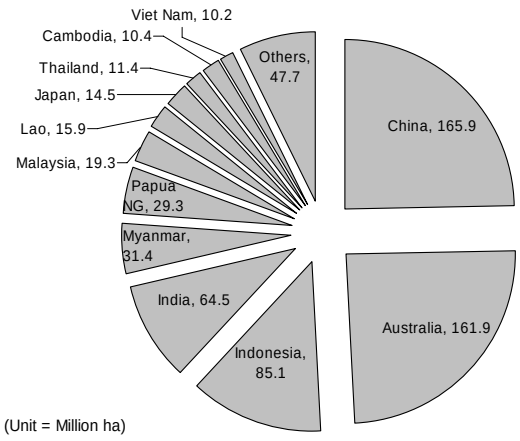


**Figure 7. Natural forest area in the APR in 2005**
Source: FRA (2005)

As shown in Figure 8, per capita forest for Australia is 8 ha, which is the highest in the region. Bhutan and Papua New Guinea, Mongolia and New Caledonia follow with 5, 4.8, 3.9 and 3 ha per capita. Many East Asian countries are ranked lower since population density is high.

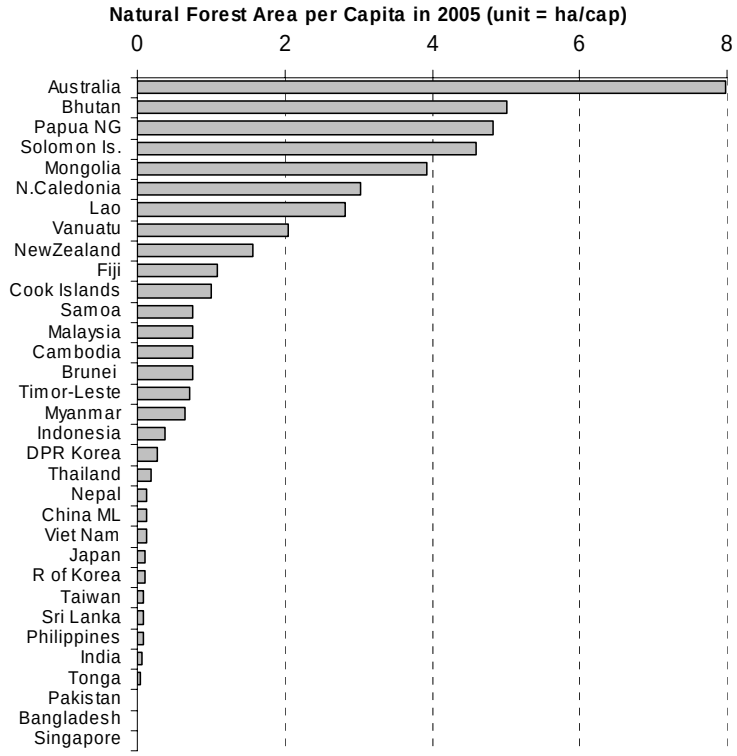



**Figure 8. Natural forest area per capita in the APR**
Source: FRA (2005).

If people cannot reach the forest easily they are not able to extract logs on a commercial basis. So, accessibility of natural forests must be a very important aspect of competitiveness of wood extraction from natural forests. Accessibility determines the costs of wood production (especially opportunity costs and transportation costs). Furthermore, poor accessibility to the natural area may result in poor forest management. Since people tend to log trees from easily accessible forests in a nation whose infrastructure is poor, some areas experience severe depletion of natural resources.

As already mentioned, the GCI has the index of infrastructure in each nation. However, this should not be highly correlated with accessibility to natural forests due to the size of forest area. Even though a nation has poor infrastructure, if the nation is small, it might not be a problem to access the natural forest. So, accessibility to natural forest should be derived by the function between the total natural forest area of the nation and the infrastructure index. I assume that the accessibility to natural forests is exponentially increased by the infrastructure index. I assume the infrastructure index raised to the power of six is the maximum forest areas which are commercially accessible. If a nation has a larger forest area than the calculated accessible forest area and people cannot reach some areas, the maximum accessible forest area equals the infrastructure index to the power of six. Vice versa, if the calculated accessible forest area is smaller than the total forest area, such as Japan, Republic of Korea and New Zealand and people can potentially access all natural forest in the nation, so the maximum accessible forest area equals the total natural forest area.

In terms of forest stock per area, Malaysia had the biggest volume with 251 $m^3$ per hectare (Figure 9). Brunei Darussalam, Bhutan, Nepal, Philippines and Japan follow Malaysia with 219, 194, 178, 174 and 171 $m^3$ per hectare. These figures are the growing stock of all forests, which include both natural and planted forests, so if a nation has large plantations with juvenile trees, the growing stock tends to be low. Actually, the commercial value or market price of forest should be the ideal variables for the purpose, but these variables are not available.

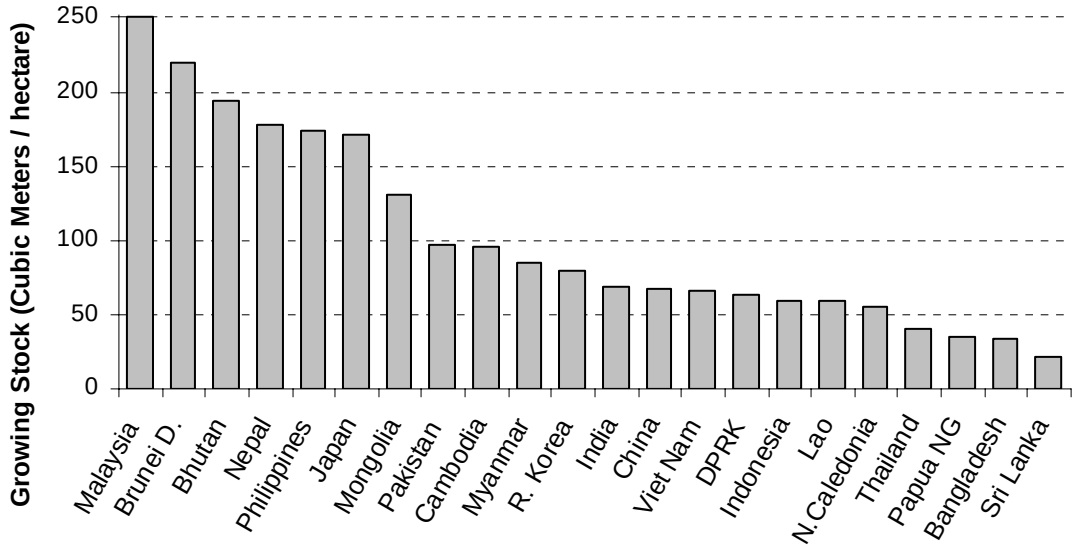



**Figure 9. Growing stock of total forests per hectare in the APR**
Source: FRA (2005).

Increasing or decreasing forest stock is not a factor of current competitiveness, but is a very important factor for future competitiveness. We have observed boom-and-burst trends of wood logging sectors in the developing world.

As shown in Figure 10, Japan's forest stock per area has grown since 1990 by more than 3 $m^3$ per hectare annually. In Japan, high wages of the aging labor force have tethered forest logging, and Japanese domestic wood is less competitive than exporting wood from other countries (Eastin et al. 2002). The Republic of Korea's forest stock grew by 3.1 $m^3$ per hectare during 2000 to 2005. Malaysia, Bhutan, Myanmar, DPRK, India and the Philippines have experienced some forest stock growth per area in the past 15 years. Either because they protect forest resources or they cannot log forest resources in some areas due to inaccessibility.

Forest stock has shrunk the most in Indonesia since 1990. It experienced 4.61 $m^3$ per hectare loss annually from 2000 to 2005. Pakistan, Viet Nam, Sri Lanka, Bangladesh, Cambodia and Papua New Guinea have experienced annual growing stock loss in the last 15 years. In China, forest stock per hectare grew 0.31 $m^3$ annually from 1990 to 2000, but lost 0.51 $m^3$ annually from 2000 to 2005. China expanded plantations considerably during that period of time, so additional young plantation areas diluted the total forest stock per area. The data from many countries, such as Australia and New Zealand, are not available in the FRA study.

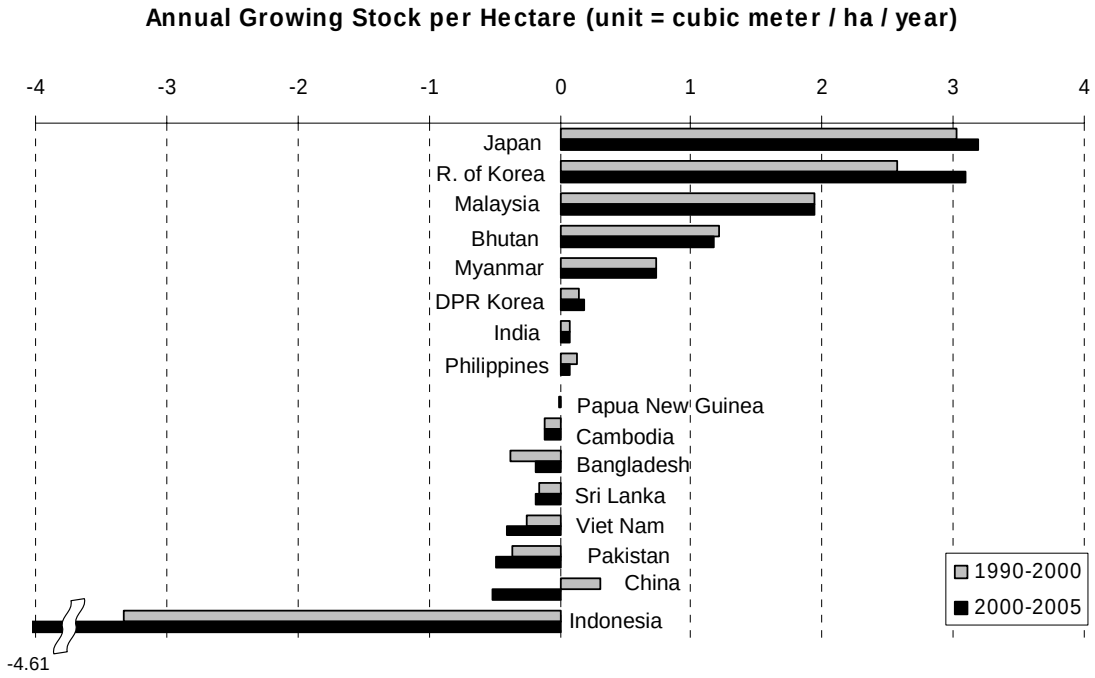



**Figure 10. Changes of growing stock in the APR**
Source: FRA (2005).

The value of wood is not homogeneous due to the species, age and growing conditions. Even though some nations have large forest areas and huge biomass, they may not be able to sell their natural resources at high monetary value. Many South East Asian countries, such as Indonesia, Malaysia and Philippines, have comparative advantage since they have preponderance of large diameter logs, such as Dipterocarpaceae. Large diameter logs are easier to peel, so veneer manufacturers would like to utilize them to keep production cost down. Therefore, large dimension logs from tropical natural forests have high price tags and people have extracted huge volumes of tropical logs from South East Asia. However, most Dipterocarpaceae are slow glowing species, so unsustainable logging activities have resulted in depletion of tropical natural forests. Concerned governments and international organizations have regulated the logging activities for sustainable forest management, and log production from natural tropical forests has decreased. Nations which imported large diameter Dipterocarpaceae have faced shortages of large diameter raw logs for veneer production from tropical nations, and consequently have developed peeling technology from small and medium diameter logs.

This scenario existed in North America as well. Veneer manufacturers and sawnwood industry utilized large logs from old growth forest because they reduced the cost of production. However, depletion of natural resources and environmental regulations raised the cost of large diameter logs from old growth forests. Factories started to adopt saw mills for small and medium diameter trees. Also, innovations reduced dependency on large diameter logs from old growth forests. Oriented structural board (OSB), fiberboard and glue laminated lumber are some of them. The OSB production method uses small, young and fast growing species, such as aspen and poplar. Also, laminated lumber allows producers to utilize small and medium diameter logs to produce bigger dimension lumber.

Besides Dipterocarpaceae, many valuable species exist in old growth natural forests. Since slow growing trees show very beautiful dense tree-rings, they are used for decorative purposes. Tectona (teak) and Pterocarpus (padauk) are well known valuable species from tropical natural forests, mainly for furniture and flooring. Old growth trees have commercial value not only in the tropical region, but also in temperate forests. For example, *Chamaecyparis obutusa* in old growth forests in Japan is very high quality timber; it is used for building houses, traditional temples and shrines and Japanese-style traditional bath tabs. However, builders in Japan have heavily utilized foreign lumber, such as *Pseudotsuga menziesii* from North America or glued laminated wood especially from Europe, in order to avoid high premiums for expensive lumber such as *Chamaecyparis obutusa*.

In general, natural forests have much more valuable tree species compared to plantations using fast growing trees with short rotation. However, buyers of raw material always seek to reduce the costs of production. High raw material costs may make buyers strategically innovate their production lines. On the other hand, when raw materials are abundant, related industry may not focus on innovation, which may result in losing competitiveness. Competitiveness is always generated by people and competitiveness is dynamic.

*Ease to cut trees from natural forests as the factor*

Since wood is a renewable resource, well-managed forests promise sound continuous production in the long run. On the other hand, ill-managed forests will face depletion, and sooner or later, strong forest regulations will be implemented and force industry to reshape. Usually, loose forest regulation and/or weak enforcements of law result in unsustainable forest managements and/or illegal logging activities. Property right is very important to manage natural forest.

Transparency International annually publishes the Corruption Perception Index (CPI). Transparency International defines corruption as “the abuse of entrusted power for private gain”, and the CPI tries to measure the perception of corruption (Transparency International, 2008). As shown in Figure 11, advanced nations and former newly industrialized economies (NIEs) have higher CPI scores. On the other hand, many developing nations have relatively lower CPI scores, which opens up the opportunity for individuals and firms to conduct illegal logging activities. Unfortunately, it is possible to lower the cost of production through illegal logging activities. Hence, a low CPI score positively affect the competitiveness of wood extraction from natural forest in the short term. However, it is critically important to emphasize that illegal logging will harm the nation’s wealth in the long-run.

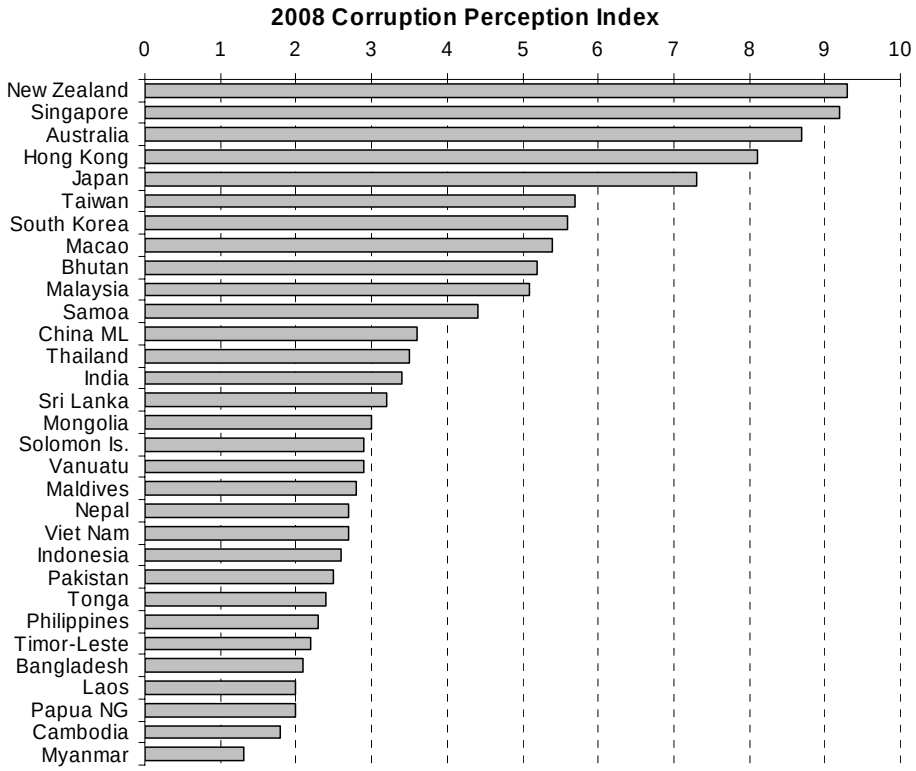



**Figure 11. Corruption Perception Index in the APR**
Source: Transparency International (2008).

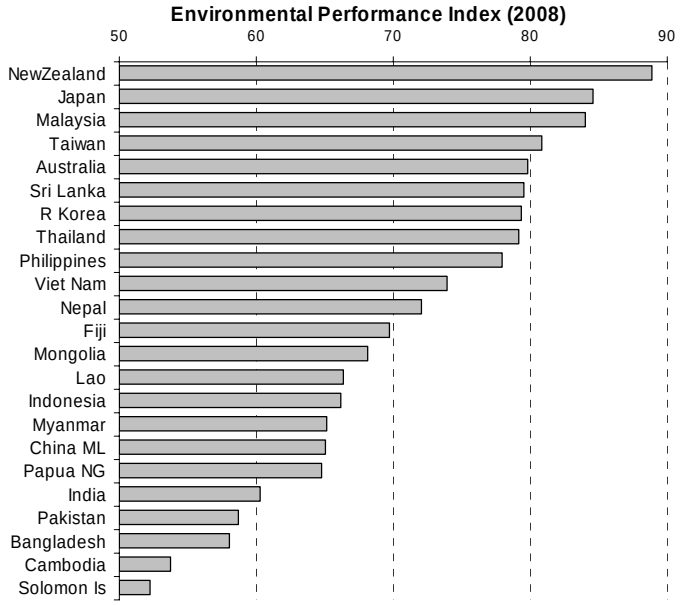
The other issue that affects the ease of cutting trees from natural forest is the environmental perception of its citizen. Forests also provide environmental services as well as commodities. As a country gets wealthier, people tend to start paying more attention to environmental conditions rather than economic development per se. This argument is often seen in the discussion on the environmental Kuznets curve. The role of forests is to produce not only commodities but also environmental services. In the developed world, people may see more environmental value in natural forests rather than commercial commodity value. Increasing pressure to set aside forests for provision of environmental services and the various environmental regulations have made wood production from natural forests much more costly, shifting its competitiveness to plantations. There are many regulations and activities especially in developed nations to alter the market condition and logging activity.

Many nations have introduced programs to change the needs from the demand side. A good example is the green public procurement program in many developed nations. The public sector is a major player in construction in most of the world, and a green procurement program can block the "non-green" wood products from public construction projects. There are various methods to evaluate the environmental performance of green building construction. For example, the UK has Building Research Establishment Environment Design (BREEAM) and the USA has Leadership in Energy and Environment Design (LEED). Japan introduced the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) since 2001. When the government applies these programs, the opportunity cost to extract wood from natural forests usually become more expensive. Firms, which rely on the raw material supply from illegal sources, are likely excluded from that market. Yet, it is critically important to note that the "greenness" of building construction varies widely among countries. Ironically, the Japanese government actually encourages producers to utilize more Japanese domestic trees from Japanese natural forests (semi-natural and modified natural forests included) to meet the green public procurement program. The rational behind its argument is that logging trees from natural forests can contribute to the reduction of $CO_2$.

Forest certification is another important driver to introduce sustainable management for forest industry. Sustainable management requires certification by a third party; consumers value wood resources from a sustainable source more highly and voluntarily pay a higher premium. The Chain-of-Custody certification is an even stricter program. The program requires the tracking of certified products throughout production to the end-users. As the environmental perception of customers (both individuals and the public) becomes higher, firms which target these customers must be aware of certified products.

Consequently, a nation which has higher environmental perception will lose the competitiveness to log trees from natural forests. Increasing pressure to set aside forests for provision of environmental services and the various environmental regulations have made wood production from natural forests much more costly, shifting its competitiveness to plantations, which are regarded as more sustainable sources of wood products. It is not easy to judge people's overall environmental perception in a nation. One available indicator is the Environmental Performance Index (EPI) by the Yale Center for Environmental Law and Policy and Center for International Earth Science Information Network at Columbia University. The EPI offers a composite index of current national environmental protection efforts. Hence, a government's efforts usually come from the will of citizens in the nation, so we assume that the EPI would reflect comparable figures of environmental perception by the citizen.

As shown in Figure 12, New Zealand has the highest EPI score with 88.9 in the region. New Zealand introduced a logging ban from natural forests. Japan and Malaysia followed New Zealand. Some nations claiming illegal logging activities and usages of wood material from illegal sources are ranked relatively lower on this index.




Source: Yale Center for Environmental Law and Policy and Center for International Earth Science Information Network (2008).

**Figure 12. Environmental Performance Index in the APR**

The final component of the ease to cut trees from natural forest is the ratio of planted forests and natural forests in a nation. If the nation has large areas of productive planted forests compared to natural forests, this would discourage people to extract trees from natural forests. As shown in Figure 13, Bangladesh, New Zealand and Republic of Korea have a higher ratio of productive planted forests, which implies that they do not have competitiveness in wood

extraction from natural forests compared to planted forests. Also, this criterion can screen some nations which assign planted forests as semi-natural or modified natural forests. For example, Japan does not have planted forest (FRA, 2005). It simply categorizes *Cryptomeria* forest in the semi-natural and modified natural forest category.

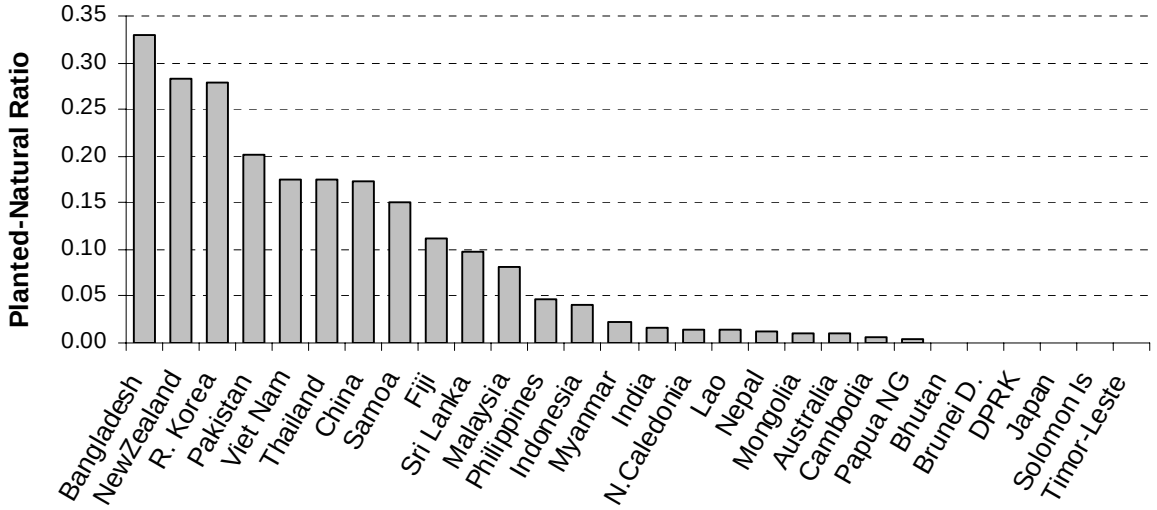



**Figure 13. Planted-natural forest ratio in AP nations**
Source: FRA (2005).

*Logging operation and productivity as the factor*

Without an abundant rural labor force, it is difficult to operate logging activities from natural forests effectively and efficiently. The agricultural labor force in each nation is utilized as the indicator of rural labor availability in this study. As shown in Figure 14, China and India hold the largest agricultural labor force in the region with 350 and 310 million persons. On the other hand, quite a few nations have an agricultural labor force of less than 100 000 persons, which limits the competitiveness of logging activities from natural forests. The labor cost of workers should be another important component for logging operation, but comparable data among nations are not available.

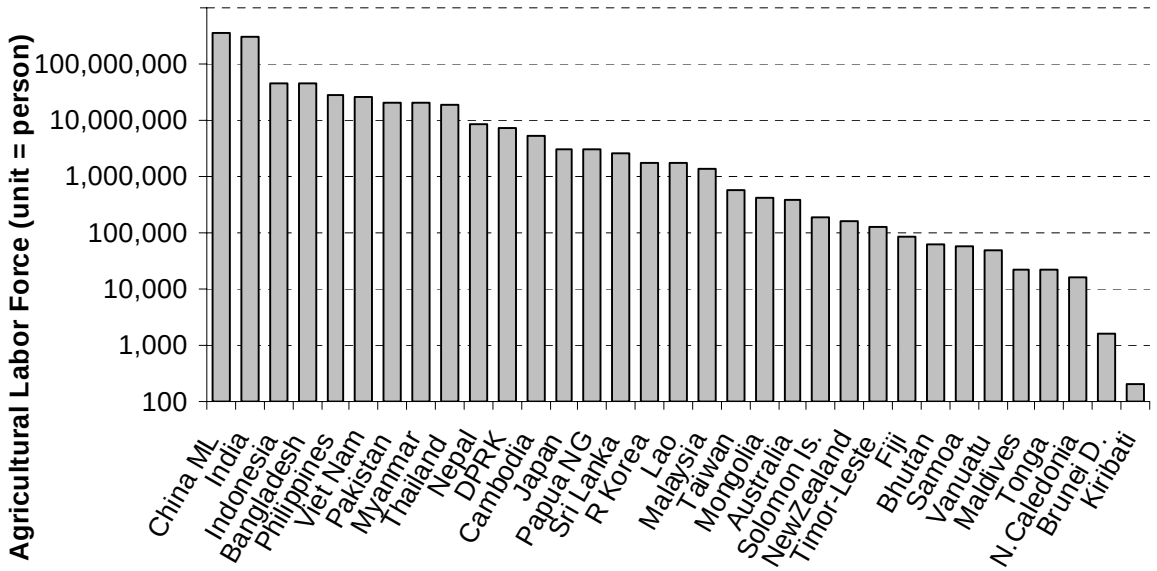


**Figure 14. Environmental Performance Index in the APR**
Source: CIA (2008).

Accessing forest, extracting logs from forest and transporting to the processing center all consume fuel. The retail gasoline price would be the best indicator for this purpose. Some nations subsidize gasoline costs, while some nations impose high tax on gasoline prices. The German Federal Ministry for Economic Cooperation and Development (GTZ) collected retail gasoline prices as of November 2006 as shown in Figure 15. Gasoline has a well-developed market, so theoretically the cost of gasoline (not including transportation costs and sales costs) should be similar all over the world. However, because of different taxation and subsidiary programs, retail gasoline prices are very different. Gasoline in Brunei Darussalam is the cheapest at US$0.34/liter. Brunei has rich oil resources, which contribute to the inexpensive oil price. The gasoline retail price in other oil producers, Indonesia and Malaysia, was US$0.57 and US$0.53/liter, respectively. China's gasoline price is also cheaper compared with other nations, around US$0.69/liter. On the other hand, Hong Kong and South Korea's retail gasoline price were much higher than other nations in the region at more than US$1.6/liter.

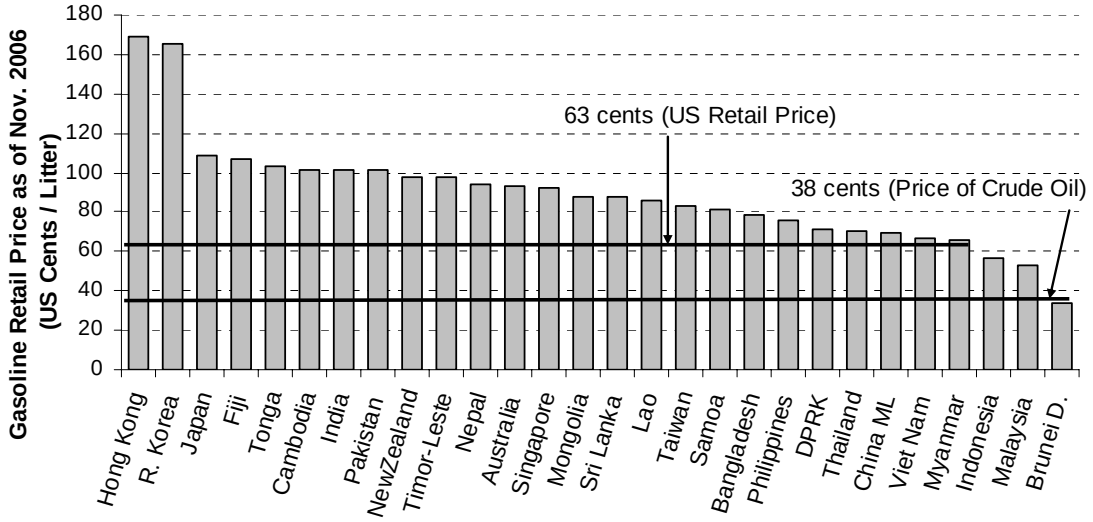



**Figure 15. Gasoline retail price in November 2006 in the APR (GTZ 2007)**
Productivity is another important component for competitiveness. How much volume of industrial wood each employee can extract from the forest can directly result in the cost of the operation. Unfortunately, there are no separate data on wood production from natural forest or plantation forest. Productivity in this study is derived from the amount of industrial roundwood production and employment data. Production from illegal sources is not included in production data by FAO, so it is not possible to know the real productivity of a nation from legal and illegal sources.

As shown in Figure 16, New Zealand recorded the highest productivity per worker in the region, with 2,730 $m^3$ per thousand workers. Australia and Fiji followed New Zealand with 2,380 and 2,080 $m^3$ per thousand workers, respectively. They mainly extract wood from planted forests. Productivity in Thailand and Bhutan has jumped 2.5 and 3.1 times in the last five years. Viet Nam, New Zealand, Australia and Japan have also increased productivity somewhat in the last five years. In theory, productivity is one of the most important aspects of competitiveness, but it will not be heavily weighted on the competitiveness of wood extraction from natural forests here due to the state of available data.

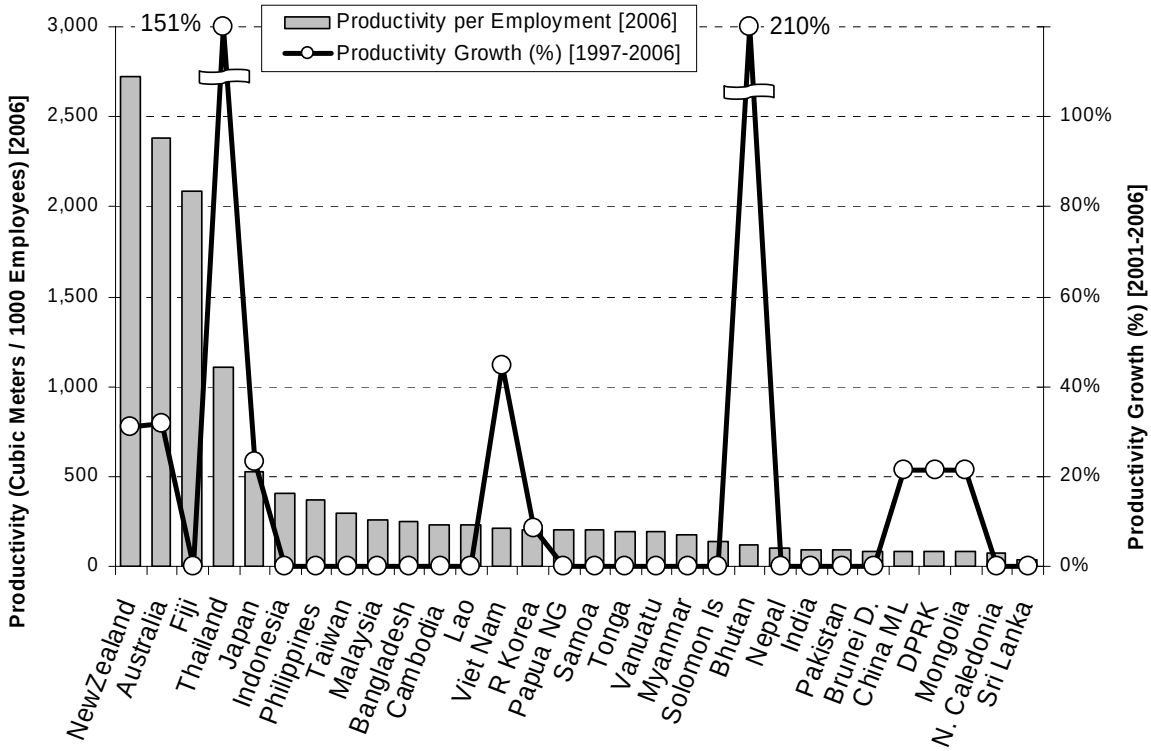



**Figure 16. Productivity of wood production per 1,000 workers in the APR**
Source: FAOSTAT (2008) and Lebedys (2004 & 2008).

*Demand condition as the main factor*

Home demand is a crucial factor for shaping the differentiation attributes of the products and services in Porter's theory of the competitiveness of nations. Usually, producers are more sensitive to domestic customers than foreign customers. Domestic customers' needs will make producers innovate their operation lines. So, the higher the domestic demand is, the higher the competitiveness of the sector. The demand for industrial roundwood in each nation is derived from FAOSTAT (2008). Theoretically, production amount minus the exporting amount plus the importing amount should be equal to the consumption in the nation if you assume the inventory level does not change. This estimation would be very rough since production statistics would be underestimated in developing countries. Furthermore, illegal wood production is not included in the statistics at all. Similar to productivity, there is no separation of production of industrial roundwood from natural forests and from plantations. Yet, the trade-off is already included in other components discussed earlier, so home demand of industrial roundwood in terms of consumption should reflect the competitiveness of the sector.

Figure 17 shows the total industrial roundwood consumption and consumption per capita in 2006. Bhutan recorded consumption with 7 $m^3$ per capita, which is the largest in the region. Yet, total consumption in Bhutan is quite low due to the population. New Zealand, Australia, Papua New Guinea and Myanmar follow Bhutan in terms of per capita consumption. India, China and Indonesia are ranked top three of total consumption of industrial roundwood in the region with 334, 328 and 98 million $m^3$, respectively.

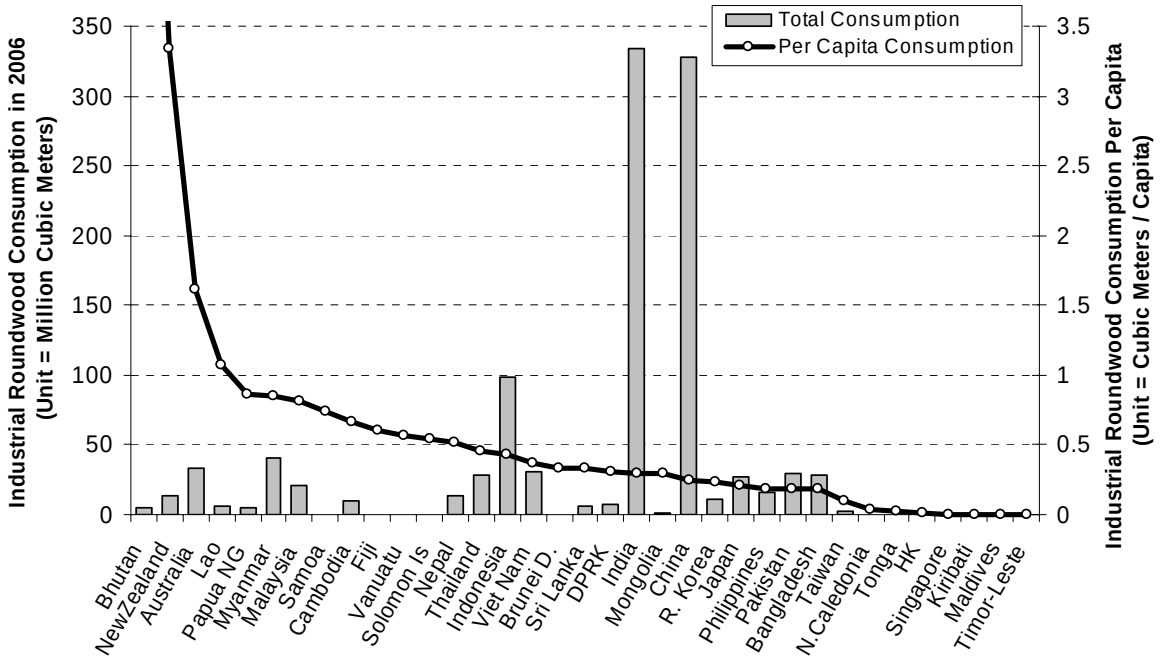



**Figure 17. Industrial roundwood consumption in the APR**
Source: FAOSTAT (2008).

Of course, the nation with high competitiveness of industrial roundwood production should target not only the domestic market buy also the international market. Export costs by the World Bank's Ease of Doing Business Index can be the best indicator of this component. Foreign customers only care about the cost and quality of goods. Transportation cost is the only additional information besides the value of goods for foreign customers. Export cost holistically includes transportation condition, port facility, transportation costs, efficiency of the system, price in the nation, distance to the market, volume of exports from the nation, and the location of the nation. As shown on Figure 18, the export cost in China, Singapore and Malaysia is the cheapest in the region. On the other hand, Kiribati, Nepal, Laos, Mongolia and Vanuatu have high export cost, around four-fold compared to China.

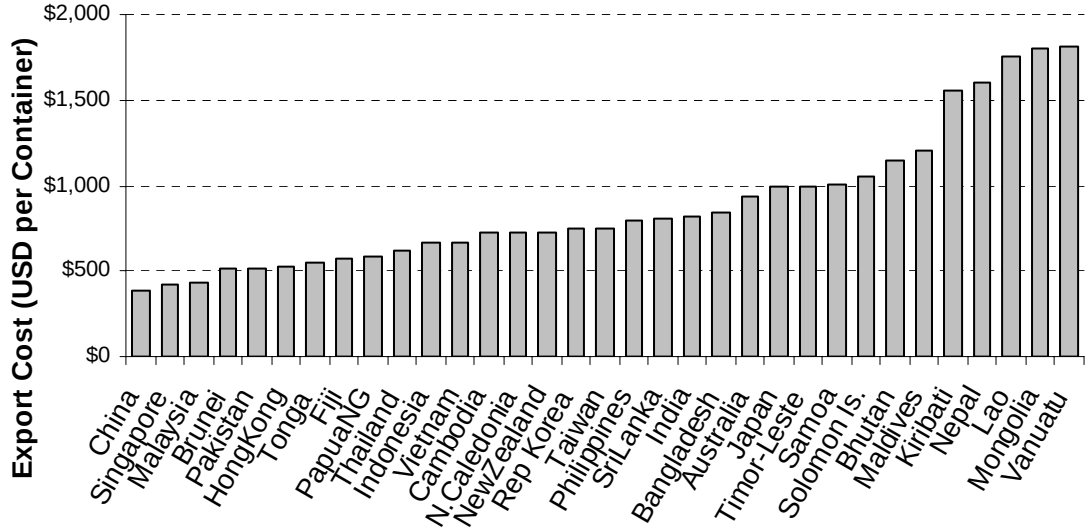



**Figure 18. Exports cost**
Source: The World Bank Group (2008).

***Current national competitiveness index of wood extraction from natural forests***

Including all the factors discussed above, the current NCI of wood extraction is estimated. The factor components are summarized and shown in relation with Porter's framework in Figure 19.

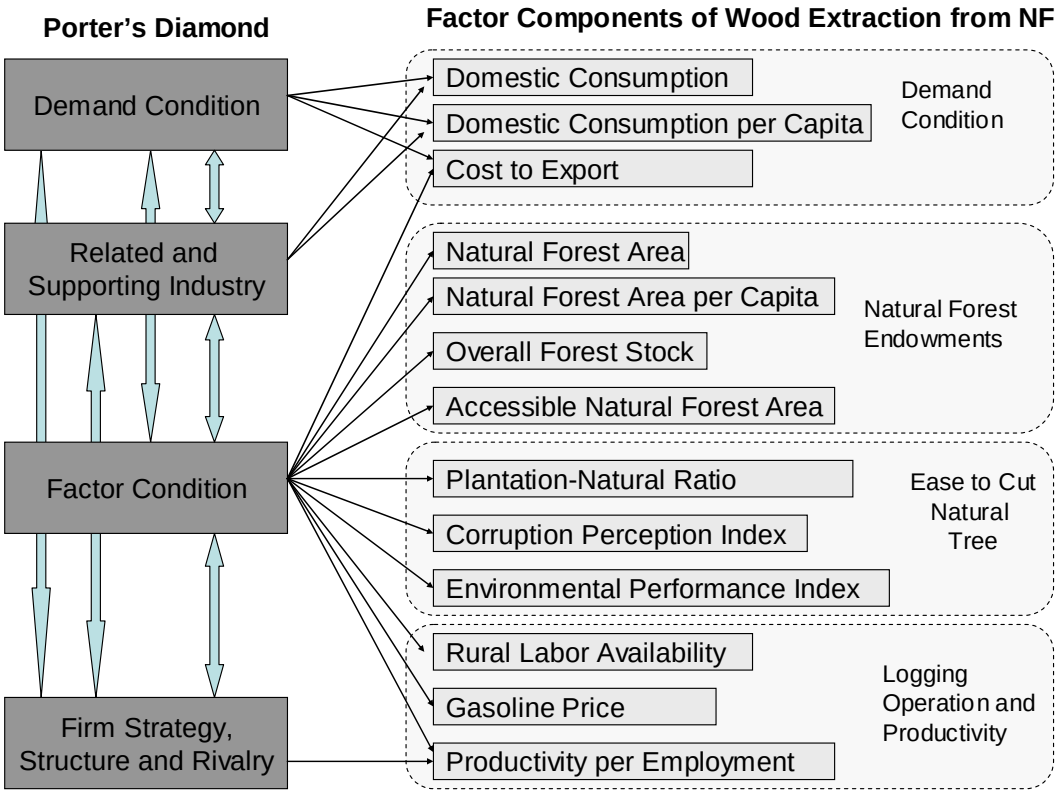



**Figure 19. Relationships between Porter's diamond and NCI factor components of wood extraction from natural forest**

There are some missing values of components, and those values are estimated by regression with other variables, such as GDP per capita, which should have high correlation or by averaging the number of similar nations. Each component is standardized and calculated as the standardized T score (Normal Distribution with mean = 50 and standard deviation = 10 [$X \sim N(\mu=50, \sigma=10)$]). The average component score is 50 and factor scores embody the relative competitiveness among nations. When the distribution of each score is extremely skewed, a logarithm is applied for the raw data to adjust if necessary. Weighting of factors is shown in Table 2.

**Table 2. Weighting of factors for wood extraction from natural forest**

| | | | |
|---|---|---|---|
| 20% | Natural Forest Endowments | Log (Natural Forest Area) | 3.3% |
| | | Log (Natural Forest Area Per Capita) | 3.3% |
| | | Overall Forest Stock | 3.3% |
| | | Accessible Natural Forest Area | 10% |
| 30% | Ease to Cut Natural Tree | Plantation-Natural Ratio | 10% |
| | | Corruption Perception Index | 10% |
| | | Environmental Performance Index | 10% |
| 30% | Logging Operation and Productivity | Rural Labor Availability | 10% |
| | | Gasoline Price | 10% |
| | | Productivity Per Worker | 10% |
| 20% | Demand Condition | Domestic Consumption | 5% |

| | | | |
|---|---|---|---|
| | | Domestic Consumption Per Capita | 5% |
| | | Cost to Export | 10% |

Factor scores were weighted and the current competitiveness score was estimated in each nation (Table 3). Companies always find ways to maximize their competitive advantages strategically, so the NCI shown may be highly simplified compared to reality.

**Table 3. NCI (2006) of wood extraction from natural forest of the APR**

| | | Natural Forest Endowments | | | | | Easiness To Cut Trees | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Overall Current Competitiveness of Wood Extraction from Natural Forest (2006)** | **Natural Forest Availability (20%)** | Natural Fores Area | Natural Forest Area per Capita | Overall Forest Stock | Accessible Natural Forest Area | **Easiness To Cut Trees (30%)** | Corruption Perception Index | Environmental Performance Index | Plantation-Natural Ratio |
| Australia | 57 | 77 | 64 | 75 | 49 | 91 | 44 | 30 | 42 | 58 |
| Bangladesh | 50 | 45 | 47 | 41 | 42 | 45 | 48 | 58 | 64 | 22 |
| Bhutan | 52 | 56 | 52 | 69 | 65 | 49 | 52 | 45 | 51 | 60 |
| Brunei | 49 | 50 | 45 | 50 | 69 | 46 | 42 | 33 | 34 | 60 |
| Cambodia | 55 | 49 | 55 | 50 | 51 | 46 | 62 | 60 | 69 | 59 |
| China ML | 53 | 50 | 64 | 43 | 47 | 49 | 50 | 52 | 57 | 40 |
| DPR Korea | 51 | 47 | 54 | 45 | 47 | 46 | 59 | 60 | 59 | 60 |
| Fiji | 53 | 51 | 48 | 53 | 63 | 47 | 51 | 53 | 52 | 47 |
| Hong Kong | N.S. | 41 | 28 | 41 | 38 | 45 | 39 | 33 | 36 | 50 |
| India | 53 | 49 | 61 | 42 | 47 | 49 | 58 | 53 | 62 | 58 |
| Indonesia | 56 | 49 | 62 | 46 | 46 | 46 | 56 | 56 | 56 | 55 |
| Japan | 51 | 63 | 56 | 43 | 62 | 71 | 44 | 36 | 37 | 60 |
| Kiribati | N.S. | 41 | 28 | 41 | 38 | 45 | 52 | 54 | 53 | 50 |
| Lao | 52 | 50 | 57 | 62 | 46 | 46 | 58 | 59 | 56 | 58 |
| Malaysia | 56 | 68 | 57 | 50 | 74 | 77 | 45 | 46 | 38 | 50 |
| Maldives | N.S. | 41 | 28 | 41 | 38 | 45 | 52 | 55 | 52 | 50 |
| Mongolia | 50 | 52 | 55 | 66 | 56 | 46 | 56 | 55 | 54 | 58 |
| Myanmar | 53 | 49 | 59 | 49 | 50 | 46 | 59 | 62 | 57 | 57 |
| Nepal | 50 | 49 | 52 | 43 | 63 | 45 | 55 | 56 | 50 | 59 |
| New Caledonia | 46 | 49 | 48 | 63 | 45 | 47 | 46 | 42 | 43 | 53 |
| New Zealand | 49 | 55 | 54 | 56 | 49 | 57 | 29 | 28 | 33 | 27 |
| Pakistan | 51 | 48 | 50 | 42 | 52 | 48 | 52 | 57 | 64 | 37 |
| Papua NG | 54 | 51 | 58 | 69 | 43 | 46 | 59 | 59 | 57 | 59 |
| Philippines | 53 | 50 | 54 | 43 | 63 | 46 | 52 | 58 | 44 | 54 |
| R of Korea | 44 | 51 | 53 | 43 | 49 | 54 | 38 | 44 | 42 | 28 |
| Samoa | 49 | 49 | 43 | 50 | 63 | 46 | 47 | 49 | 50 | 42 |
| Singapore | N.S. | 41 | 28 | 41 | 38 | 45 | 38 | 28 | 34 | 50 |
| Solomon Is. | 52 | 50 | 51 | 68 | 43 | 46 | 62 | 55 | 70 | 60 |
| Sri Lanka | 49 | 46 | 50 | 43 | 41 | 47 | 48 | 54 | 42 | 48 |
| Taiwan | 49 | 50 | 51 | 43 | 62 | 49 | 45 | 43 | 41 | 50 |
| Thailand | 54 | 53 | 56 | 44 | 43 | 58 | 45 | 52 | 43 | 40 |
| Timor-Leste | 48 | 47 | 48 | 50 | 46 | 45 | 55 | 58 | 56 | 50 |
| Tonga | N.S. | 41 | 33 | 42 | 38 | 45 | 53 | 57 | 51 | 50 |
| Vanuatu | 47 | 47 | 46 | 59 | 38 | 46 | 53 | 55 | 53 | 50 |
| Viet Nam | 51 | 47 | 55 | 43 | 47 | 46 | 48 | 56 | 48 | 40 |

| | Logging Operation and Productivity | | | | Demand Condition | | | |
|---|---|---|---|---|---|---|---|---|
| | **Logging Operation (30%)** | Rural Labor Availability | Gasoline Price | Productivity per Employment | **Demand Condition (20%)** | Total Domestic Demand | Domestic Demand Per Capita | Cost to Export |
| Australia | 58 | 50 | 49 | 75 | 57 | 58 | 72 | 50 |
| Bangladesh | 55 | 60 | 55 | 50 | 51 | 57 | 44 | 52 |
| Bhutan | 47 | 46 | 51 | 46 | 54 | 53 | 73 | 45 |
| Brunei | 52 | 38 | 73 | 44 | 53 | 44 | 48 | 59 |
| Cambodia | 50 | 55 | 46 | 49 | 55 | 55 | 56 | 55 |
| China ML | 56 | 64 | 59 | 44 | 58 | 64 | 46 | 62 |
| DPR Korea | 53 | 56 | 58 | 44 | 41 | 54 | 47 | 31 |
| Fiji | 55 | 46 | 44 | 75 | 54 | 47 | 55 | 58 |
| Hong Kong | 28 | 22 | 20 | 41 | 50 | 43 | 38 | 59 |
| India | 52 | 64 | 46 | 45 | 54 | 64 | 47 | 53 |
| Indonesia | 60 | 60 | 64 | 55 | 56 | 61 | 51 | 56 |
| Japan | 52 | 54 | 43 | 59 | 50 | 57 | 45 | 49 |
| Kiribati | 40 | 33 | 45 | 41 | 34 | 26 | 38 | 36 |
| Lao | 51 | 53 | 52 | 49 | 45 | 53 | 64 | 32 |
| Malaysia | 56 | 53 | 65 | 50 | 59 | 57 | 59 | 61 |
| Maldives | 43 | 43 | 45 | 41 | 39 | 29 | 38 | 44 |
| Mongolia | 48 | 50 | 51 | 44 | 39 | 48 | 47 | 31 |
| Myanmar | 55 | 58 | 60 | 47 | 45 | 58 | 60 | 31 |
| Nepal | 50 | 56 | 49 | 44 | 45 | 56 | 52 | 35 |
| New Caledonia | 44 | 43 | 45 | 45 | 46 | 37 | 39 | 55 |
| New Zealand | 57 | 48 | 48 | 75 | 60 | 56 | 73 | 55 |
| Pakistan | 50 | 58 | 46 | 45 | 55 | 58 | 44 | 59 |
| Papua NG | 50 | 54 | 46 | 48 | 57 | 53 | 60 | 58 |
| Philippines | 56 | 59 | 56 | 54 | 51 | 56 | 44 | 53 |
| R of Korea | 41 | 53 | 21 | 48 | 52 | 55 | 45 | 54 |
| Samoa | 49 | 46 | 54 | 48 | 49 | 44 | 57 | 48 |
| Singapore | 38 | 22 | 50 | 41 | 50 | 39 | 38 | 62 |
| Solomon Is. | 46 | 48 | 45 | 46 | 48 | 45 | 53 | 47 |
| Sri Lanka | 49 | 54 | 51 | 43 | 52 | 54 | 48 | 53 |
| Taiwan | 52 | 51 | 53 | 51 | 50 | 51 | 41 | 54 |
| Thailand | 64 | 58 | 59 | 75 | 56 | 57 | 51 | 57 |
| Timor-Leste | 48 | 47 | 48 | 48 | 41 | 29 | 38 | 49 |
| Tonga | 43 | 43 | 46 | 41 | 47 | 34 | 39 | 59 |
| Vanuatu | 46 | 45 | 45 | 48 | 40 | 43 | 54 | 31 |
| Viet Nam | 56 | 59 | 60 | 49 | 55 | 58 | 49 | 56 |

The result of current competitiveness of wood extraction is shown in Figure 20. Australia had the highest competitiveness in 2006 mainly from its rich natural forests. Malaysia and

Indonesia follow Australia. Republic of Korea and New Zealand ranked lower compared with other nations, because of the difficulty to cut trees from natural forests.

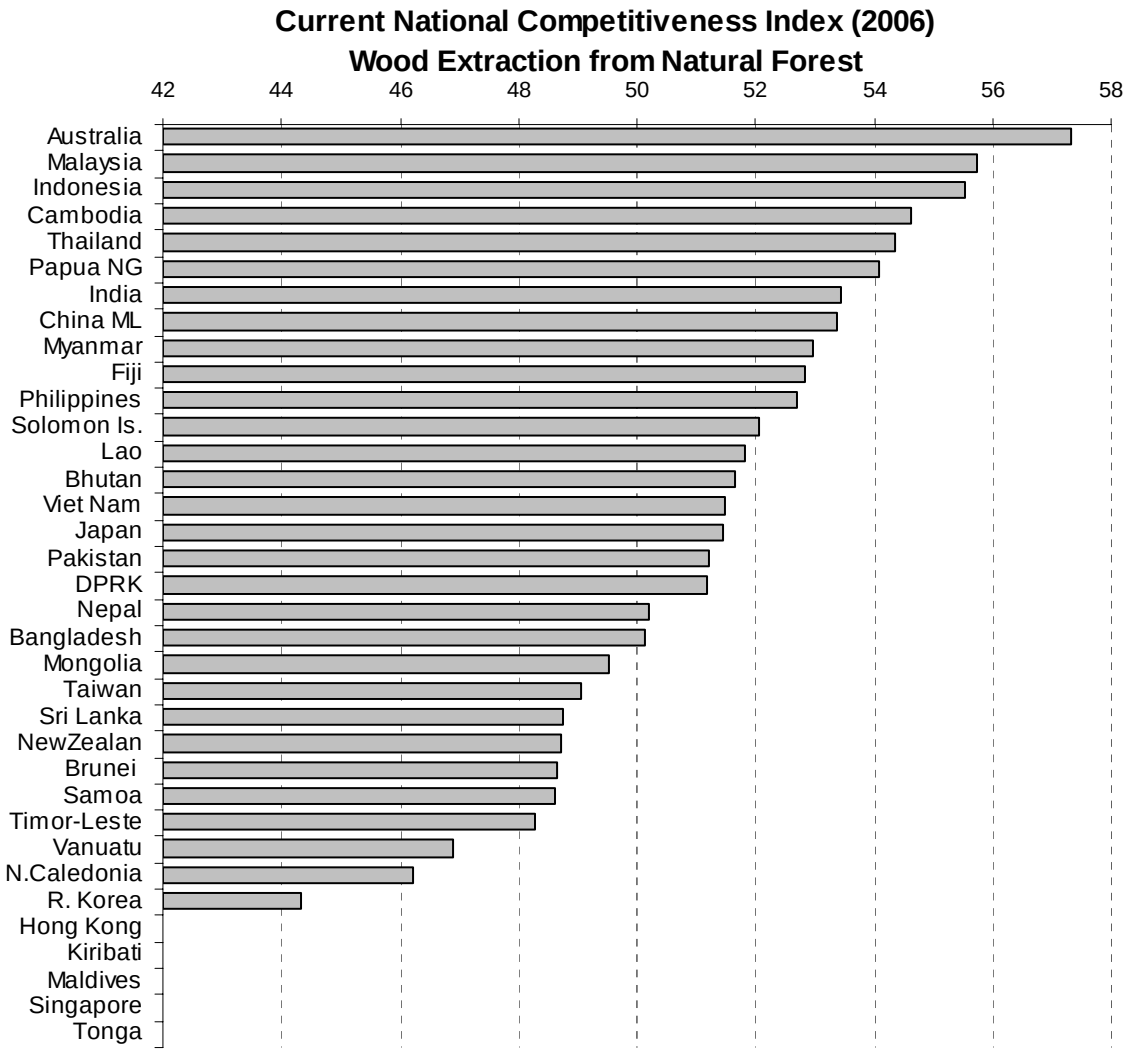



**Figure 20. Current NCI (2006) of wood extraction from natural forest**

**Wood production from planted forests**

Generally, forest plantations are regarded as more sustainable than wood extraction activities from natural forests. The definition of plantation forest is difficult, and the FRA's category of plantation has changed in recent years. There are many types of forest plantations – both industrial and non-industrial usages. This study only addresses productive plantations. Productive semi-natural forest (FRA 2005) is not included in this section, and should relate to the previous section.

***Wood production from planted forest in the global context***

The APR totals 2.8 billion hectares, which is around 21 percent of the total world land area (Figure 21). East Asia holds 8.8 percent, South and South East Asia hold 6.5 percent and Oceania holds 6.5 percent of the world's total land area.

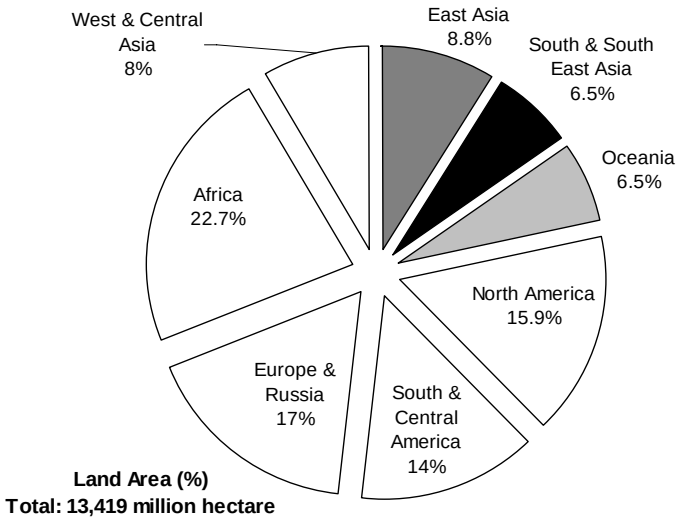



**Figure 21. Land area by world regions**
Source: FRA (2005).

The APR holds most of the world's productive planted forest area. As shown in Figure 22, the APR accounted for 46 percent of total productive plantations in 2005. East Asia had 30 percent of the world's total productive planted forest, South East and South Asia had 12 percent. This preponderance of Asian plantations is mainly a result of efforts to establish new plantations in the past three decades.

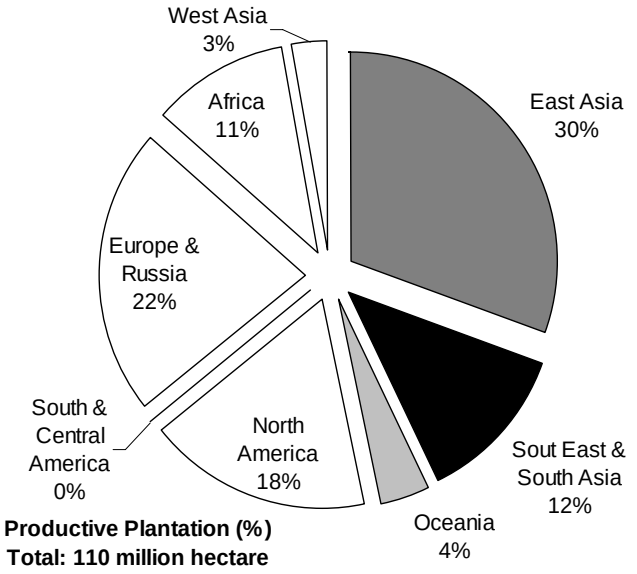



**Figure 22. Productive planted forest area by world regions**
Source: FRA (2005).

As shown in Figure 23, age distributions of plantations vary by region. Age distributions are mainly attributable to species variation in forest plantations and their rotations. Species variations are influenced not only by the climate and soil of the plantation but also the demand conditions of the area. Europe has much older age-class trees in forest plantations; 26.7 percent of productive plantations are 40 years or older and only 36 percent of productive plantations are less than 20 years old in Europe. Europeans have traditionally exercised logging activities from planted forests and *Quercus* and *Fagus* in European plantations usually require much longer rotations than pulp grade trees. In North America, 8.6 percent of productive plantations are also 40 years or older and there are many sawnwood grade plantations. On the other hand, South America has very young distribution of productive plantations — 68.4 percent of productive plantations are ten years or younger.

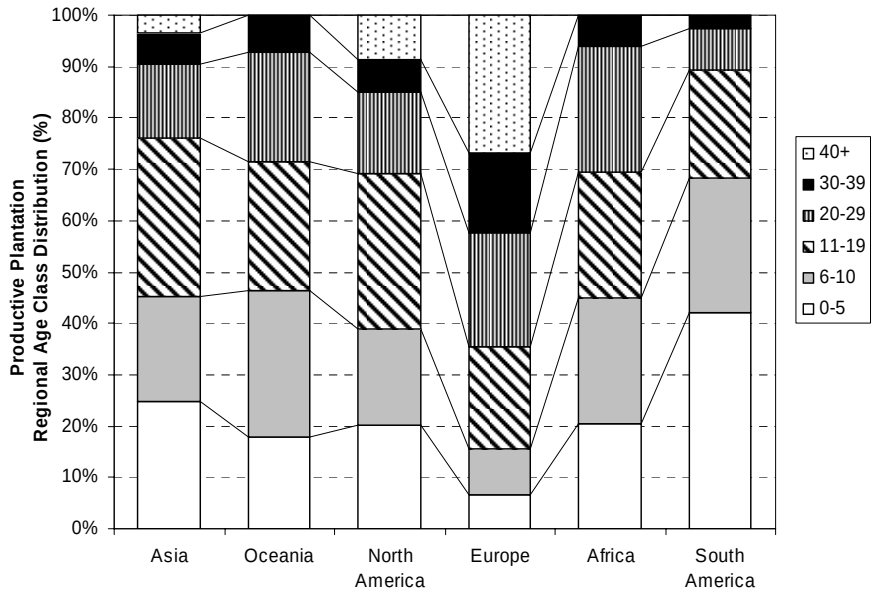



**Figure 23. Age distribution of planted forest by world regions**
Source: FRA (2005).

In Asia, there have been many plantation programs during the last 30 years (Brown, 2000) — 90.5 percent of productive plantations are less than 30 years old. *Larix* and some *Pinus* species in East Asia plantations have more than 50 years of rotation period. *Eucalyptus* and *Populus* are very popular for Asian plantations and they are short-rotation species. *Eucalyptus* and *Populus* are heavily utilized for pulp and fiber for wooden panels. Some sawnwood grade plantations are found in Asia as well.

***Key factors concerning competitiveness of wood extraction from planted forests***

Unlike natural forests, it is possible to expand the areas of plantations. Hence, the competitiveness factors of productive plantations are quite different from those of log extraction from natural and semi-natural forests. Brown (2000) proposed several competitive advantages in producing wood materials from forest plantations by using the Porter's diamond:

1. Strong and active competition between domestic forest growers, leading to well-developed plantation management techniques and practices and an industry that is attuned to innovation and enterprise (firm strategy, structure and rivalry).
2. Natural advantages in land availability and forest plantation yields, combined with a well-trained workforce (factor endowments).
3. A strong domestic processing and manufacturing industry that is familiar with the types of species grown in the country's forest plantations (demand conditions).
4. Efficient infrastructure (i.e. strong clusters of interacting and supporting industries, for example: seed orchards; nurseries; specialized equipment manufacture or servicing industries; harvesting contractors; and transport companies), strong forest research capability and a policy environment that encourages enterprise (related and supporting industries).

In this study, we propose five key factors which influence the competitiveness of wood extraction from forest plantations based on Porter's diamond: 1) availability of land area, 2) land investment, 3) demand condition, 4) managerial competencies and 5) productivity and technology. These five factors are measurable as discussed later and combining them totally covers what Brown (2000) proposed.

*Availability of land area*

Two components influence the current availability of land area, and one component influences the future availability of land area. Land area and rural population density directly affect current availability. Without land, it is not possible to establish wood plantations. The more land a nation has, potentially more wood plantations can be established if the climate and other conditions are controlled. Climate and soil may even be surmountable issues these days since technologies, such as irrigation systems, fertilizers and biotechnology, are advancing very quickly. Rural population density is important, since the lower the rural population is, the more opportunity exists to invest in plantations. Rural population density is changing, which affects future availability. Changes in rural population are discussed here and used to analyze future competitiveness in later chapters.

Land area is the critical key factor for the competitiveness of wood production from planted forests. Within the APR, China is the biggest nation in the region with 933 million hectares and Australia has the second biggest land area with 768 million hectares (Figure 24). India, Indonesia and Mongolia follow with 297, 181 and 157 million hectares, respectively. Those five nations account more than 80 percent of the region.

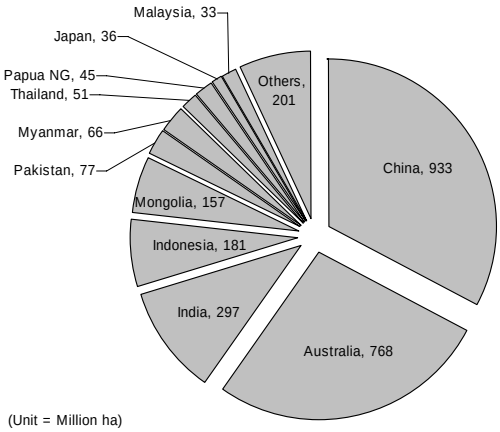



**Figure 24. Land area by nation in the APR**
Source: FRA (2005).

Population density is a critical factor in land availability. Mongolia and Australia are two of the lowest density nations in the world with 1.6 and 2.6 persons per square kilometre in 2005 (Figure 25). Then, New Caledonia, Papua New Guinea, Bhutan, New Zealand, Solomon Islands, Vanuatu and Laos follow. On the other hand, former NIEs have very high population density. Bangladesh, Maldives, India and Japan are non-NIE nations, but still have high populations. China has the largest population, but population density was just 137 persons per square kilometre in 2005.

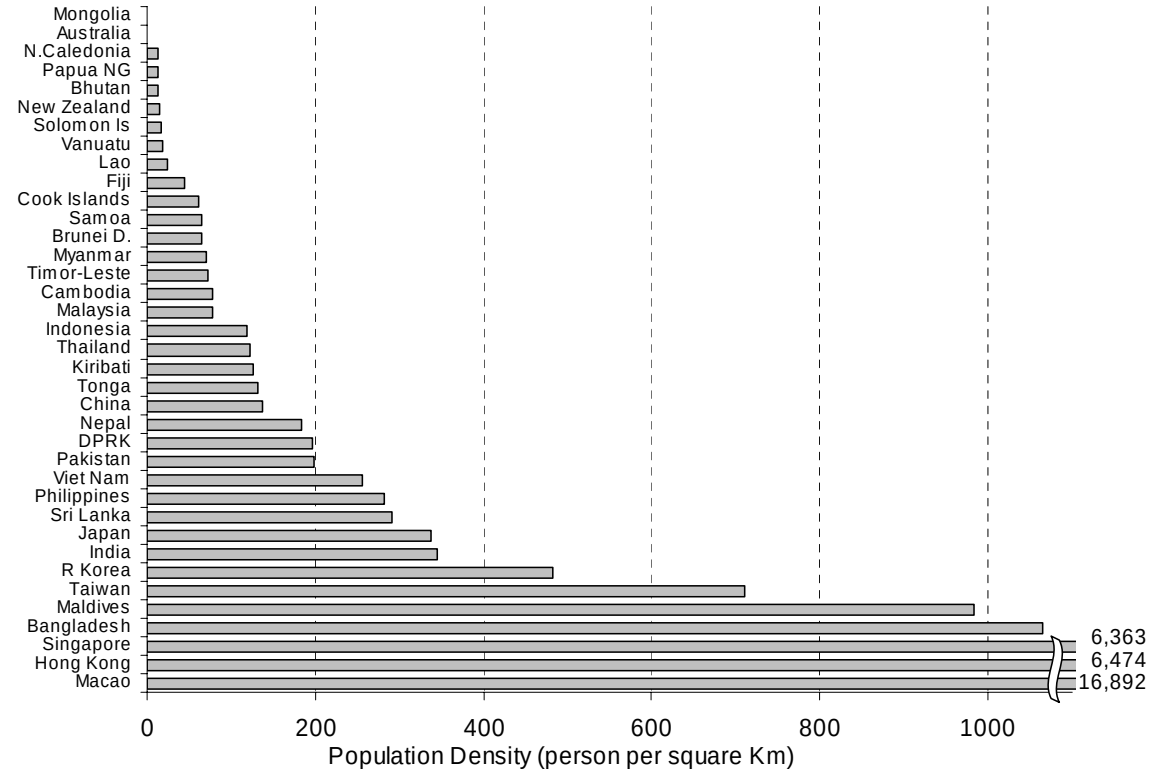



**Figure 25. Population density by nations in the APR**
Source: UN (2008) and FAOSTAT (2008).

As a nation becomes modernized, rural populations migrate to urban areas. When the rural population decreases, this opens up the opportunity to establish plantations there. Also, concentrating urban populations increases the demand for forest products. The rural population is the key component of current plantation business and decreasing rural

population generally brings competitiveness for the future forest plantation business. There is no consensus where the rural area is, but the size of rural area in each nation can be derived from FAO land statistics. The "Other" land category of FAO land statistics signifies urban areas, so any other terrestrial land may be considered rural area. As shown in Figure 26, Australia has the smallest estimated rural population density in the region. Also, Australia has experienced annually a 0.5 percent decline in rural population, which opens up more plantation opportunities in the future. Mongolia and New Zealand follow Australia in terms of low rural population density. On the other hand, Maldives and Bangladesh have extremely high rural population density with more than one thousand persons per square kilometre. In East and South East Asia, Malaysia, Indonesia, China, Republic of Korea, and Japan also experienced rural population loss from 2000 to 2005, which will open up competitiveness in the future.

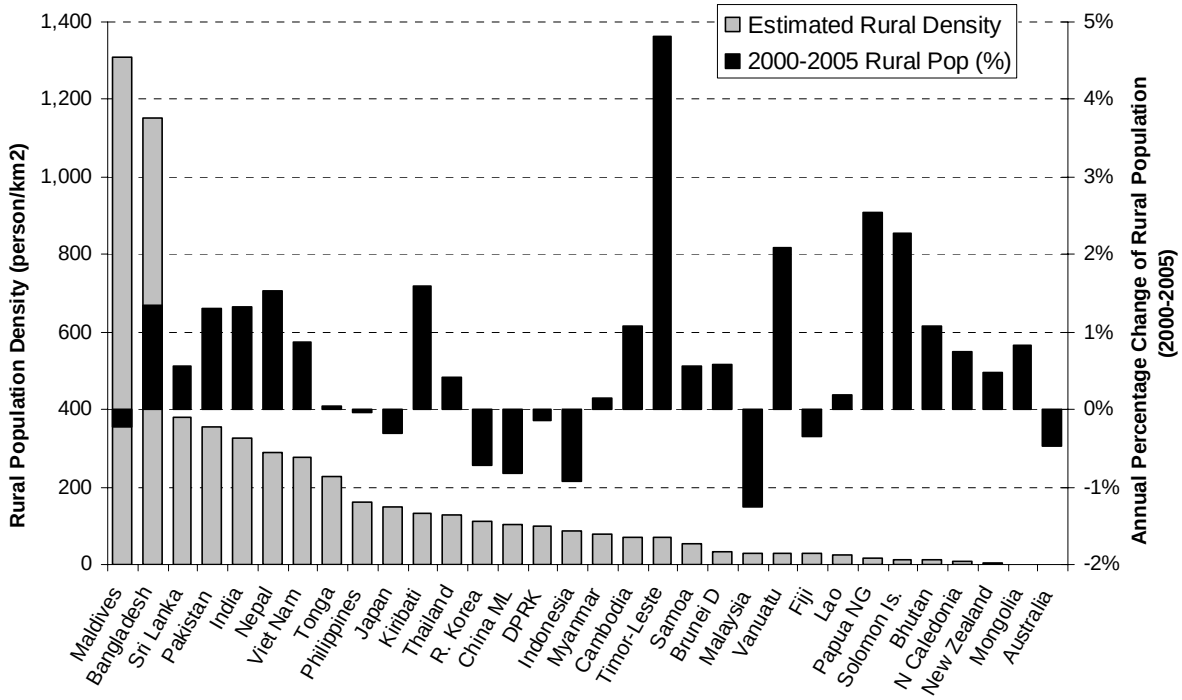



**Figure 26. Population density by nations in the APR**
Source: FAOSTAT (2008) and UN (2008).

*Land investment*

Two components determine the condition of investment: initial cost and discount rate. Land price is the single most important initial cost of investment for planted forests. Country "risk" is an important discount rate factor when you invest in a foreign country. Consequently, the land investment factor score will be derived from these two component scores in this study.

Land price is determined by considering the aforesaid factors. It is extremely important to note that the degrees of property rights in nations are different, so the land price is not determined by the market force. Initially, land price is the fundamental fixed-asset to invest to start forest plantations. The comparison between the initial investments and the future cash flow is the rate of return, so land price is the critical factor to determine the investment in plantations. When the land price is artificially lower than the fair value for some reason (e.g. setting the price by a government), the circumstance can generate abnormal return for entrepreneurs; however it will likely harm the macroeconomic health of the nation in the long run.

Brown (2000) introduced land price data based on the World Bank Global Approach to Environmental Analyses (World Bank, 1999), which are shown in Table 4. The data are quite old and were derived before many emerging nations experienced real estate appreciation and Japan experienced severe land price depreciation. However this study is very useful since this is one of the few attempts to integrate comparable land price information. Plantation establishment in China and Viet Nam has been very successful, and the land prices per hectare of these nations were very inexpensive compared with other nations at that time. Bhutan, Nepal, Cambodia and Laos are other nations where land prices are comparably cheaper than other nations which recorded similar GDP per capita (nominal).

**Table 4. Land price range per hectare in the APR**

| Land price range per hectare (US$) | Countries |
|---|---|
| Less than 100 | Bhutan, Viet Nam, Nepal |
| 101-200 | Cambodia, China ML, Laos |
| 201-300 | Bangladesh, Pakistan |
| 301-500 | India, Mongolia |
| 501-1,000 | Kiribati, Myanmar, Philippines, Papua New Guinea, Indonesia, Solomon Islands, Sri Lanka |
| 1,001-2,000 | DPRK, Vanuatu |
| 2,001-3,000 | Thailand, Tonga, Fiji |
| 3,000-5,000 | New Caledonia, Malaysia |
| 5,001-10,000 | New Zealand, Republic of Korea, Brunei, Singapore |
| 10,001-15,000 | Australia |
| Greater than 15,000 | Japan |

Source: World Bank (1999); Brown (2000).

Discount rate is very important for investment. The higher the discount rate is, the smaller the present value of expected cash flows. Investors usually use a higher discount rate for a project which contains higher uncertainties and risk. Plantations usually take a long time to cash in the benefit, so the discount rate is fundamentally important. Country risk, including inflation rate risk, political uncertainties and social unrest, refers to the likelihood that changes in the business environment will adversely affect operating profits or the value of assets in a specific country. How to evaluate country risk is very controversial, and many consulting firms release their country risk rating for their customers especially for foreign investment purposes. Table 5 shows the country score and sovereign rating by the Economic Intelligence Unit (EIU). The sovereign rating measures the risk of a build-up in arrears of principal and/or interest on foreign- and/or local-currency debt that is the direct obligation of the sovereign or guaranteed by the sovereign (EIU, 2008). Basically, the lower the country score is the safer it is to invest in long-term fixed capital. China and Malaysia had a lower score in the region as of 2008. The EIU does not score all nations, so missing values are estimated by GDP (PPP) per capita and inflation rate as independent values.

**Table 5. Country score, sovereign rating and inflation rate in the APR**

| Country | Score | Rating | Outlook | Inflation rate (2007) |
|---|---|---|---|---|
| Hong Kong | 19 | AA | Stable | 2.0% |
| Singapore | 20 | AA | Stable | 2.1% |
| Taiwan | 24 | A | Stable | 1.8% |
| Japan | 27 | A | Stable | 0.1% |
| Rep. of Korea | 30 | A | Stable | 2.5% |
| China M.L. | 31 | BBB | Stable | 4.8% |
| New Zealand | 31 | A | Stable | 2.4% |
| Australia | 32 | A | Stable | 2.3% |
| Malaysia | 32 | BBB | Stable | 2.0% |
| India | 36 | BBB | Stable | 6.4% |
| Papua NG | 42 | BB | Stable | 0.9% |
| Philippines | 44 | BB | Stable | 2.8% |
| Thailand | 44 | BB | Stable | 2.2% |
| Bangladesh | 50 | B | Negative | 9.1% |
| Indonesia | 50 | B | Stable | 6.3% |
| Sri Lanka | 52 | B | Stable | 15.8% |
| Viet Nam | 57 | B | Stable | 8.3% |
| Cambodia | 61 | CCC | Stable | 5.9% |
| Pakistan | 63 | CCC | Stable | 7.6% |
| Myanmar | 77 | CC | Stable | 35.0% |
| Kiribati | | - | | 0.2% |
| Brunei D. | | - | | 0.4% |
| New Caledonia | | - | | 1.4% |
| Cook Islands | | - | | 2.1% |
| Vanuatu | | - | | 3.9% |
| Laos | | - | | 4.5% |
| Fiji | | - | | 4.8% |
| Bhutan | | - | | 4.9% |
| Maldives | | - | | 5.0% |
| Tonga | | - | | 5.9% |
| Samoa | | - | | 6.0% |
| Solomon Islands | | - | | 6.3% |
| Nepal | | - | | 6.4% |
| Macau | | - | | 7.2% |
| Timor-Leste | | - | | 7.8% |
| Mongolia | | - | | 9.0% |

Source: EIU (2008) and CIA (2008).

*Demand condition*

Home demand is a very important aspect for Porter's competitiveness of the nation. Strong demand will enhance the competitive advantage of the sector. Furthermore, related and supporting industries are other determinants of national competitiveness. Therefore, in order to gain competitiveness of wood extraction from forest plantations, it is very important to analyze the demand and related industry. Wood resources from plantations are raw materials, so all demand is based on the production of downstream industry. Wood materials from plantations are always sent to firms for manufacture and finally delivered to end users as paper, lumber or particle board.

Raw wood materials from plantations are usually low grade small-dimension trees, such as *Eucalyptus* or *Populus*. Yet, there are still sawnwood grade species for productive plantations.

The transportation cost of low grade small-dimension trees is expensive since they take up much space, so it is always a good idea to locate processing centers near plantations and compress raw materials to make final or intermediate products such as paper and pulp, particle board and fiberboard, chips or sawnwood. So, the domestic production of paper, particle and fiberboard, chips and sawnwood is utilized as component scores to estimate the demand factor.

Home demand cannot explain the demand condition fully. Foreign markets are also very important. In the APR, the greatest demands for wood products are concentrated along coastal areas. Many large urban areas are concentrated in Japan, Republic of Korea, and the Greater Chinese region to South East and South Asia. Therefore, shipping transportation is very well connected among these urban areas, and frequent traffic lowers the transportation cost. The demand for APR wood products also exists in North America and Europe, but products usually travel via ports of their coastal cities. Conversely, areas distant from coastal areas increase transportation cost. The export cost by the Ease of Doing Business Index (World Bank 2008) is utilized to measure ease to access foreign markets.

*Managerial competencies and productivity*

Plantation ownership is the crucial factor of competitiveness. Managerial competencies vary among owners. Competencies emerge over time through an organizational process of accumulating and learning how to deploy different resources and capabilities. Large well-managed plantations usually have more competencies than smaller plantations because of their efficiencies to accumulate and to utilize their knowledge. Knowledge includes what species can produce well in specific locations, how to market those species, how to utilize those species and how to maximize the productivity of planted forests. Good governance and management of productive plantations should raise productivity; therefore, managerial competencies directly affect the competitiveness of wood extraction from productive plantations. Regardless of its importance, to quantify the managerial competencies of the business sector in each nation is extremely important. In this study, I assume that results already reflect managerial competencies. The size of current productive plantations already includes the differences of managerial competencies of productive plantations in each nation.

Figure 27 shows the area of productive plantation by nation in the region. China holds 28.5 million ha of productive plantations, which accounts for 62.5 percent of total plantations in the region. The main plantation species in China is *Cunninghamia lanceolata*. *Acacia* spp., *Eucalyptus* spp., *Hevea brasiliensis*, *Tectona grandis*, *Populus* spp. and *Casuarina* spp. are also considered very important species for plantations in FRA 2000 studies (FAO 2006). There are quite large plantations in South East Asia as well. Indonesia, Thailand, Viet Nam, Malaysia and Myanmar have 3.4, 2.0, 1.8, 1.6 and 0.7 million ha of forest plantations, respectively. *Acacia mangium* is the main species, grown for timber, panel products, and pulp and paper in South and South East Asia. *Tectona grandis* and *Eucalyptus* spp. are also common species. In Oceania, the main species used for plantation is *Pinus radiata*. New Zealand and Australia have both around 1.8 million ha of productive plantations. Species composites affect the competitiveness of wood extraction from plantations since demand condition and related industry, rotation and value of wood are not homogeneous.

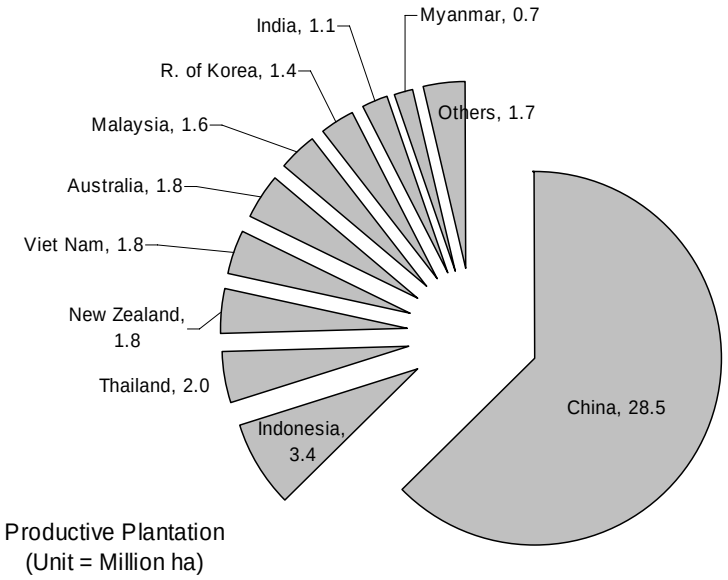



**Figure 27. Area of productive plantations in 2005 by nations in the APR (FRA 2005)**

In order to analyze future competitiveness, the changing area of plantation is a dynamic key component. As shown in Figure 28, China has increased forest area by around 181 million $m^3$ annually, most of which comes from dedicated afforestation and plantation programs. Forest stock grew by 79 million $m^3$ in Japan during 2000 to 2005. Republic of Korea, Viet Nam, India, Malaysia and Bhutan have experienced forest stock growth in the past 15 years. On the other hand, Indonesia, Philippines, Cambodia and Myanmar have lost forest stock continuously over the last 15 years and they need to rework their plantation programs if they want to gain competition in forest industry in the long-run.

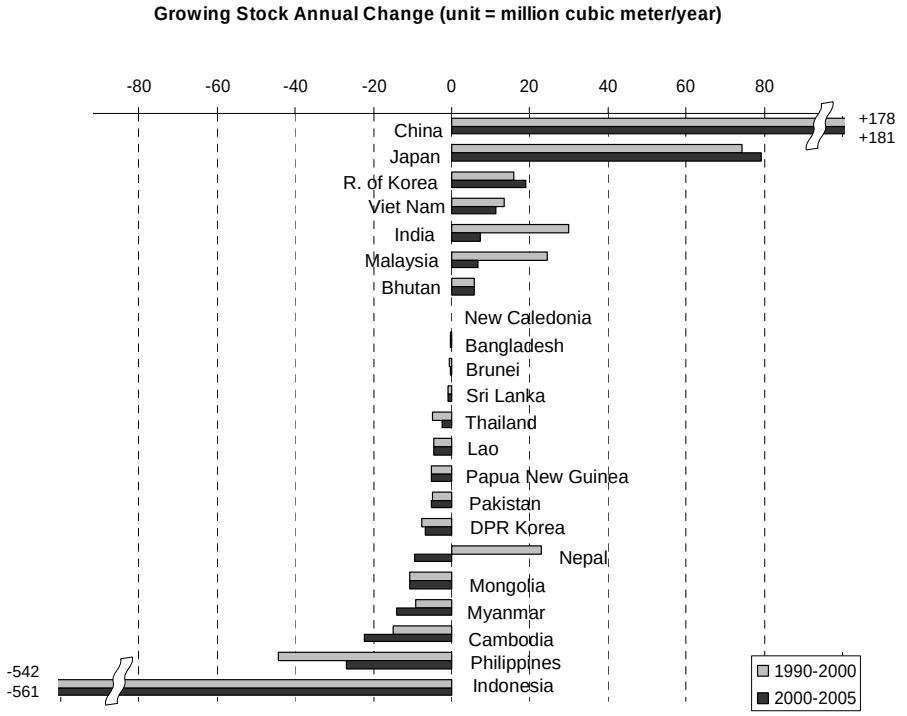



**Figure 28. Changes in forest area by nations in the APR (FRA 2005)**

Forest plantation management has improved in many nations, mainly due to the wider application of existing knowledge about best practices in areas such as: species selection; ground preparation; planting techniques; and protection. Technological levels of plantations and skills and knowledge of managers and employees are very important factors of competitive advantage. Partially, the technology and productivity factor overlaps with the factor of managerial competencies. Both factors influence the productivity of planted forests.

Technology is intangible and difficult to quantify. Here, the technological score of efficiency by the WEF is utilized to estimate the productivity and technology factor. The score is given in Table 1.

The productivity of industrial round wood is already well argued in the competitiveness of wood extraction from natural forests. FAOSTAT does not divide forest production from natural forests and from planted forests, the same productivity data are utilized here in the competitiveness of wood extraction from planted forests as well. Total productivity and per capita productivity are utilized to estimate this factor.

**Box 1. China's Plantation**

The Chinese government is aggressively promoting development of a domestic wood pulp industry, integrated with a productive plantation and paper production (Barr and Cossalter, 2004). As shown in Figure 29, China expanded its timber forest by more than 3 million ha annually from 1983 to 1992 (Zhang et al., 2007). However, China has gradually increased protection forest and decreased timber forest since the late 1990s. Substantial investments have been made in forest plantations and this may provide some cost advantage for raw material supply in the long term. Russia lifted the export tariff to 25 percent on industrial roundwood in 2008 and is planning to raise further to 80 percent in 2009, which will damage the manufacturers of neighboring countries, relying on raw materials from Russia. Forty-six percent of Russian roundwood was exported to China and 13 percent exported to Japan in 2005 (Global Trade Atlas, 2008). Chinese plantations may mitigate the impact of Russian tariff compared with other nations.

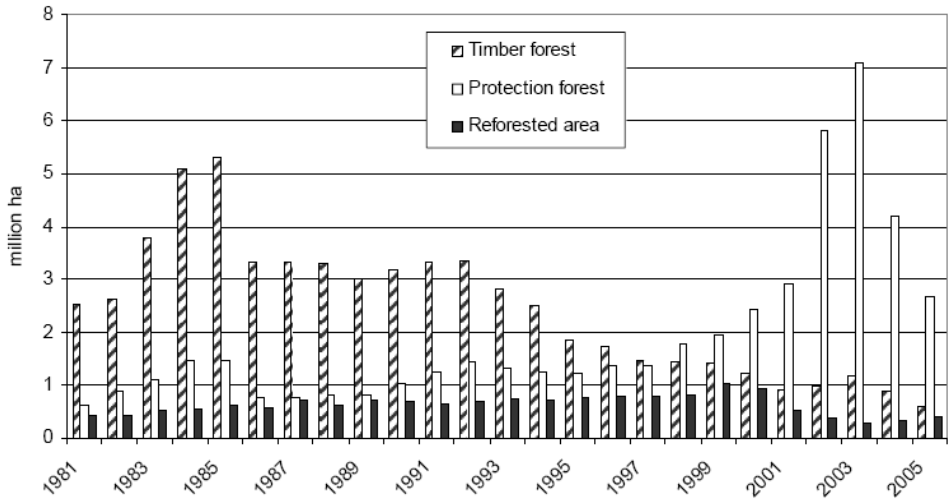



**Figure 29. Expansion of timber forest in China**
Source: Zhang et al. (2007).

***Current national competitiveness index of wood extraction from planted forests***

Including all the factors discussed above, the current NCI of wood extraction from planted forest is estimated. The factor components are summarized and shown in relation with Porter's framework in Figure 30.

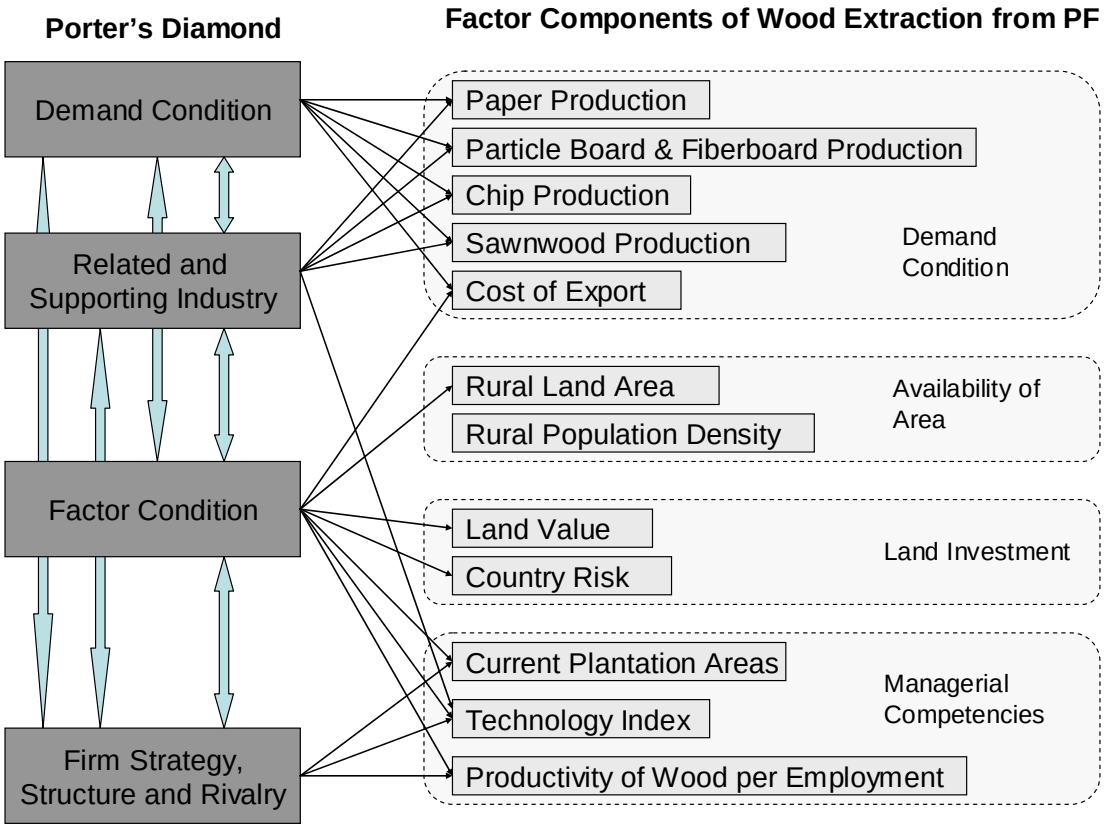



**Figure 30. Relationships between Porter's diamond and NCI factor components of wood extraction from planted forest**

There are some missing values of components, and these values are estimated by regression with other factors which should have high correlation or by averaging out the figures from similar nations. A natural logarithm was applied for rural land area, fiberboard production, paper production, chip production, sawnwood production and current area of plantation because these figures are extremely skewed. Also, these factors are not directly influenced by competitiveness. Furthermore, knowledge and intangible factors related to related industries and current plantations should have a much slower increment than the actual volume of output or area of plantation as they increase.

Each factor was standardized and calculated as the standardized T score (normal distribution with mean = 50 and standard deviation = 10 [$X \sim N(\mu=50, \sigma=10)$]). Weightings of factors were subjectively assigned due to opinions from forest plantation experts in FAO and academia (Table 6).

**Table 6. Weighting of factors for wood extraction from planted forest**

| | | | |
|---|---|---|---|
| 10% | Availability of Area | Rural Land Area | 5% |
| | | Rural Population Density | 5% |
| 20% | Land Investment | Land Value | 10% |
| | | Country Risk | 10% |
| 20% | Demand Condition | Paper Production | 3% |
| | | Particle & Fiberboard Production | 3% |
| | | Chip Production | 3% |
| | | Sawnwood Production | 1% |
| | | Cost of Export | 10% |
| 50% | Managerial Competencies | Current Plantation Areas | 20% |
| | | Productivity of Wood per Employment | 20% |
| | | Technology Index | 10% |

Of course, some enterprises always find ways to maximize their competitive advantages strategically, so the NCI shown here (Table 7) is highly simplified compared to reality. Furthermore, political agenda influences capital investment in forest plantations, but this cannot be measured and could not be utilized for this index.

## Table 7. NCI (2006) of wood extraction from planted forest in the APR

| | Competitiveness of Wood Extraction from Planted Forest (2006) | Availability of Land | | | Land Investment | | |
|---|---|---|---|---|---|---|---|
| | | Availability of Land (10%) | Rural Area | Rural Density | Land Investment (20%) | LandValue | Risk |
| Australia | 60 | 61 | 66 | 56 | 41 | 24 | 58 |
| Bangladesh | 49 | 40 | 52 | 27 | 51 | 57 | 46 |
| Bhutan | 48 | 53 | 49 | 56 | 54 | 57 | 50 |
| Brunei D | 49 | 48 | 41 | 55 | 51 | 38 | 65 |
| Cambodia | 49 | 54 | 54 | 54 | 47 | 57 | 38 |
| China ML | 58 | 60 | 66 | 54 | 58 | 57 | 59 |
| DPRK | 41 | 53 | 52 | 54 | 39 | 54 | 25 |
| Fiji | 56 | 51 | 46 | 55 | 50 | 51 | 49 |
| Hong Kong | N.S. | 25 | 28 | 23 | 51 | 35 | 67 |
| India | 53 | 55 | 63 | 48 | 56 | 56 | 55 |
| Indonesia | 57 | 57 | 61 | 54 | 51 | 56 | 46 |
| Japan | 50 | 54 | 56 | 52 | 40 | 18 | 62 |
| Kiribati | N.S. | 25 | 35 | 53 | 53 | 56 | 51 |
| Lao | 48 | 55 | 54 | 56 | 51 | 57 | 46 |
| Malaysia | 56 | 56 | 56 | 55 | 52 | 47 | 58 |
| Maldives | N.S. | 25 | 32 | 23 | 52 | 54 | 50 |
| Mongolia | 47 | 59 | 61 | 56 | 51 | 56 | 45 |
| Myanmar | 47 | 56 | 57 | 54 | 41 | 56 | 27 |
| Nepal | 46 | 50 | 52 | 49 | 51 | 57 | 44 |
| N Caledonia | 49 | 50 | 45 | 56 | 51 | 47 | 55 |
| NewZealand | 60 | 56 | 56 | 56 | 48 | 38 | 59 |
| Pakistan | 50 | 52 | 56 | 47 | 47 | 57 | 36 |
| Papua NG | 51 | 56 | 56 | 56 | 53 | 56 | 51 |
| Philippines | 53 | 53 | 55 | 52 | 53 | 56 | 50 |
| R. Korea | 55 | 53 | 52 | 53 | 49 | 38 | 59 |
| Samoa | 48 | 48 | 41 | 55 | 52 | 55 | 50 |
| Singapore | N.S. | 25 | 27 | 23 | 52 | 38 | 66 |
| Solomon Is. | 45 | 52 | 48 | 56 | 50 | 56 | 44 |
| Sri Lanka | 49 | 48 | 50 | 47 | 50 | 56 | 44 |
| Taiwan | 51 | 51 | 49 | 54 | 54 | 44 | 64 |
| Thailand | 59 | 55 | 56 | 53 | 50 | 51 | 50 |
| Timor-Leste | 45 | 50 | 46 | 54 | 49 | 56 | 42 |
| Tonga | N.S. | 25 | 34 | 50 | 50 | 51 | 50 |
| Vanuatu | 44 | 49 | 43 | 55 | 52 | 54 | 50 |
| Viet Nam | 53 | 52 | 55 | 49 | 49 | 57 | 41 |

| | Demand Condition | | | | | | Managerial Competencies | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Demand Condition (20%) | Paper Production | Fiber Panel Production | Chip Production | Sawnwood Production | Cost to Export | Managerial Competencies (50%) | Current Plantation Area | Productivity per Employment | Technology |
| Australia | 57 | 60 | 63 | 69 | 59 | 50 | 68 | 61 | 75 | 66 |
| Bangladesh | 52 | 54 | 54 | 44 | 53 | 52 | 49 | 55 | 50 | 39 |
| Bhutan | 46 | 39 | 55 | 44 | 47 | 45 | 45 | 42 | 46 | 49 |
| Brunei D | 51 | 39 | 40 | 44 | 49 | 59 | 47 | 38 | 44 | 68 |
| Cambodia | 48 | 39 | 40 | 44 | 43 | 55 | 48 | 51 | 49 | 40 |
| China ML | 64 | 64 | 67 | 69 | 61 | 62 | 55 | 70 | 44 | 45 |
| DPRK | 39 | 55 | 40 | 44 | 53 | 31 | 41 | 38 | 44 | 40 |
| Fiji | 53 | 39 | 40 | 62 | 51 | 58 | 60 | 53 | 75 | 47 |
| Hong Kong | 56 | 56 | 57 | 44 | 54 | 59 | 45 | 38 | 41 | 66 |
| India | 54 | 61 | 59 | 44 | 62 | 53 | 51 | 60 | 45 | 46 |
| Indonesia | 59 | 61 | 61 | 63 | 56 | 56 | 60 | 63 | 55 | 61 |
| Japan | 56 | 63 | 63 | 67 | 61 | 49 | 52 | 38 | 59 | 64 |
| Kiribati | 38 | 39 | 40 | 44 | 23 | 36 | 41 | 38 | 41 | 46 |
| Lao | 37 | 39 | 40 | 44 | 51 | 32 | 50 | 55 | 49 | 41 |
| Malaysia | 61 | 58 | 62 | 64 | 59 | 61 | 56 | 61 | 50 | 58 |
| Maldives | 42 | 39 | 40 | 44 | 23 | 44 | 42 | 38 | 41 | 48 |
| Mongolia | 38 | 39 | 50 | 44 | 53 | 31 | 47 | 53 | 44 | 40 |
| Myanmar | 39 | 54 | 40 | 44 | 56 | 31 | 51 | 59 | 47 | 41 |
| Nepal | 41 | 52 | 40 | 44 | 54 | 35 | 45 | 50 | 44 | 39 |
| N Caledonia | 48 | 39 | 40 | 44 | 42 | 55 | 48 | 46 | 45 | 58 |
| NewZealand | 58 | 58 | 62 | 65 | 59 | 55 | 67 | 62 | 75 | 61 |
| Pakistan | 57 | 59 | 58 | 44 | 56 | 59 | 49 | 56 | 45 | 42 |
| Papua NG | 50 | 39 | 40 | 44 | 49 | 58 | 49 | 52 | 48 | 42 |
| Philippines | 53 | 59 | 54 | 44 | 54 | 53 | 53 | 56 | 54 | 47 |
| R. Korea | 59 | 62 | 63 | 65 | 59 | 54 | 56 | 61 | 48 | 64 |
| Samoa | 45 | 39 | 40 | 44 | 46 | 48 | 48 | 48 | 48 | 50 |
| Singapore | 56 | 55 | 54 | 44 | 47 | 62 | 46 | 38 | 41 | 68 |
| Solomon Is. | 44 | 39 | 40 | 44 | 45 | 47 | 42 | 38 | 46 | 41 |
| Sri Lanka | 51 | 53 | 52 | 44 | 49 | 53 | 47 | 54 | 43 | 43 |
| Taiwan | 54 | 61 | 58 | 44 | 54 | 54 | 49 | 38 | 51 | 65 |
| Thailand | 59 | 60 | 62 | 66 | 53 | 57 | 63 | 62 | 70 | 50 |
| Timor-Leste | 44 | 39 | 40 | 44 | 23 | 49 | 42 | 38 | 48 | 37 |
| Tonga | 50 | 39 | 40 | 44 | 41 | 59 | 42 | 38 | 41 | 49 |
| Vanuatu | 36 | 39 | 40 | 44 | 47 | 31 | 44 | 38 | 48 | 47 |
| Viet Nam | 58 | 58 | 60 | 65 | 58 | 56 | 53 | 61 | 49 | 43 |

Figure 31 shows the calculated current NCI of wood extraction from planted forest. Unlike the wood extraction from natural forest, New Zealand has the highest NCI. Australia is just behind New Zealand, and Thailand, China, Indonesia and Malaysia follow. Most small nations and nations with higher country risk have lower scores.

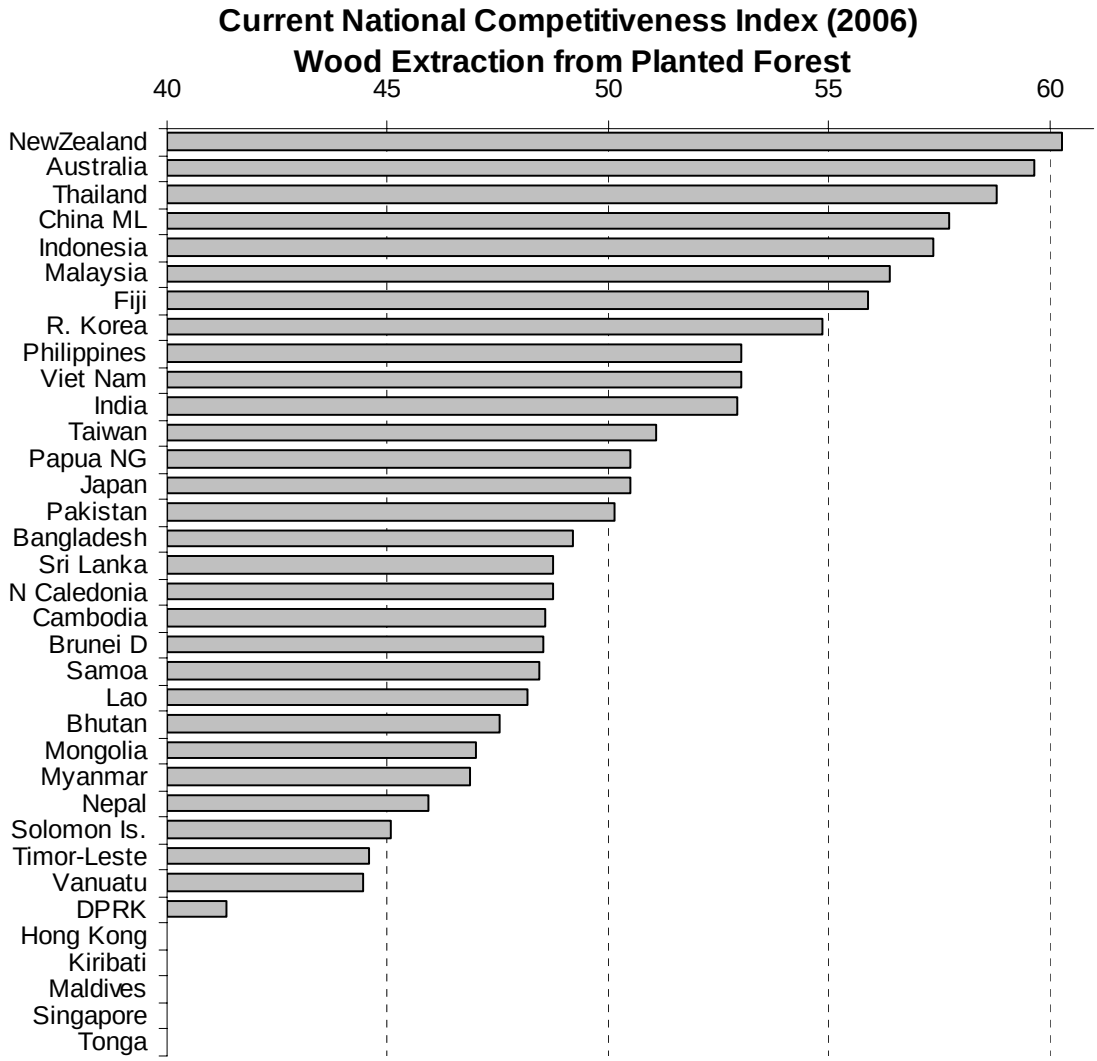



**Figure 31. Current NCI (2006) of wood extraction from planted forest**

**Sawnwood production**

The value of sawnwood totally depends on the usage of sawnwood (market condition) and raw material input (supply side). In this section, the demand condition of sawnwood and then the supply condition of sawnwood shall be discussed. Later the factors deriving competitiveness of sawnwood production shall be analyzed.

***Demand condition of sawnwood***

The sawnwood market is not well distributed. When you rely on ForesSTAT by FAO and assume that inventory level does not change, production amount minus exporting amount plus importing amount should be equal to the consumption in a nation. This estimation would be very rough since production statistics would be underestimated in developing countries. For example, Indonesia's estimated consumption was negative in 2006, which should not be true.

There are two types of sawnwood: coniferous (softwood) sawnwood and non-coniferous (hardwood) sawnwood. They are generally produced in different climate zones, and the usages are different. Sawnwood consumption by types is shown in Figure 32. As of 2006, 73 percent of sawnwood consumed in the region was estimated to be softwood sawnwood (the remaining 27 percent being hardwood sawnwood). The percentage of softwood lumber usage has gradually increased. The amount of sawnwood consumed in the APR sharply declined in 1998, and the estimated consumption in 2006 of 73 million $m^3$ is only two-thirds of the estimated consumption in 1990. Those figures are mainly attributable to the Japanese housing slump in the 1990s and the Asian Financial Crisis in 1997.

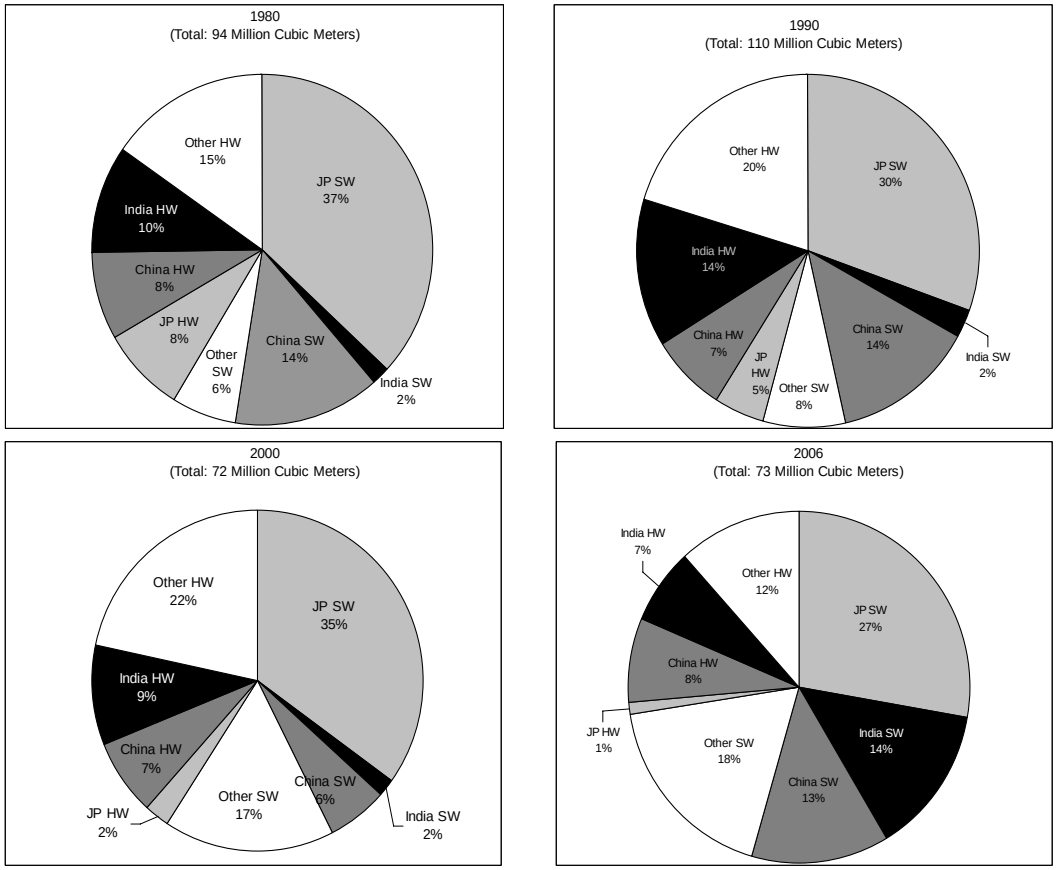



**Figure 32. Sawnwood consumption by types of wood in the APR**
Source: FAOSTAT (2008).

Most softwood sawnwood species are produced in temperate areas. Major softwood sawnwood species include *Pinus, Picea, Abies, Tsuga, Pseudotsuga, Cryptomeria, Larix, Chamaecyparis* and *Cunninghamia*. As shown in Figure 33, Japan has been a major consumer of softwood sawnwood. In the early 1990s, Japan consumed around 60 percent of softwood sawnwood consumed in the APR, but this percentage declined to 38.4 percent in 2006. China had increased consumption of coniferous sawnwood till the early 1980s, but consumption declined sharply in the late 1980s; it recovered somewhat in the early 1990s, but again sharply declined in the late 1990s.

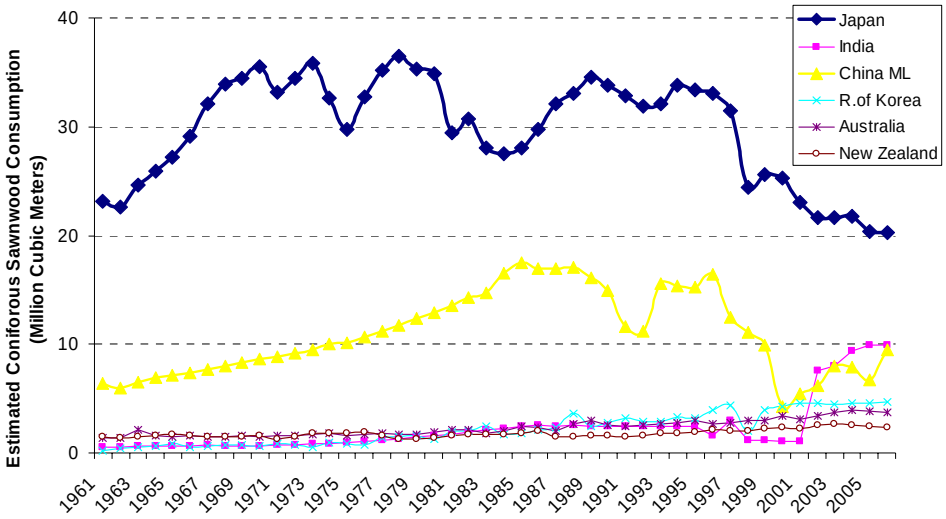



**Figure 33. Coniferous sawnwood consumption by nation in the APR**
Source: FAOSTAT (2008).

Hardwood species are highly diversified, and price ranges vary according to species and age. Hardwood sawnwood is used for packaging, civil engineer works, industrial uses, decorative uses, furniture and construction uses. As shown in Figure 34, Japan was the major consumer of hardwood sawnwood till the 1970s, but India and China's national consumptions have gradually increased. However, total hardwood sawnwood consumption in those nations has shown some volatility since the late 1990s.

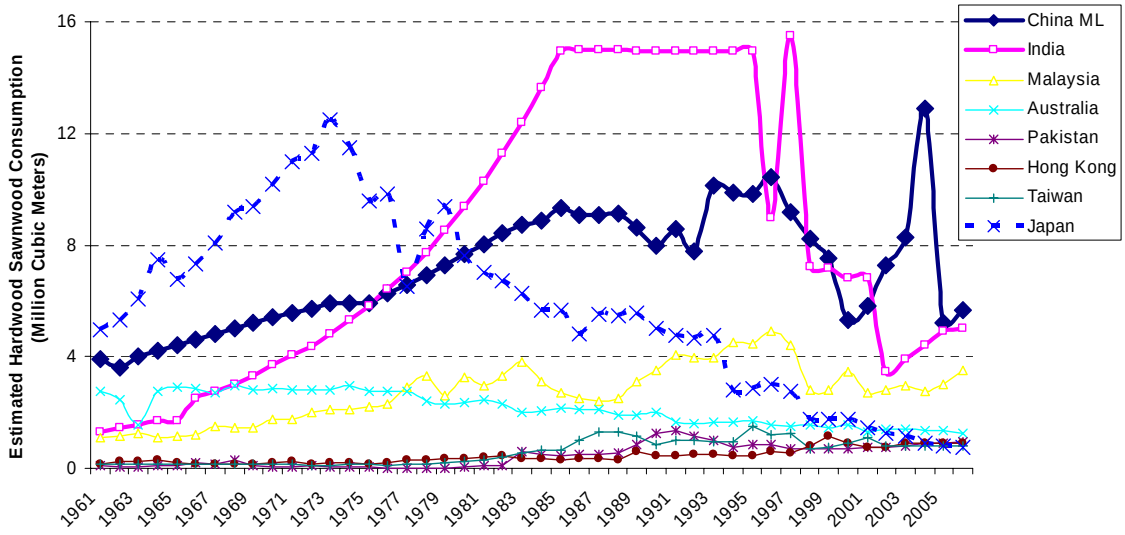



**Figure 34. Non-coniferous sawnwood consumption in the APR**
Source: FAOSTAT (2008).

Although Japan's consumption of sawnwood lumber has decreased, Japan is still the biggest market for sawnwood lumber in the APR. In Japan, around 80 percent of sawnwood is absorbed in the housing construction industry and Japan built 559,201 units of wood-frame residential house in 2006, down by 23.2 percent from 727,765 units built in 1990 (Sasatani et al. 2009). Japan utilizes domestic species, such as *Cryptomeria japonica* and *Chamaecyparis obtusa*, for posts and beams of wood-frame houses, but imports much softwood lumber from other foreign countries, especially from North America, Russia, and Scandinavian nations. Japan imports some amounts of softwood sawnwood from the APR, especially from New Zealand, mainly *Pinus radiata*. Some *Pinus radiata* sawnwood is consumed in housing markets as engineered laminated wood and some is consumed as packaging material. Also, some hardwood sawnwood lumber is imported from South East Asia, mainly for packaging and civil engineering. However, the ratio of imports to Japan from the APR compared to imports from the rest of the world was 12.9 percent in 2000 and it declined to 7.9 percent in 2006 (Figure 35). This implies that the APR's sawnwood production is not competitive against other regions. In general, many North American and European sawnwood producers are much more efficient and productive compared with small-scale sawnmills in Asia.

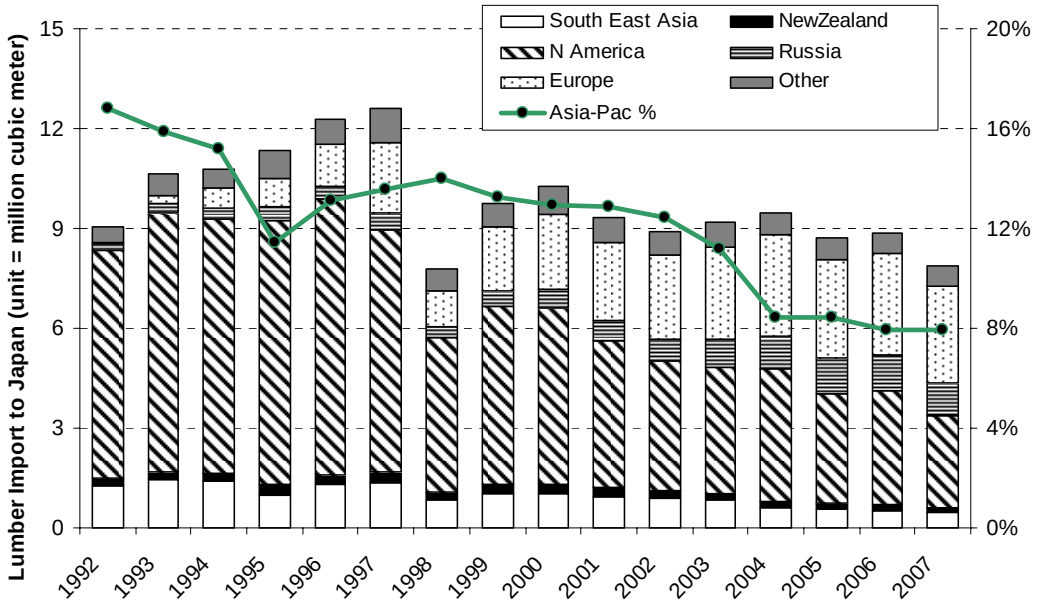



**Figure 35. Japan's lumber imports by regions**
Source: Japan Customs.

In addition to importing sawnwood lumber directly, Japan imports much lumber-grade roundwood especially from North America and Russia and produces sawnwood from these raw materials in Japan. This implies that the sawnwood processing sector in Japan is somewhat competitive compared with North American or Russian mills, but extracting roundwood from forest is not competitive at all. Japanese domestic demand conditions (e.g. sophistication of domestic demand, partially from the government's regulations) and efficiency may enhance the relative competitiveness of the sawnwood industry in Japan. Competitiveness against other regions is beyond the scope of this study, though.

***Supply side of sawnwood***

Figure 36 shows the APR's sawnwood production in the global context. Sawnwood production in the APR decreased from 108 million $m^3$ (26 percent of the world share) to 67 million $m^3$ (16 percent of the world share) in 2006.

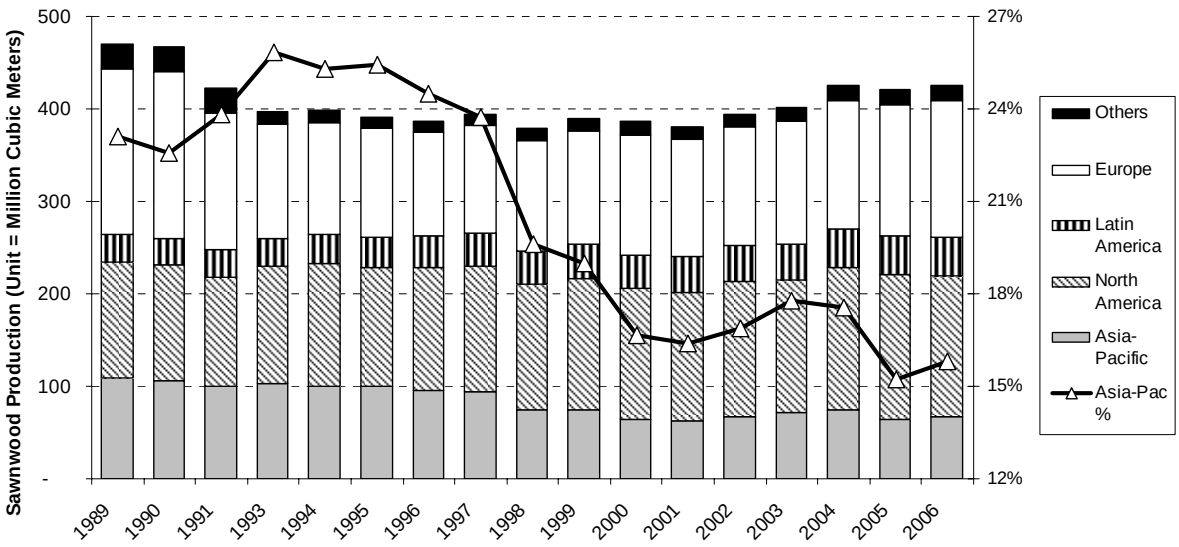



**Figure 36. World's sawnwood production by region**
Source: FAOSTAT (2008).

As shown in Figure 37, sawnwood production in Japan has continuously declined since 1990 due to the housing slump. Japan produced 29.8 million $m^3$ of sawnwood in 1990, but it declined by 58 percent to 12.6 million $m^3$ in 2006. Overall, sawnwood production in China has also declined from 22.7 million $m^3$ in 1990 to 9.3 million $m^3$ in 2006. On the other hand, Viet Nam and New Zealand increased their production capacity from 1990 to 2006.

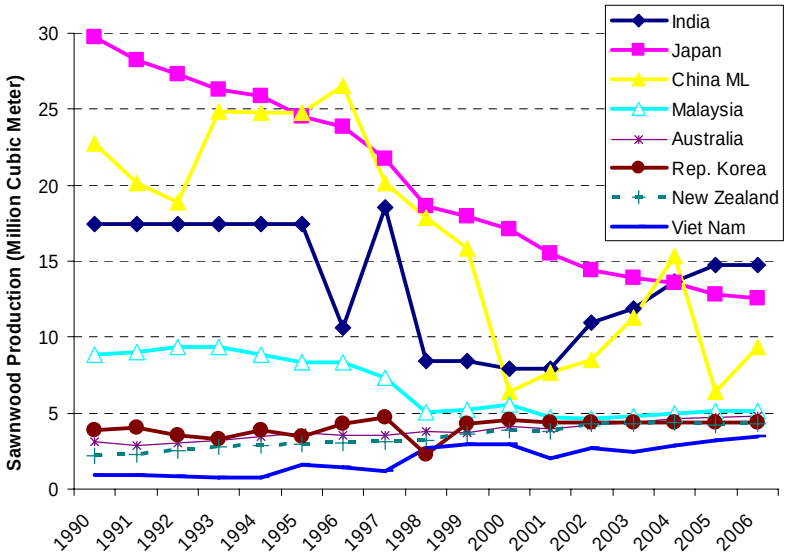



**Figure 37. Sawnwood production by nation in the APR**
Source: FAOSTAT (2008).

As shown in Figure 38, New Zealand exports the largest amount of coniferous sawnwood in the region. Exports from New Zealand increased from 580 000 $m^3$ in 1990 to 1.96 million in 2006. Most being *Pinus radiate* sawnwood from planted forests.

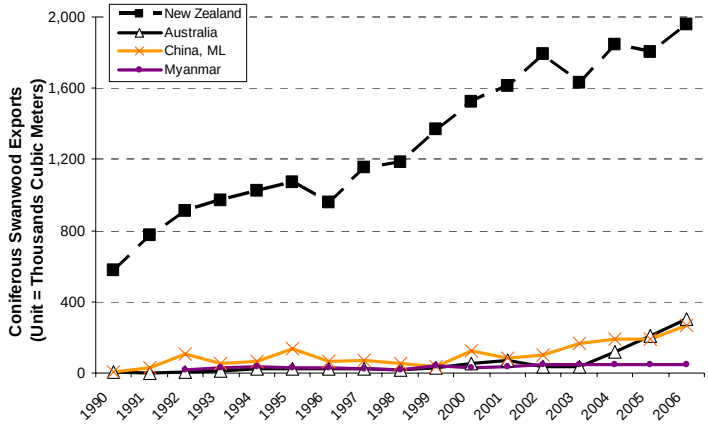



**Figure 38. The volume of coniferous sawnwood exports by nation in the APR**
Source: FAOSTAT (2008).

Regarding non-coniferous sawnwood, exports from Malaysia declined from 5.3 million $m^3$ to 2.6 million $m^3$ in 2006 (Figure 39). Indonesia and Thailand have recovered their export of non-coniferous sawnwood since the Asian Financial Crisis.

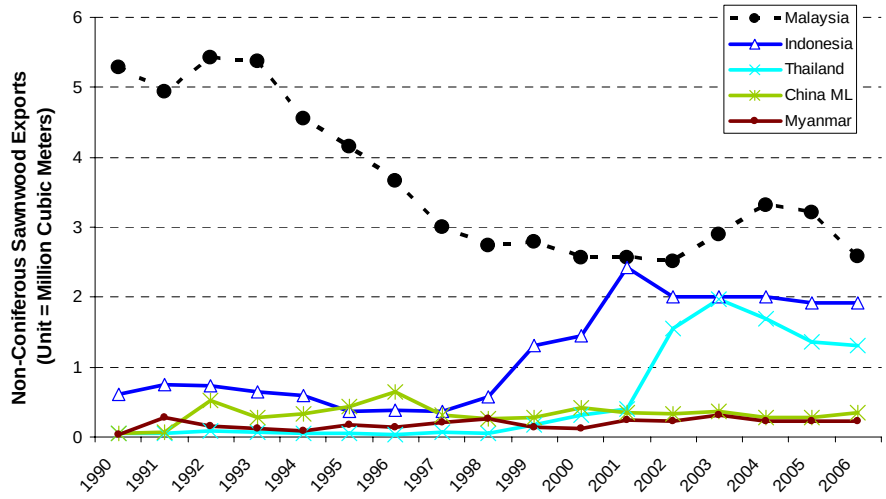



**Figure 39. Non-coniferous sawnwood exports by nation in the APR**
Source: FAOSTAT (2008).

***Factors of sawnwood production***

Five factors are the driving forces of competitiveness in the sawnwood industry; 1) related upstream industry, 2) demand condition, 3) energy cost, 4) labor cost and 5) productivity and efficiency.

*Related upstream industry*

For the sawnwood mill, raw industrial roundwood supply is the critical factor for operation. When the mill can constantly access valuable raw material, it may have competitive advantage. Can firms in a nation which has huge forest resources gain competitiveness in the sawmill industry as well? Of course, the amount of log extraction from natural forest is partially important for the sawmill operation, but sawmills can buy raw materials from anywhere in the world. For example, there are quite a few sawmills in Japan; China imports huge amounts of raw logs from other nations.

Supporting and related industry is one of the most important concepts of Porter's competitiveness of nations. Knowledge, skill and products flow from one sector to the other. In the theory, because the wood extraction sector is competitive in one nation, the sawnwood sector also gains competitiveness. The sawnwood sector in a nation where wood extraction is competitive can access raw material constantly. It also can gain important information and knowledge from the wood extraction sector. Supported by raw material supply, knowledge and information, the sawnwood industry can strategically establish competitiveness against competitors in other nations.

The current NCI of wood extraction from natural forest and from planted forest, calculated in the last section, is utilized as the component of related upstream industry as the factor. Since both natural forest and planted forest both provide raw material to the sawnwood sector, the same weights are applied to estimate the factor score.

*Demand condition*

Home demand is as important as upstream industry in Porter's theory. When home demand is sophisticated, firms try to brush up their operation line and products to satisfy their most important customers. Sophisticated customers and demand in the nation improve the competitiveness of the industry. Sawnwood is still an intermediary product, and construction sectors, furniture sectors, civil engineering sectors, packaging sectors, engineered wood sectors and other sectors consume sawnwood. Total sawnwood consumption and per capita sawnwood consumption in a nation are utilized as components to estimate the factor. Also, cost of exports is utilized to estimate the easiness to export in order to include the foreign demand condition.

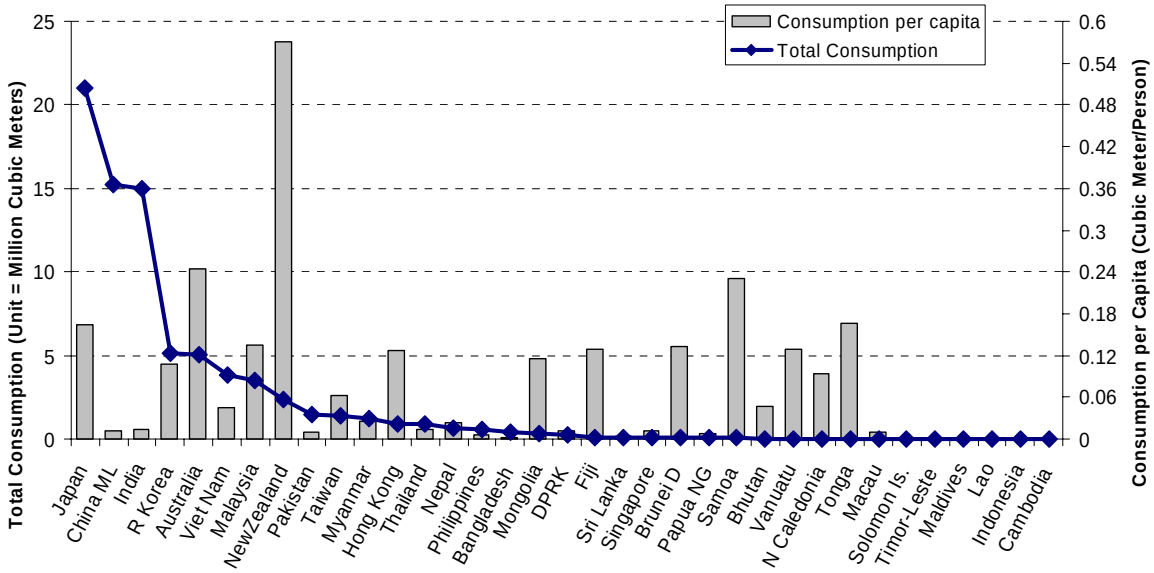



**Figure 40. Overall sawnwood consumption by nation in the APR**
Source: FAOSTAT (2008).

The demand for sawnwood varies widely among nations. Consumption-wise, Japan, China, and India were the top three ranked nations in the region in 2006. Regarding per capita consumption, New Zealand was the largest consumer per capita with 0.57 $m^3$ per person (Figure 40). Australia followed New Zealand with 0.24 $m^3$ per capita. Japan's consumption was around 0.16 $m^3$ per capita in 2006. Consumption per capita in some island nations in the South Pacific was very high and in Indonesia, Laos and Cambodia was negative. Unfortunately, the preciseness of the data source is questionable. Hence, when we estimated

the component scores, average consumption of other similar nations was carefully checked, and the outlying data was revised if necessary.

*Energy cost*

Energy cost is an important factor for the sawmill industry in terms of operation. Sawmills use not only electricity but also other fossil fuel inputs as energy sources. The relative energy cost factor score was estimated by combining the gasoline price component score and electricity price component score. Gasoline price has already discussed in the previous section. Since electricity price is a fundamental input and extremely important in terms of competitiveness for the pulp and paper industry, electricity price shall be discussed later.

*Labor cost*

Labor cost is an important factor for any business operation but is extremely important for labor intensive manufacturing. Whenever firms rely on manpower for their production, labor cost becomes a critically important operation cost, which determines firms' return. Hence, labor cost is a crucial factor for the competitiveness of the sawnwood industry as well, especially in developing countries. Therefore, the cheaper the labor cost is, the more competitive advantage a nation has. Of course, one can argue that labor cost should not be so important for capital-intensive sawnwood mills compared with labor-intensive mills. The productivity and efficiency factor, discussed in the next section, can cancel out this trade-off.

Current labor cost is of course important for current competitiveness; yet, the scenario of future wages is a fundamentally different component which can change future competitiveness. The inflation risk of wages harms the present valuation of future cash flow, so investors are reluctant to invest in labor-intensive firms in a country where the labor wage is expected to inflate in the future. So, if expectations of labor inflation are high in some nations, labor-intensive business operations, like sawnwood manufacturing, plywood manufacturing and furniture manufacturing sectors, will likely lose competitive edge in the future. So, business owners may need to invest more in capital in order to survive the business strategically. The data for future labor cost are shown in this section, but shall be utilized to estimate future competitiveness in the next chapter.

Labor cost information was gathered from EIU (2008). Figure 41 shows the hourly labor cost in advanced nations and former NIEs. The labor cost per hour in Australia was US$25.8 in 2006, which was the highest in the region. The Japanese labor cost per hour was US$20.9 in 2004, which has declined since 2004 because of the weak Japanese yen and deflationary pressure on prices in the country. Republic of Korea was US$15.4 in 2006 and passed New Zealand with US$14.5. Former Asian NIEs and areas experienced inflation of labor cost and attempted to catch up with advanced nations in the region as they became wealthier.

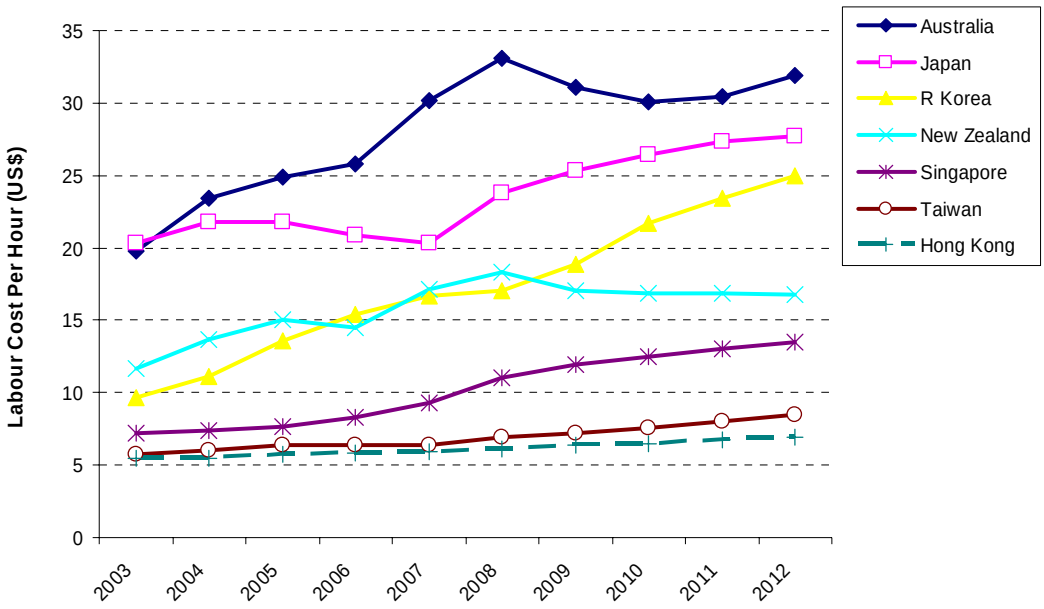



**Figure 41. Hourly labor cost of developed APR nations**
Source: EIU (2008).

Figure 42 shows the hourly labor cost of developing countries in the region. The labor cost per hour in Malaysia and in Thailand was US$2.6 and US$1.5 in 2006, respectively. China's labor cost per hour was US$0.87 in 2003 but increased to US$1.35 in 2006, which means its labor cost increased 55.2 percent in just three years. It was predicted by the EIU that China's labor cost would surpass Thailand in 2008 and Malaysia in 2012. This suggests that some firms in China may experience severe difficulties in the near future if they depend too much on China's abundant and inexpensive labor force. Yet, it is also known that the discrepancy of labor cost within China is very large. Labor cost in major developed cities, such as Shanghai and Beijing, and rural areas, especially inland, are totally different. For example, hourly compensation per employee in urban areas was estimated as US$1.19 in 2004, whereas that of town and village enterprises was estimated as US$0.45 in 2004, which is only 38 percent compared to urban employees (Lett and Banister, 2006). Although, comparable labor cost data from most nations are not available, they should be more or less than Indonesia or Sri Lanka, where the labor cost per hour is US$0.6 and US$0.4, respectively. Nations which are expected to enjoy higher economic growth than others will likely experience a higher rate of wage inflation than other nations. Unfortunately, there are no comparable data on labor cost in most developing nations. Current labor cost of these nations is estimated by the nominal GDP per capita as an independent variable.

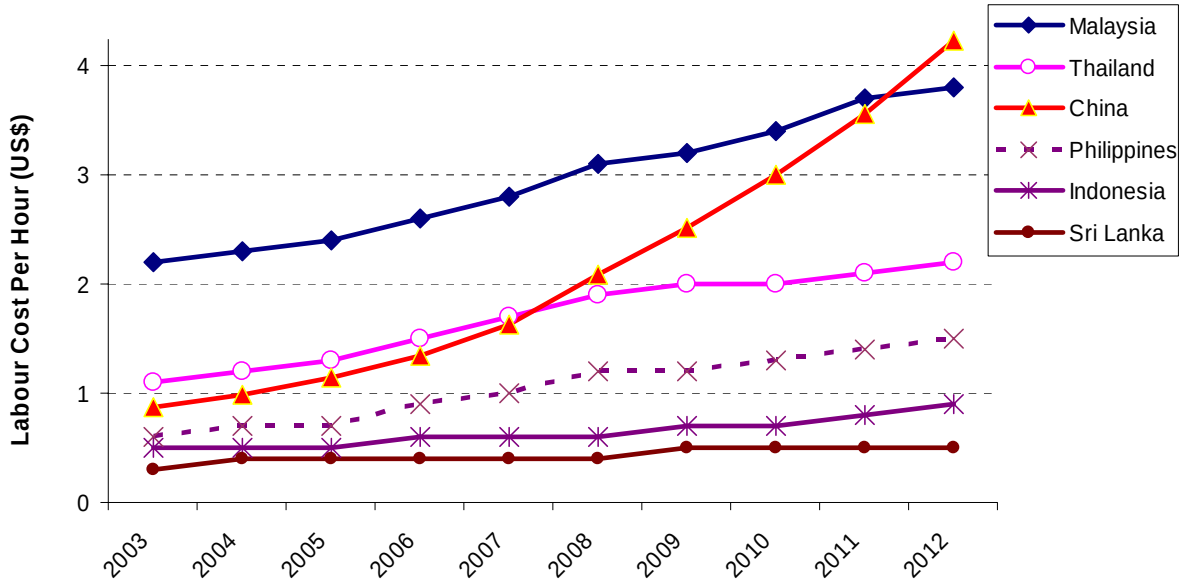



**Figure 42. Hourly labor cost in emerging nations in the APR**
Source: EIU (2008).

Besides the hourly labor cost, the availability of manufacturing labor is also utilized as the component to estimate the labor cost factor. Whenever a nation has a bigger manufacturing labor force, firms in the nation can access to labor easily. Figure 43 shows the manufacturing labor force in each nation. China has the largest manufacturing labor force with around 200 million persons. India has 62 million persons, and Indonesia, Japan, Pakistan, Viet Nam and Bangladesh then follow. Small nations in the South Pacific have a manufacturing labor force of sometimes less than 10,000 persons.

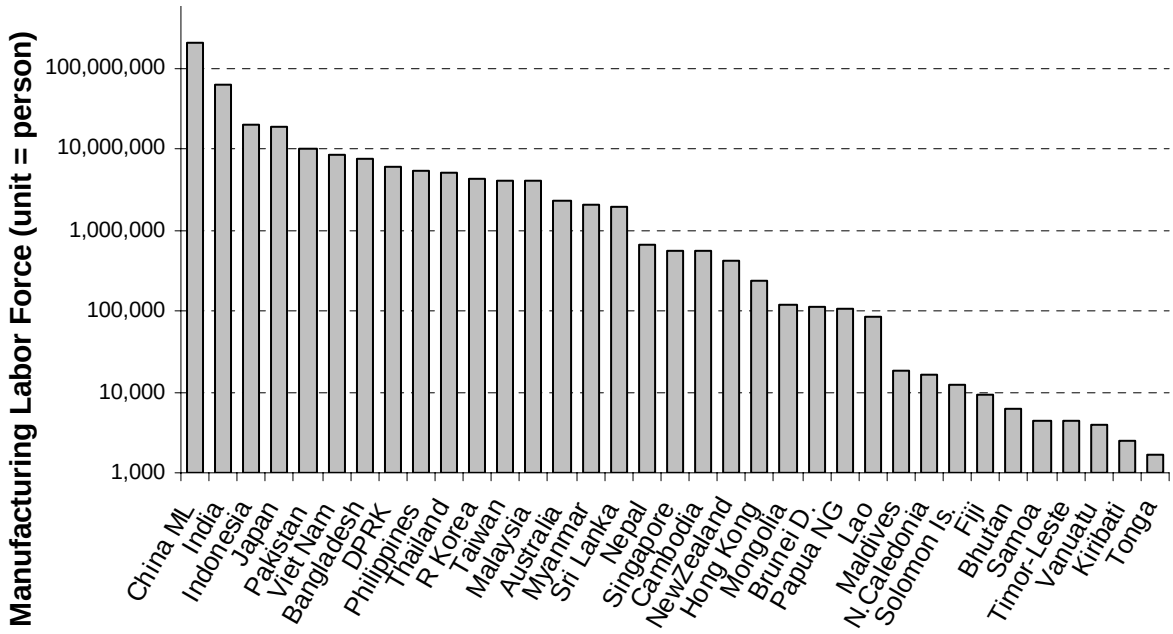



**Figure 43. Manufacturing labor force in the APR**
Source: CIA (2008).

*Productivity and efficiency*

If labor cost is the major cost for manufacturing firms, then they should move to nations where the labor cost is cheapest. Firms in a nation that do not have competitive advantage in labor cost should find another competitive edge to survive. One strategy is to intensify capital rather than labor to reduce the operation cost. Yet, it is not easy to quantify the capital intensity of a nation. Efficiency is one component that can cancel out the labor cost. Productivity is influenced by these issues, which can affect the score of productivity.

The higher the efficiency index is, the more competitive the nation is. Missing values in the GCI (Table 1) are estimated by the purchasing power parity based on GDP per capita as the independent variable.

Productivity per worker is the key component of competitiveness. For the industrial roundwood and paper industry, volume of production per worker is used as the productivity component score. Unfortunately, this is not possible for the sawnwood and wood-based panel industry. The available data on employment are the sum of the wood processing sector, which includes both sawnwood and wood-based panels, so it is not possible to get comparable production volume data per worker. Also, as discussed above, the value of sawnwood widely varies, so the volume of production would not be an adequate variable. The available data on employment are the value-added data of the wood processing sector. However, the price level is different in each nation. So, considering purchasing power parity in each nation, the value-added per worker can be utilized as the comparable productivity data both for sawnwood and for wood-based panels.

Figure 44 shows the total value-added of the wood processing industry and value-added per worker. Japan added the most value in the wood processing industry, annually averaging US$8.5 billion (PPP) in the last five years. China, Indonesia, Australia, Malaysia, Republic of Korea and New Zealand follow. Australia, New Zealand and Republic of Korea have high value-added per worker. Pacific island nations have extremely high value-added per employment due to the inaccuracy of data and their price level. These suspicious values were substituted to the figures of other similar nations.

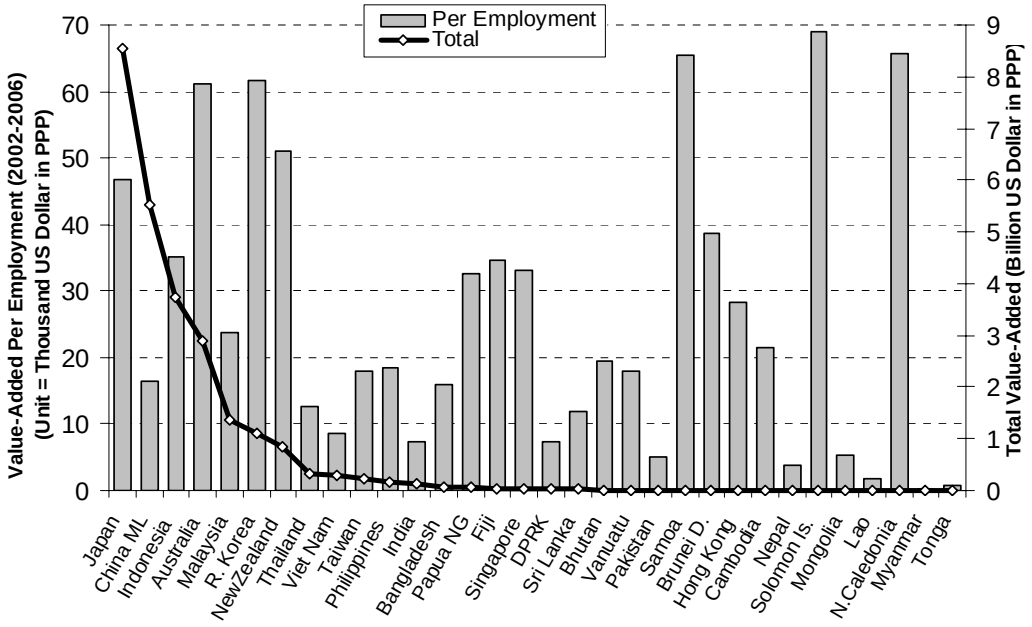



**Figure 44. Value-added productivity of the wood processing industry by PPP**
Source: Lebedys (2008) and CIA (2008).

***Current national competitiveness index of the sawnwood industry***

Including all the factors discussed above, the current NCI of the sawnwood industry was estimated. The factor components are summarized and shown relation with Porter's framework in Figure 45.

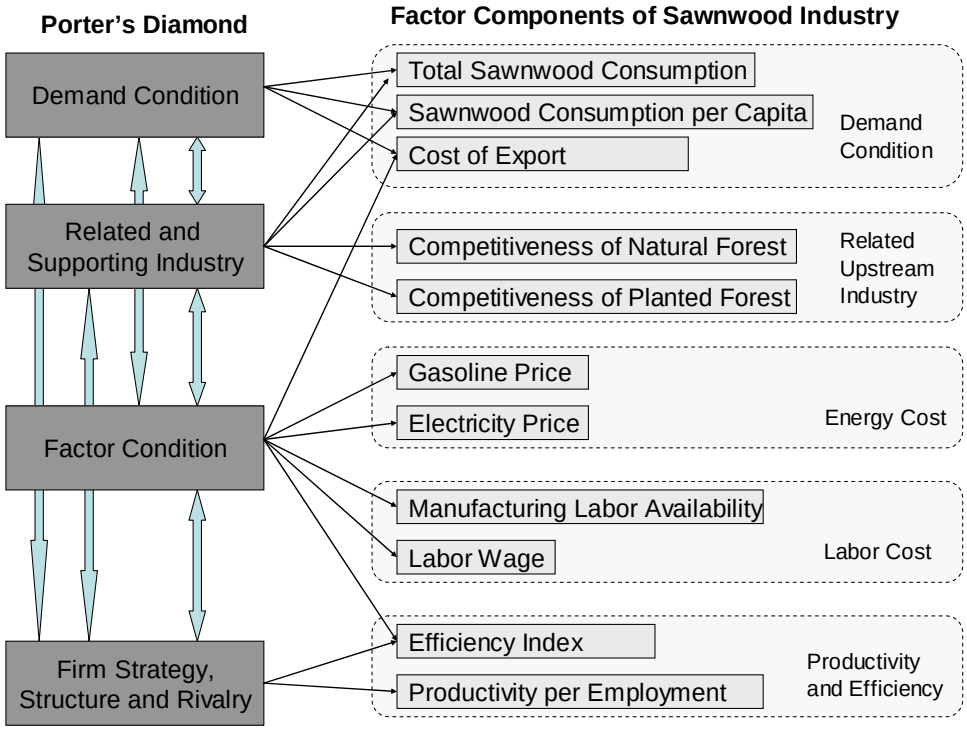



**Figure 45. Relationships between Porter's diamond and NCI factor components of the sawnwood industry**

Missing values were estimated by regression with other factors which should have high correlation or by averaging the number of similar nations. A natural logarithm was applied for total sawnwood consumption because the figure was extremely skewed. Then, each factor was standardized and calculated as the standardized T score. Weightings were subjectively assigned due to the opinions from forest product experts in FAO and academia as shown in Table 8. Of course, some enterprises always find ways to maximize their competitive advantages strategically, so the NCI shown here is highly simplified compared to reality (Table 9). Furthermore, political agendas influence the capital investment of forest plantations, but they cannot be measured, and could not be utilized for this index.

**Table 8. Weighting of factors for the sawnwood industry**

| | | | |
|---|---|---|---|
| 10% | Related Upstream Industry | Competitiveness of Natural Forest | 5% |
| | | Competitiveness of Planted Forest | 5% |
| 20% | Demand Condition | Total Sawnwood Consumption | 6.7% |
| | | Sawnwood Consumption per capita | 6.7% |
| | | Cost of Export | 6.7% |
| 10% | Energy Cost | Gasoline Price | 5% |
| | | Electricity Price | 5% |
| 20% | Labor Cost | Manufacturing Labor Availability | 6.7% |
| | | Labor Wage | 13.3% |
| 40% | Productivity and Efficiency | Productivity per Employment | 20% |
| | | Efficiency Index | 20% |

## Table 9. NCI (2006) for the sawnwood industry in the APR

| | | Upstream Related Industry | | | Demand Conditon | | | |
|---|---|---|---|---|---|---|---|---|
| | **Overall Current Competitiveness of Sawnwood Industry (2006)** | **Upstream Related Industry (10%)** | Competitiveness of Natural Forest | Competitiveness of Planted Forest | **Demand Condition (20%)** | Total Sawnwood Consumption | Sawnwood Consumption per Capita | Cost of Export |
| Australia | 56 | 58 | 57 | 60 | 57 | 56 | 65 | 50 |
| Bangladesh | 48 | 50 | 50 | 49 | 47 | 46 | 43 | 52 |
| Bhutan | 48 | 50 | 52 | 48 | 46 | 45 | 47 | 45 |
| Brunei | 51 | 49 | 49 | 49 | 53 | 45 | 55 | 59 |
| Cambodia | 47 | 52 | 55 | 49 | 48 | 45 | 43 | 55 |
| China ML | 54 | 56 | 53 | 58 | 61 | 76 | 44 | 62 |
| DPR Korea | 44 | 46 | 51 | 41 | 40 | 46 | 44 | 31 |
| Fiji | 51 | 54 | 53 | 56 | 53 | 46 | 55 | 58 |
| HK | 51 | 25 | 25 | 25 | 54 | 47 | 55 | 59 |
| India | 53 | 53 | 53 | 53 | 58 | 76 | 44 | 53 |
| Indonesia | 55 | 56 | 56 | 57 | 48 | 45 | 43 | 56 |
| Japan | 56 | 51 | 51 | 50 | 65 | 88 | 58 | 49 |
| Kiribati | 42 | 25 | 25 | 25 | 42 | 45 | 45 | 36 |
| Lao | 46 | 50 | 52 | 48 | 40 | 45 | 43 | 32 |
| Malaysia | 56 | 56 | 56 | 56 | 56 | 53 | 55 | 61 |
| Maldives | 43 | 25 | 25 | 25 | 44 | 45 | 43 | 44 |
| Mongolia | 45 | 48 | 50 | 47 | 43 | 46 | 53 | 31 |
| Myanmar | 44 | 50 | 53 | 47 | 41 | 48 | 45 | 31 |
| Nepal | 44 | 48 | 50 | 46 | 42 | 47 | 45 | 35 |
| New Caledonia | 51 | 47 | 46 | 49 | 51 | 45 | 52 | 55 |
| New Zealand | 58 | 54 | 49 | 60 | 66 | 50 | 94 | 55 |
| Pakistan | 48 | 51 | 51 | 50 | 51 | 48 | 44 | 59 |
| Papua NG | 50 | 52 | 54 | 51 | 49 | 45 | 44 | 58 |
| Philippines | 51 | 53 | 53 | 53 | 48 | 46 | 44 | 53 |
| R of Korea | 55 | 50 | 44 | 55 | 54 | 56 | 53 | 54 |
| Samoa | 51 | 49 | 49 | 48 | 53 | 45 | 64 | 48 |
| Singapore | 52 | 25 | 25 | 25 | 50 | 45 | 44 | 62 |
| Solomon Islands | 48 | 49 | 52 | 45 | 45 | 45 | 43 | 47 |
| Sri Lanka | 48 | 49 | 49 | 49 | 47 | 46 | 44 | 53 |
| Taiwan | 54 | 50 | 49 | 51 | 50 | 48 | 49 | 54 |
| Thailand | 52 | 57 | 54 | 59 | 50 | 47 | 44 | 57 |
| Timor-Leste | 46 | 46 | 48 | 45 | 46 | 45 | 43 | 49 |
| Tonga | 44 | 25 | 25 | 25 | 54 | 45 | 58 | 59 |
| Vanuatu | 47 | 46 | 47 | 44 | 44 | 45 | 55 | 31 |
| Viet Nam | 50 | 52 | 51 | 53 | 52 | 53 | 47 | 56 |

| | Energy Cost | | | Labor Cost | | | Productivity and Efficiencty | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Energy Cost (10%)** | Gasoline Price | Electricity Price | **Labor Cost (20%)** | Hourly Labor Cost | Manufacturing Labor Availability | **Productivity (40%)** | Efficiency | Value-added per Employment |
| Australia | 54 | 49 | 58 | 28 | 15 | 55 | 70 | 67 | 74 |
| Bangladesh | 50 | 55 | 44 | 56 | 55 | 59 | 43 | 39 | 47 |
| Bhutan | 46 | 51 | 42 | 49 | 55 | 37 | 48 | 49 | 47 |
| Brunei | 67 | 72 | 61 | 34 | 29 | 46 | 56 | 61 | 51 |
| Cambodia | 44 | 46 | 42 | 54 | 55 | 51 | 44 | 38 | 50 |
| China ML | 60 | 59 | 61 | 59 | 54 | 69 | 47 | 46 | 47 |
| DPR Korea | 41 | 58 | 25 | 56 | 55 | 58 | 41 | 40 | 42 |
| Fiji | 43 | 44 | 42 | 49 | 54 | 38 | 52 | 46 | 58 |
| HK | 40 | 20 | 60 | 48 | 48 | 48 | 60 | 66 | 54 |
| India | 50 | 46 | 54 | 59 | 55 | 66 | 48 | 54 | 42 |
| Indonesia | 62 | 63 | 61 | 58 | 56 | 62 | 55 | 52 | 58 |
| Japan | 43 | 43 | 42 | 40 | 28 | 62 | 65 | 66 | 65 |
| Kiribati | 44 | 45 | 42 | 48 | 55 | 34 | 42 | 46 | 38 |
| Lao | 60 | 52 | 67 | 52 | 55 | 45 | 41 | 43 | 38 |
| Malaysia | 61 | 65 | 58 | 54 | 52 | 57 | 56 | 61 | 51 |
| Maldives | 50 | 45 | 54 | 50 | 54 | 40 | 43 | 48 | 38 |
| Mongolia | 47 | 51 | 42 | 52 | 55 | 46 | 42 | 43 | 40 |
| Myanmar | 42 | 60 | 25 | 55 | 55 | 55 | 39 | 41 | 37 |
| Nepal | 46 | 49 | 42 | 54 | 55 | 51 | 38 | 37 | 40 |
| New Caledonia | 44 | 45 | 42 | 45 | 48 | 40 | 56 | 56 | 57 |
| New Zealand | 54 | 48 | 60 | 39 | 33 | 50 | 66 | 64 | 67 |
| Pakistan | 50 | 46 | 54 | 57 | 55 | 60 | 41 | 42 | 40 |
| Papua NG | 52 | 46 | 58 | 52 | 55 | 46 | 49 | 41 | 57 |
| Philippines | 53 | 56 | 50 | 56 | 55 | 58 | 48 | 49 | 48 |
| R of Korea | 40 | 22 | 59 | 41 | 33 | 57 | 68 | 62 | 74 |
| Samoa | 48 | 54 | 42 | 48 | 55 | 36 | 53 | 49 | 57 |
| Singapore | 52 | 50 | 55 | 46 | 44 | 51 | 63 | 69 | 57 |
| Solomon Islands | 44 | 45 | 42 | 50 | 55 | 39 | 49 | 41 | 57 |
| Sri Lanka | 53 | 51 | 54 | 55 | 56 | 55 | 44 | 45 | 44 |
| Taiwan | 57 | 53 | 60 | 51 | 48 | 57 | 57 | 66 | 48 |
| Thailand | 58 | 58 | 57 | 55 | 54 | 58 | 49 | 54 | 45 |
| Timor-Leste | 45 | 48 | 42 | 49 | 55 | 36 | 45 | 34 | 57 |
| Tonga | 44 | 46 | 42 | 47 | 55 | 33 | 43 | 49 | 38 |
| Vanuatu | 50 | 45 | 54 | 48 | 55 | 35 | 47 | 46 | 48 |
| Viet Nam | 58 | 60 | 57 | 57 | 55 | 60 | 43 | 44 | 42 |

Figure 46 shows the NCI score. New Zealand has the highest competitive score in the region. Japan is ranked number two. Malaysia, China, Australia, Indonesia and Republic of Korea then follow.

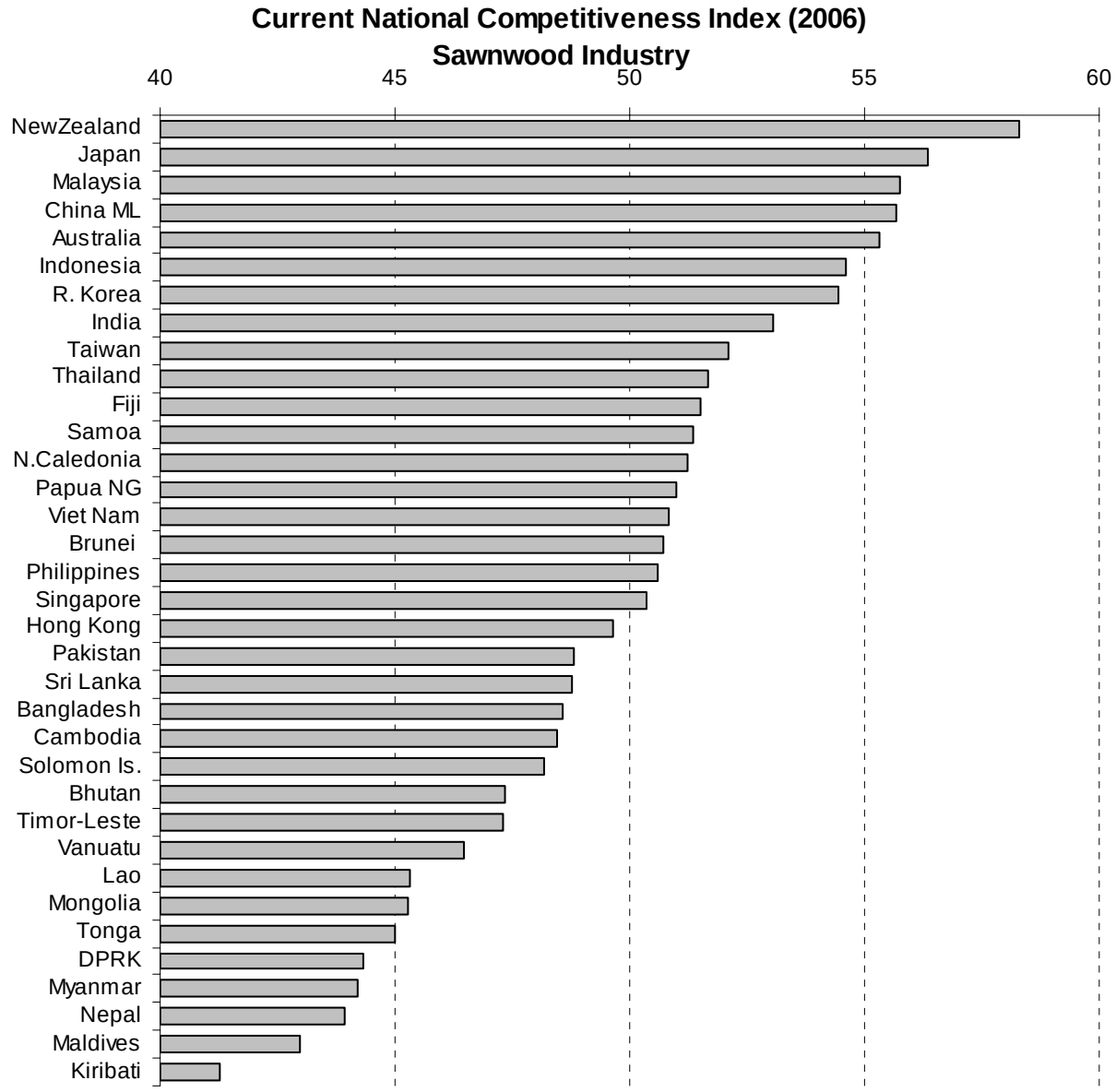



**Figure 46. Current NCI (2006) of the sawnwood industry**

**Wood-based panel (plywood and fiberwood) production**

Wood-based panel products are used for construction, civil engineering, packaging and furniture production. The most important keywords of panel production during the last several decades have been product substitution and innovation. Even though the total volume of plywood production has increased as the world has developed, the percentage of plywood over total panel production has been decreasing, as shown in Figure 47. The percentage of plywood production (including veneer sheets even though this may risk double counting) was around 80 percent in early the 1980s, but it declined to 54 percent in 2006. On the other hand, the percentage of fiberboard (including insulating board, MDF, hardboard and particle board) increased from around 20 percent in the 1980s to 46 percent in 2006.

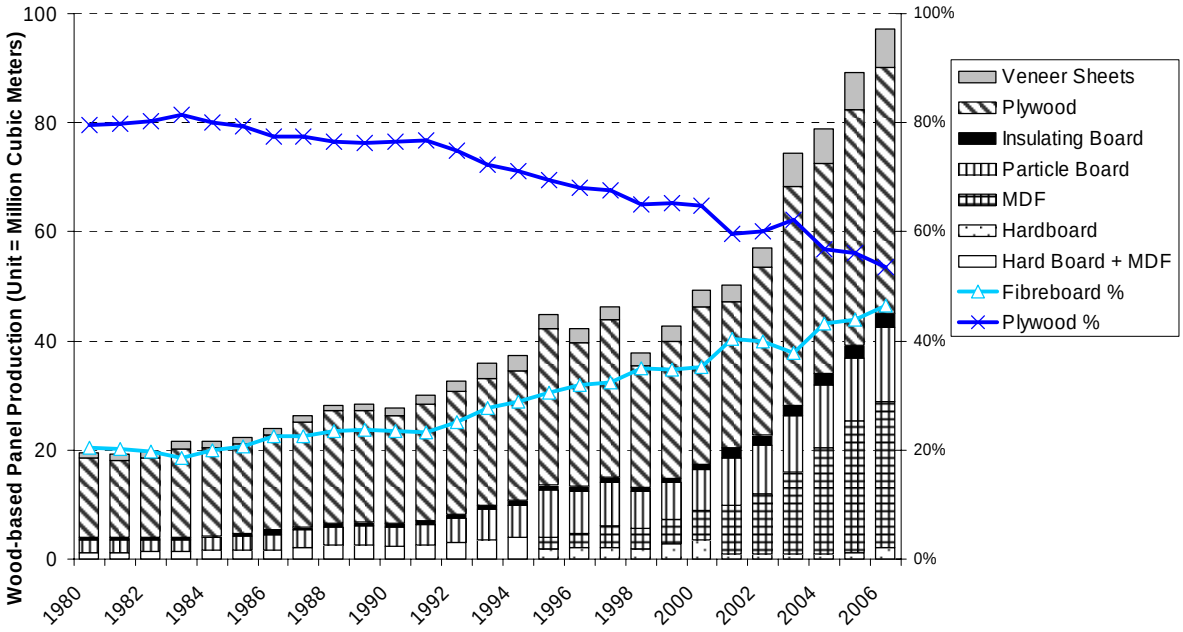



**Figure 47. World's wood-based panel production by type**
Source: FAOSTAT (2008).

Plywood is made from thin sheets of wood or veneer sheets. Generally, plywood production requires straight logs of large diameter which are more efficient than logs of small diameter. Logs are then peeled into thin sheets, and layers are glued together. Some amounts of the center core remain, but the amount of residuals depends on the sophistication of peelers. In order to maximize productivity, firms tend to utilize larger logs, which mostly come from old growth forests. Recently, many institutions and firms have invested huge amounts of money to develop efficient production methods for logs of small and medium diameter because of the difficulty in acquiring large-dimension logs. However, many firms, especially in developing nations, depend on large-dimension logs from old growth forests to produce plywood.

Fiberboard is made from wood fiber instead of sheets of veneer. Wood fiber is glued and pressed to make boards. Medium density fiberboard (MDF), oriented standard board (OSB), particle board and hard board are included in fiberboard, but the sizes of flakes or fiber to produce the board panel are different. Since it is possible to produce fiberboards from lower grade logs, such as aspen or Eucalyptus from plantations, fiberboard is sometimes considered as a green product. The size of wood diameter is not really important since wood has to be ground into small particles, strips or flakes.

Thus, competitive advantage strategies for plywood production and fiberboard production are different. Production factors will be discussed separately.

### *The global context*

World plywood production increased from 48.2 million $m^3$ in 1990 to 74.3 million $m^3$ in 2006, which is a 54.3 percent increase in 16 years (Figure 48). Although the APR experienced a sharp decline during the Asian financial crisis, as a whole the share of plywood production has increased gradually from 41 percent (19.9 million $m^3$) in 1990 to 61 percent (45.1 million $m^3$).

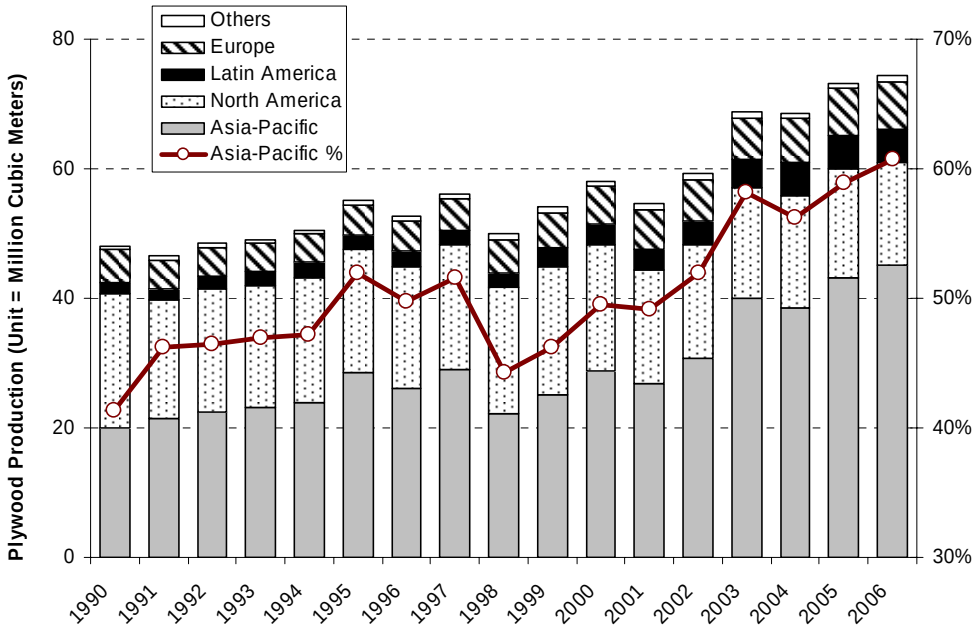



**Figure 48. World's plywood production by region**
Source: FAOSTAT (2008).

Within the APR context, China's production of plywood increased from 759 000 $m^3$ in 1990 to 27.3 million $m^3$ in 2006, which means production expanded roughly 36 times (Figure 49). Indonesia has lost its competitiveness against China, especially after 1997 when Indonesia could not establish competitive advantage during the log export ban period.

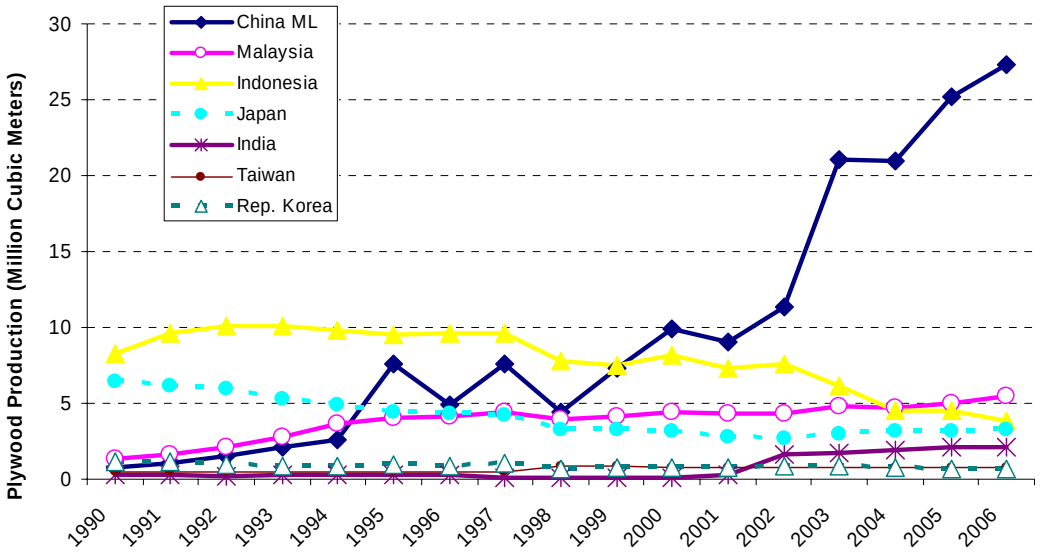



**Figure 49. Plywood production by nation in the APR**
Source: FAOSTAT (2008).

Particle board is a type of fiberboard, but made up of larger particles of wood than MDF or hardboard. OSB is categorized in this group. Although the APR has gradually increased the share of particle board production from 6 percent in 1990 to 13 percent in 2006, North America and Europe dominate the production of particle board (Figure 50).

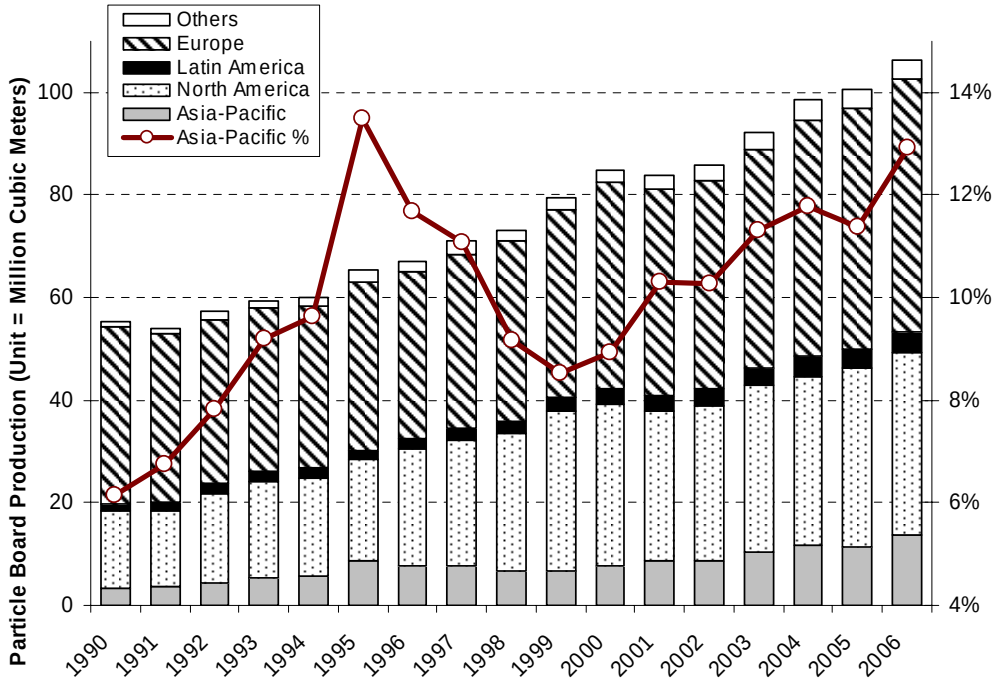



**Figure 50. World's particle board production by region**
Source: FAOSTAT (2008).

As shown on Figure 51, China has become a major particle board player in the APR. China produced only 430 000 $m^3$ in 1990, but this increased to 8.3 million $m^3$ in 2006. According to ChinaWood International, China counts around 800 particleboard manufacturing firms (EPF, 2008). Although China produces considerable amounts of particle board, China still imports particle board from other countries, especially nations in the APR. Thailand and Malaysia are

two major exporters of particle board to China, and Australia and Japan export some amounts to China as well. Yet, China's rate of importing particle wood has been decreasing at a significant pace. It is said that 80 percent of particle board in China is consumed in the furniture industry. China seems to be expanding its production line, so the biggest challenge for the particle board industry in China is raw material supply. Russia has increased tariffs, so China needs to find a stable supply source for its particle board industry. Also, it should utilize more recycled wood as raw material for particle board.

Japan produced the largest amount of particle board at 990 000 $m^3$ in 1990, but was second to China with 1.2 million $m^3$ (+26%) in 2006. Since Japan's new building standard regulates the emission of VOCs, especially formaldehyde, from building products, the Japanese housing industry needed to seek low VOC emission material, certificated by Japan Agricultural Standards (JAS). Japan produces mainly JAS-certificated particle board domestically (e.g. F four star), and the panels have an average thickness of 16.5 mm. Yet many foreign producers are targeting the Japanese market, and they have produced to meet Japanese building standards.

Australia produced 1 million $m^3$ in 2006, an increase of 39 percent since 1990. Australian particle board is mainly consumed in either the furniture industry or construction industry. Republic of Korea produced 85 000 $m^3$ in 2006, a more than five-fold increase since 1990. Republic of Korea has installed new formaldehyde emission standards for wood-based panels since 2006, which may increase low formaldehyde emission particle board production in the next several years.

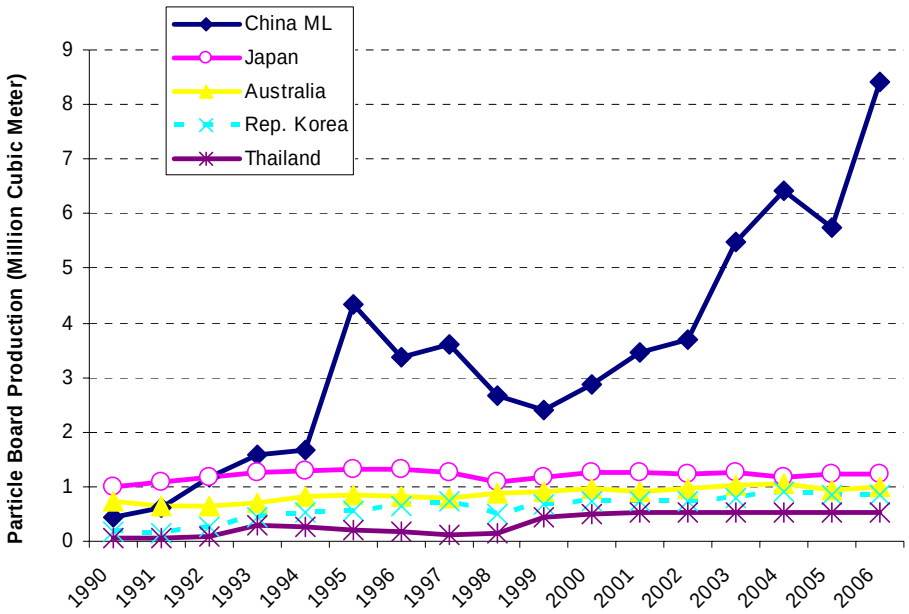



**Figure 51. Particle board production by nation in the APR**
Source: FAOSTAT (2008).

According to FAOSTAT, fiberboard only includes board made from smaller particles than particle board, such as MDF and hardboard. As shown in Figure 52, fiberboard production in the APR has become significantly important since the global share increased from 19 percent in 1990 to 48 percent in 2006. Besides the APR, the European share increased while the North American share stagnated during the period.

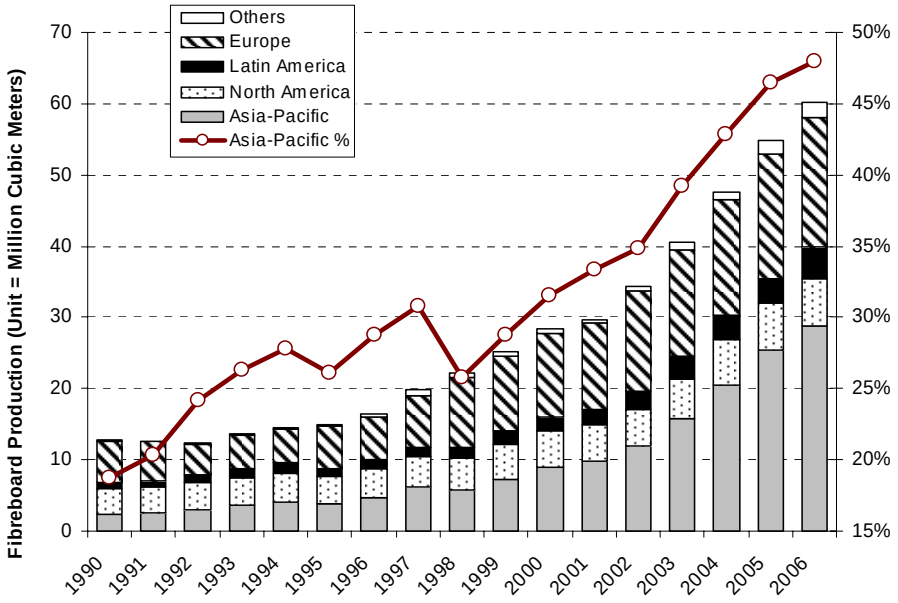



**Figure 52. World's fiberboard production by region**
Source: FAOSTAT (2008).

China's fiberboard production rapidly increased from 1.2 million $m^3$ in 1990 to 24 million $m^3$ in 2006 (Figure 53). Chinese MDF production is concentrated in the coastal area (EPF, 2008). China produces huge amounts of MDF but still imported 1.7 million $m^3$ of fiberboard from other nations in 2006, especially from South East Asian nations, of which 1.47 million $m^3$ were MDF. The furniture industry in China has boomed, so fiberboard production has also boomed as a related sector with the furniture industry.

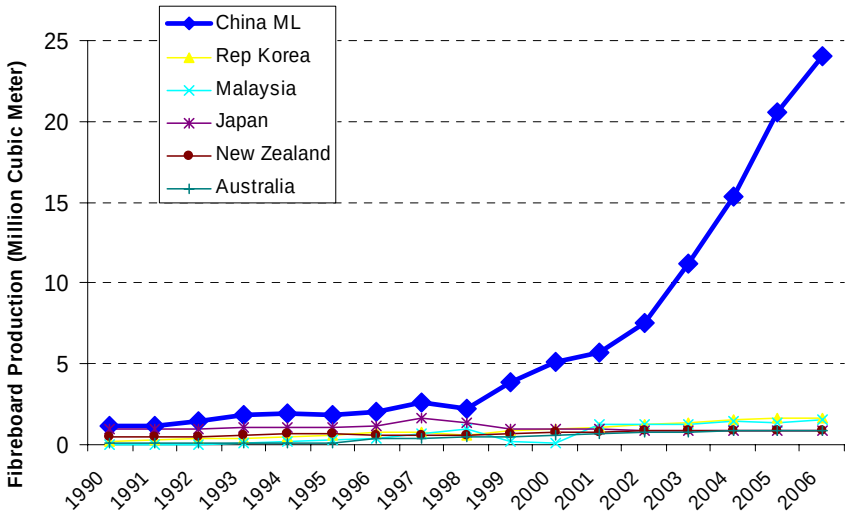



**Figure 53. Fiberboard production by nation in the APR**
Source: FAOSTAT (2008).

***Factors of panel production***

*Related upstream industry and raw material sources*

Plywood

For the plywood industry, acquiring large diameter logs is the fundamental competitive advantage. In most developed nations, where regulations are strict and law compliance is well-ensured, firms cannot access large diameter logs easily. Therefore, the costs of large diameter logs are high in developed nations. For advanced nations, rather than undertaking the risk of importing large diameter logs, importing plywood from other developing nations is generally much easier and less expensive.

On the other hand, some nations which can access large diameter logs easily have high competitive advantage in veneer sheet production. Some nations may have abundant natural resources and large old-growth trees. Or, some nations have low standards of legal compliance or do not have strong regulations. In these nations, firms can acquire large diameter logs, which assure the global competitiveness of veneer sheet production. Firms may even access artificially cheap logs sometimes.

Therefore, the current NCI of wood extraction from natural forest and the corruption perception index are utilized to estimate the factor score of the related upstream plywood industry.

Fiberboard and particle board

Size and quality of wood cannot create competitive advantage for fiberboard production. However, if firms locate close to raw material production sites, they have competitive advantage. Raw wood is cut and compressed to become particle board or fiberboard, so the volume of fiberboard should be much less than the raw material; thus the final products are much easier to transport. Plantations are one source of raw materials for fiberboard. When a nation has big plantations with fast-growing species, it should have competitive advantage. Also, natural forests can produce raw materials for fiberboard and particle board industries. Besides the logged wood, recycled wood and by-products can be utilized to produce fiberboard.

To estimate the related upstream industry of fiberboard factor, the competitiveness of wood extraction from planted forest, the competitiveness of wood extraction from natural forests and the competitiveness of sawnwood industry are integrated. Competitiveness scores were all calculated in previous sections.

*Demand condition*

Related industry and home demand are the key concept of the competitive advantage of the nation by Porter (1990). Porter empirically found the tendency for successful industries within each country to be grouped into clusters of related and supporting industries. If some sectors are competitive in a country, related sectors also gather in the same region. Clearly, the furniture industry in China has helped to boost fiberboard and plywood production. There are many downstream-related industries which utilize wood-based panels, such as the furniture industry, civil engineering industry and construction industry. So, total domestic consumption and per capita domestic consumption of these wood-based panels are used as components to estimate the demand condition factor. Besides the home demand condition, firms can always export products, so the cost of export from the Ease of Doing Business Index is also partially used to estimate the score of the demand condition factor.

Plywood

Figure 54 shows the total consumption and per capita consumption of plywood. Singapore, New Zealand, Japan and Taiwan have high per capita consumption of plywood with 99, 89, 65, 58 and 41 $m^3$ per thousand people. In terms of total consumption, China consumed 20.5 million $m^3$ in 2006, which is more than double that of Japan, which consumed 8.3 million $m^3$ in 2006 and ranked second in the region. India, Republic of Korea and Taiwan follow, having consumed 2.1, 2 and 1.3 million $m^3$ in 2006.

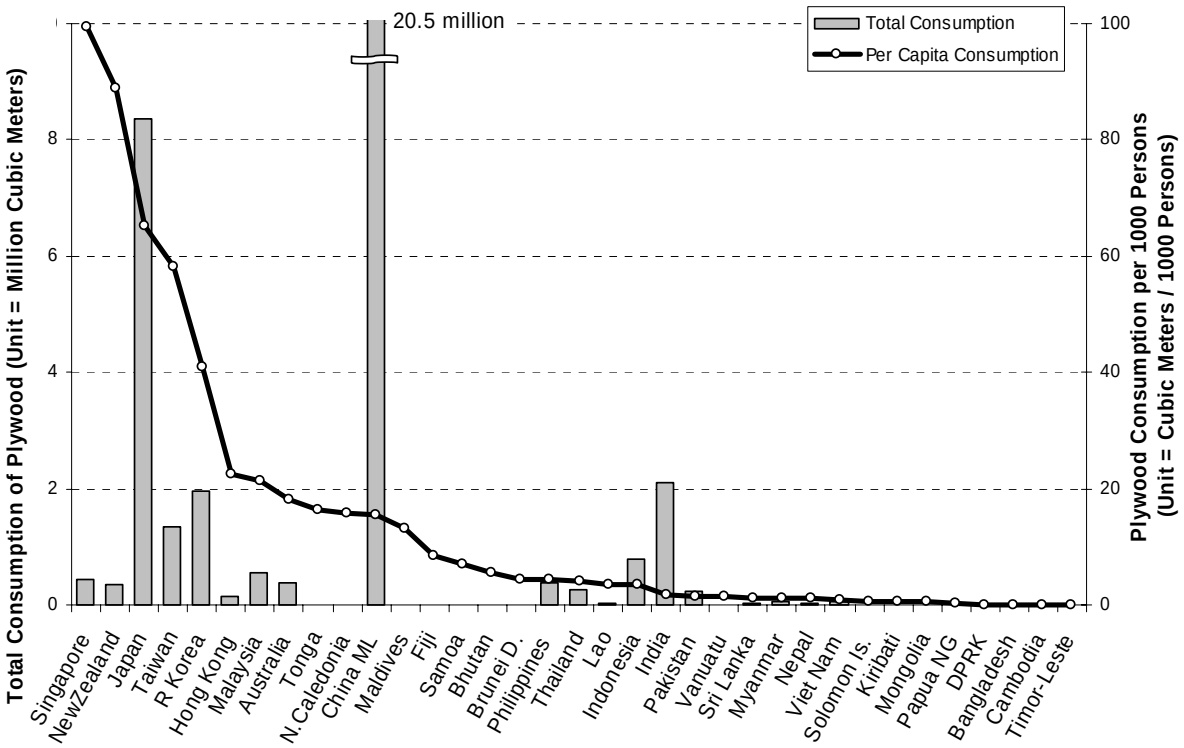



**Figure 54. Plywood consumption by nation in the APR**
Source: FAOSTAT (2008).

Fiberboard and particle board

Figure 55 shows the total and per capita consumption of fiberboard. Republic of Korea, Australia and New Zealand consumed 81, 77 and 77 $m^3$ per 1,000 people in 2006, respectively. Taiwan, China and Japan followed. In terms of total consumption, China consumed 32.8 million $m^3$ of board panels in 2006, which was 8.5 times greater than Republic of Korea, which was ranked second in the region with 3.9 million $m^3$. Japan, Australia, Viet Nam and Taiwan followed.

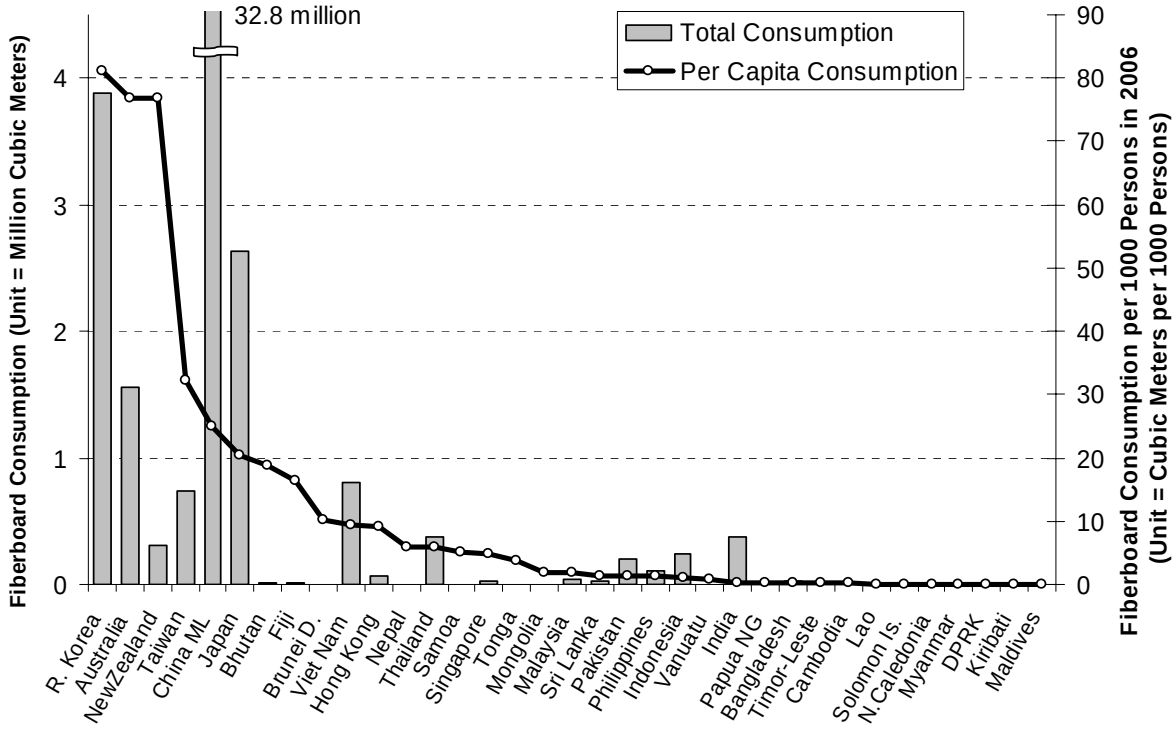



**Figure 55. Fiberboard consumption by nation in the APR**
Source: FAOSTAT (2008).

In terms of total consumption, China predominates in the consumption of wood-based panels. However, this does not mean that these wood-based panels are all consumed by end-users in China. The furniture industry absorbs significant amounts of wood-based panels in China and also ships furniture products to foreign countries. It is well known that Asian industry is export oriented. If the furniture industry experiences turmoil, the wood-panel industry in China would also experience a bumpy ride. As of 2008, the world economy started to slow down so the world's consumption of durable goods might slow down as well in the near future. This is a major uncertainty for the Chinese panel board industry to face in the next couple of years (discussed further in the next chapter). External factors may alter the shape of the Chinese wood industry.

*Energy cost*

Energy cost is the fundamental variable to determine the operational cost of manufacturing. Energy cost for the wood-panel industry is as important as that for sawnwood industry. However the plywood industry and particle and fiberboard industry have different energy requirements.

Plywood

The energy cost condition of plywood industry is quite similar to that of sawnwood. Hence, the factor score is the same as that shown in the sawnwood section. Component scores of electricity price and gasoline price are evenly weighted and the energy cost factor is estimated.

Fiberboard and particle board

Electricity is more important for fiberboard and particle board production than the plywood and sawnwood sector. Machinery to compress panel boards consumes a lot of electricity. Hence, electricity price and electrification get more weighting to estimate the factor score of the energy cost for the fiberboard and particle board industry. Electricity is the core factor of paper production's operation, so it shall be discussed in the next section. Electrification rate, electricity price and gasoline price are the components to estimate the factor score of energy for the fiberboard and particle board industry.

*Labor cost*

Similar to the sawnwood industry, labor cost is an important factor for a firm. Labor availability for manufacturing and hourly labor cost are two components of the labor cost factor score, the same as the sawnwood industry. The only difference between the plywood industry and the particle board and fiberboard industry is the intensity of labor. Plywood manufacturing is more labor intensive than the particle board and fiberboard industry, so weighting is different.

*Productivity, efficiency and innovation*

Nations where labor cost is high tend to invest more in capital. The first stage of capital investment is to bring efficiency to cut the labor cost. There are three components: productivity per employment, the efficiency index and the innovation index. The three components are combined to estimate the factor score both for the plywood industry and fiberboard and particle board industry. Value-added per capita and total value-added of the wood-processing industry are the key variables to estimate the productivity of the wood-based panel industry. Productivity is important since many firms in developed nations have recently consolidated their business to achieve higher productivity and successfully reduce the cost of production.

Plywood

Earlier it was stated that large diameter logs determine competitiveness for the plywood sector; yet, some manufacturers in advanced nations try to develop innovative technology to produce plywood efficiently from medium and small diameter logs. For example, Japanese plywood manufacturers introduced innovative machines that can peel small and medium diameter *Cryptomeria japonica* to produce veneer sheets efficiently. The more innovative the nation is, the higher competitiveness it has. The GCI innovation score is calculated annually by the WEF. As shown in Table 1, advanced nations and former NIEs have higher scores of innovation.

Fiberboard and particle board

Usually, fiberboard and particle board production need much capital to pursue competitiveness. Currently, some small-scale firms in developing nations need to consolidate and merge to gain competitive advantage since firms in North America and Europe are generally pursuing competitiveness according to economy of size. Productivity is an extremely important factor for this industry.

**Box 2. Innovation and Product Life-cycle Theory by Vernon**

There are a lot of small plywood manufacturers currently all over the world. Since plywood is one of the simplest forest products, so the governments of many nations encourage people to establish small sawmills to increase employment and to boost the economy. However, nations where labor costs are inexpensive tend not to invest enough money since labor-intensive operations can produce products inexpensively; therefore, they have competitiveness. Yet, sophisticated machinery can produce plywood much more efficiently than smaller mills because of the economy of size, so labor-intensive small plywood mills usually lose competitiveness over time.

As shown in Figure 56, the production of plywood has followed the life-cycle curve by Vernon (1966). This product life-cycle theory proposes that production gradually moves away from more developed nations to less developed nations as the product life-cycle (e.g. introduction, growth, maturity and decline) shifts in each country. Japanese plywood production increased sharply in the 1960s, and then peaked out in the 1970s. Republic of Korea increased production from the late 1960s, but peaked out at the end of the 1970s. Indonesia has increased production sharply in the early 1980s, but peaked out in the early 1990s. Malaysia has increased its production since the late 1980s. China has increased its production capacity especially since the beginning of this millennium. It may be possible to explain this trend from the supply side. Plywood productions are totally dependent on manpower, so as a nation gets wealthier and production cost increases, the industry gradually loses the competitiveness of production. Currently, China totally dominates the production of plywood, but the labor cost is expected to increase sharply in the next several years. Unless China invests in capital to achieve economy of size, competitiveness in plywood manufacturing will lose its edge against nations where labor costs are cheaper.

Firms in nations where large dimension logs are not abundant need to find ways to produce plywood from small and medium diameter wood. Whenever demand or supply shock shakes the industry, affected nations suddenly tend to lose competitive advantage. Also, as nations develop, labor costs tend to inflate and firms need to prepare for the next level. Capital investment is always very important for a nation to hold competitive edge.

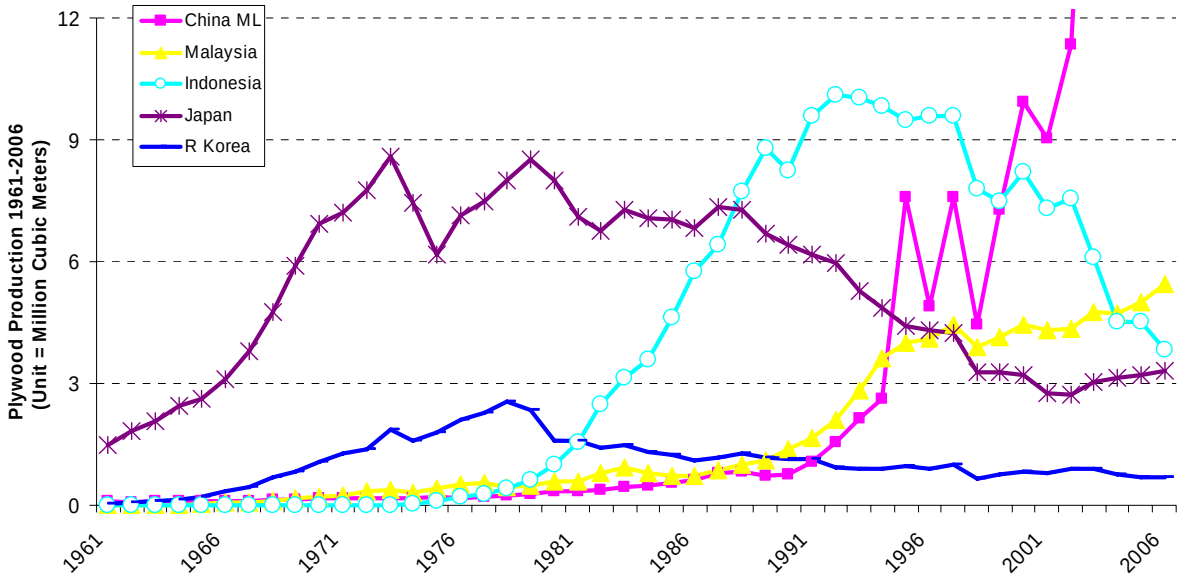



**Figure 56. Plywood production 1981-2006**

***Current national competitiveness index of the wood-panel industry***

Including all the factors discussed above, the current NCI of the wood panel industry was estimated. Although, plywood, fiberboard and particle board are the same wood-based panels,

plywood and other wood-based panels (fiberboard and particle board) are estimated separately because the factors influencing competitiveness are very dissimilar as discussed above. There are some missing factor values and these values were estimated by regression with other factors which should have high correlation or by averaging the number of similar nations. Each factor was standardized and calculated as the standard T score. Of course, companies always find ways to maximize their competitive advantages strategically, so the NCI shown here is highly simplified compared to reality.

*Plywood industry*

The factor components of the plywood industry are summarized and shown in relation with Porter's framework in Figure 57. Weightings to estimate the overall competitiveness of the plywood industry are shown in Table 10.

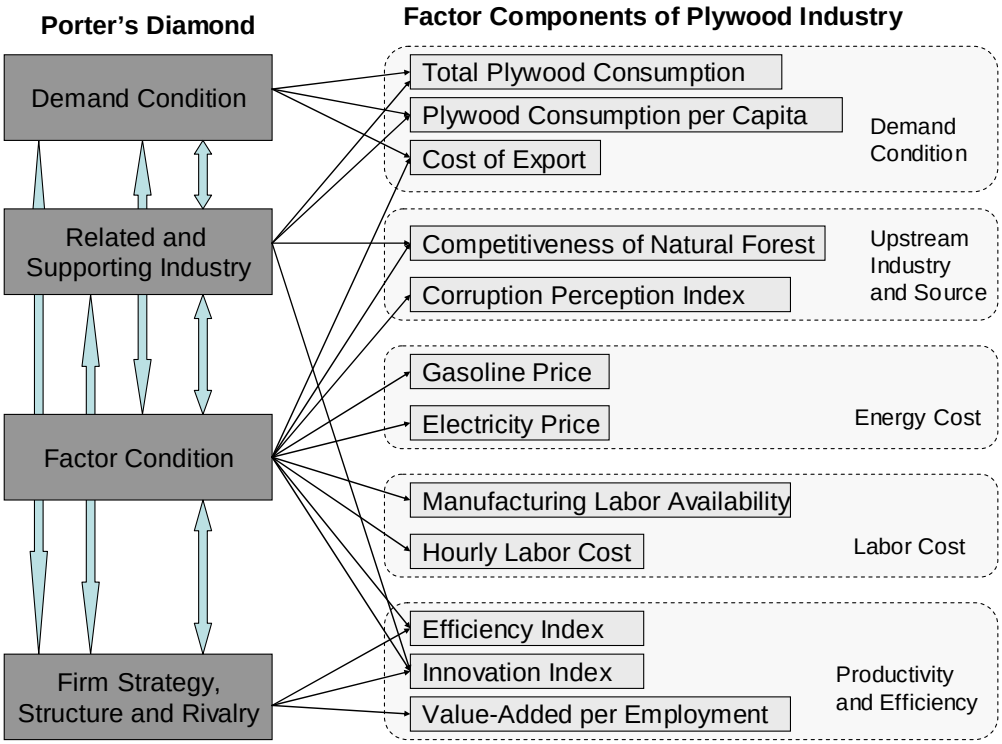



**Figure 57. Relationships between Porter's diamond and NCI factor components of the plywood industry**

**Table 10. Weightings to estimate the overall competitiveness of the plywood industry**

| | | | |
|---|---|---|---|
| 10% | Upstream Related Industry and Source | Competitiveness of Natural Forest | 6.7% |
| | | Corruption Perception Index | 3.3% |
| 20% | Demand Condition | Total Plywood Consumption | 5% |
| | | Plywood Consumption per capita | 5% |
| | | Cost of Export | 10% |
| 10% | Energy Cost | Gasoline Price | 5% |
| | | Electricity Price | 5% |
| 20% | Labor Cost | Manufacturing Labor Availability | 6.7% |
| | | Hourly Labor Cost | 13.3% |
| 40% | Productivity | Value-Added per Employment | 20% |
| | | Efficiency Index | 10% |
| | | Innovation Index | 10% |

**Table 11. NCI (2006) for the plywood industry in the APR**

| | Overall Current Competitiveness of Plywood Industry (2006) | Related Industry and Source | | | Demand Condition | | | | Energy Cost | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Related Industry (10%) | Natural | Corruption | Demand Condition (20%) | Total Plywood Consumption | Plywood Consumption per Capita | Export | Energy Cost (10%) | Gasoline Price | Electricity Price |
| Australia | 53 | 48 | 57 | 30 | 50 | 48 | 51 | 50 | 54 | 49 | 58 |
| Bangladesh | 48 | 53 | 50 | 58 | 49 | 47 | 44 | 52 | 50 | 55 | 44 |
| Bhutan | 48 | 50 | 52 | 45 | 46 | 47 | 46 | 45 | 46 | 51 | 42 |
| Brunei | 50 | 43 | 49 | 33 | 53 | 47 | 46 | 59 | 67 | 72 | 61 |
| Cambodia | 49 | 56 | 55 | 60 | 50 | 47 | 44 | 55 | 44 | 46 | 42 |
| China ML | 56 | 53 | 53 | 52 | 70 | 104 | 50 | 62 | 60 | 59 | 61 |
| DPR Korea | 45 | 54 | 51 | 60 | 38 | 47 | 44 | 31 | 41 | 58 | 25 |
| Fiji | 51 | 53 | 53 | 53 | 53 | 47 | 47 | 58 | 43 | 44 | 42 |
| HK | 51 | 28 | 25 | 33 | 55 | 47 | 53 | 59 | 40 | 20 | 60 |
| India | 52 | 53 | 53 | 53 | 51 | 53 | 45 | 53 | 50 | 46 | 54 |
| Indonesia | 56 | 56 | 56 | 56 | 52 | 49 | 45 | 56 | 62 | 63 | 61 |
| Japan | 56 | 46 | 51 | 36 | 59 | 70 | 70 | 49 | 43 | 43 | 42 |
| Kiribati | 42 | 35 | 25 | 54 | 41 | 47 | 44 | 36 | 44 | 45 | 42 |
| Lao | 46 | 54 | 52 | 59 | 39 | 47 | 45 | 32 | 60 | 52 | 67 |
| Malaysia | 56 | 52 | 56 | 46 | 56 | 49 | 53 | 61 | 61 | 65 | 58 |
| Maldives | 45 | 35 | 25 | 55 | 46 | 47 | 49 | 44 | 50 | 45 | 54 |
| Mongolia | 44 | 51 | 50 | 55 | 38 | 47 | 44 | 31 | 47 | 51 | 42 |
| Myanmar | 44 | 56 | 53 | 62 | 38 | 47 | 44 | 31 | 42 | 60 | 25 |
| Nepal | 44 | 52 | 50 | 56 | 41 | 47 | 44 | 35 | 46 | 49 | 42 |
| New Caledonia | 51 | 45 | 46 | 42 | 52 | 47 | 50 | 55 | 44 | 45 | 42 |
| New Zealand | 55 | 42 | 49 | 28 | 59 | 48 | 80 | 55 | 54 | 48 | 60 |
| Pakistan | 49 | 53 | 51 | 57 | 53 | 48 | 45 | 59 | 50 | 46 | 54 |
| Papua NG | 51 | 56 | 54 | 59 | 52 | 47 | 44 | 58 | 52 | 46 | 58 |
| Philippines | 51 | 54 | 53 | 58 | 50 | 48 | 46 | 53 | 53 | 56 | 50 |
| R of Korea | 55 | 44 | 44 | 44 | 55 | 52 | 60 | 54 | 40 | 22 | 59 |
| Samoa | 50 | 49 | 49 | 49 | 48 | 47 | 47 | 48 | 48 | 54 | 42 |
| Singapore | 55 | 26 | 25 | 28 | 64 | 48 | 84 | 62 | 52 | 50 | 55 |
| Solomon Islands | 48 | 53 | 52 | 55 | 46 | 47 | 44 | 47 | 44 | 45 | 42 |
| Sri Lanka | 49 | 50 | 49 | 54 | 49 | 47 | 44 | 53 | 53 | 51 | 54 |
| Taiwan | 55 | 47 | 49 | 43 | 57 | 51 | 67 | 54 | 57 | 53 | 60 |
| Thailand | 52 | 54 | 54 | 52 | 52 | 48 | 46 | 57 | 58 | 58 | 57 |
| Timor-Leste | 47 | 52 | 48 | 58 | 47 | 47 | 44 | 49 | 45 | 48 | 42 |
| Tonga | 46 | 36 | 25 | 57 | 54 | 47 | 50 | 59 | 44 | 46 | 42 |
| Vanuatu | 46 | 50 | 47 | 55 | 38 | 47 | 44 | 31 | 50 | 45 | 54 |
| Viet Nam | 50 | 53 | 51 | 56 | 51 | 47 | 44 | 56 | 58 | 60 | 57 |

| | Labor Cost | | | Productivity | | | |
|---|---|---|---|---|---|---|---|
| | Labor Cost (20%) | Hourly Labor Cost | Manufacturing Labor Availability | Productivity (40%) | Innovation | Efficiency | Value-Added per Employment |
| Australia | 28 | 15 | 55 | 68 | 60 | 67 | 74 |
| Bangladesh | 56 | 55 | 59 | 43 | 39 | 39 | 47 |
| Bhutan | 49 | 55 | 37 | 48 | 49 | 49 | 47 |
| Brunei | 34 | 29 | 46 | 54 | 52 | 61 | 51 |
| Cambodia | 54 | 55 | 51 | 44 | 40 | 38 | 50 |
| China ML | 59 | 54 | 69 | 47 | 49 | 46 | 47 |
| DPR Korea | 56 | 55 | 58 | 41 | 40 | 40 | 42 |
| Fiji | 49 | 54 | 38 | 52 | 47 | 46 | 58 |
| HK | 48 | 48 | 48 | 60 | 64 | 66 | 54 |
| India | 59 | 55 | 66 | 49 | 59 | 54 | 42 |
| Indonesia | 58 | 56 | 62 | 55 | 52 | 52 | 58 |
| Japan | 40 | 28 | 62 | 68 | 76 | 66 | 65 |
| Kiribati | 48 | 55 | 34 | 42 | 46 | 46 | 38 |
| Lao | 52 | 55 | 45 | 40 | 42 | 43 | 38 |
| Malaysia | 54 | 52 | 57 | 56 | 62 | 61 | 51 |
| Maldives | 50 | 54 | 40 | 43 | 48 | 48 | 38 |
| Mongolia | 52 | 55 | 46 | 40 | 38 | 43 | 40 |
| Myanmar | 55 | 55 | 55 | 39 | 41 | 41 | 37 |
| Nepal | 54 | 55 | 51 | 38 | 38 | 37 | 40 |
| New Caledonia | 45 | 48 | 40 | 56 | 54 | 56 | 57 |
| New Zealand | 39 | 33 | 50 | 65 | 60 | 64 | 67 |
| Pakistan | 57 | 55 | 60 | 42 | 48 | 42 | 40 |
| Papua NG | 52 | 55 | 46 | 49 | 42 | 41 | 57 |
| Philippines | 56 | 55 | 58 | 48 | 46 | 49 | 48 |
| R of Korea | 41 | 33 | 57 | 68 | 64 | 62 | 74 |
| Samoa | 48 | 55 | 36 | 53 | 49 | 49 | 57 |
| Singapore | 46 | 44 | 51 | 62 | 65 | 69 | 57 |
| Solomon Islands | 50 | 55 | 39 | 49 | 41 | 41 | 57 |
| Sri Lanka | 55 | 56 | 55 | 45 | 46 | 45 | 44 |
| Taiwan | 51 | 48 | 57 | 58 | 69 | 66 | 48 |
| Thailand | 55 | 54 | 58 | 49 | 54 | 54 | 45 |
| Timor-Leste | 49 | 55 | 36 | 45 | 31 | 34 | 57 |
| Tonga | 47 | 55 | 33 | 43 | 49 | 49 | 38 |
| Vanuatu | 48 | 55 | 35 | 47 | 47 | 46 | 48 |
| Viet Nam | 57 | 55 | 60 | 43 | 43 | 44 | 42 |

Figure 58 shows the current NCI of the plywood industry. Four countries, Malaysia, China, Japan and Indonesia are the highest ranked nations of competitiveness. Labor cost and

demand condition influence Chinese competitiveness. On the other hand, competitiveness of related industry and ease to acquire raw material mainly give Indonesia and Malaysia competitive edge. Productivity, efficiency and innovation drive Japan's competitiveness. Republic of Korea, New Zealand, Taiwan and Singapore follow.

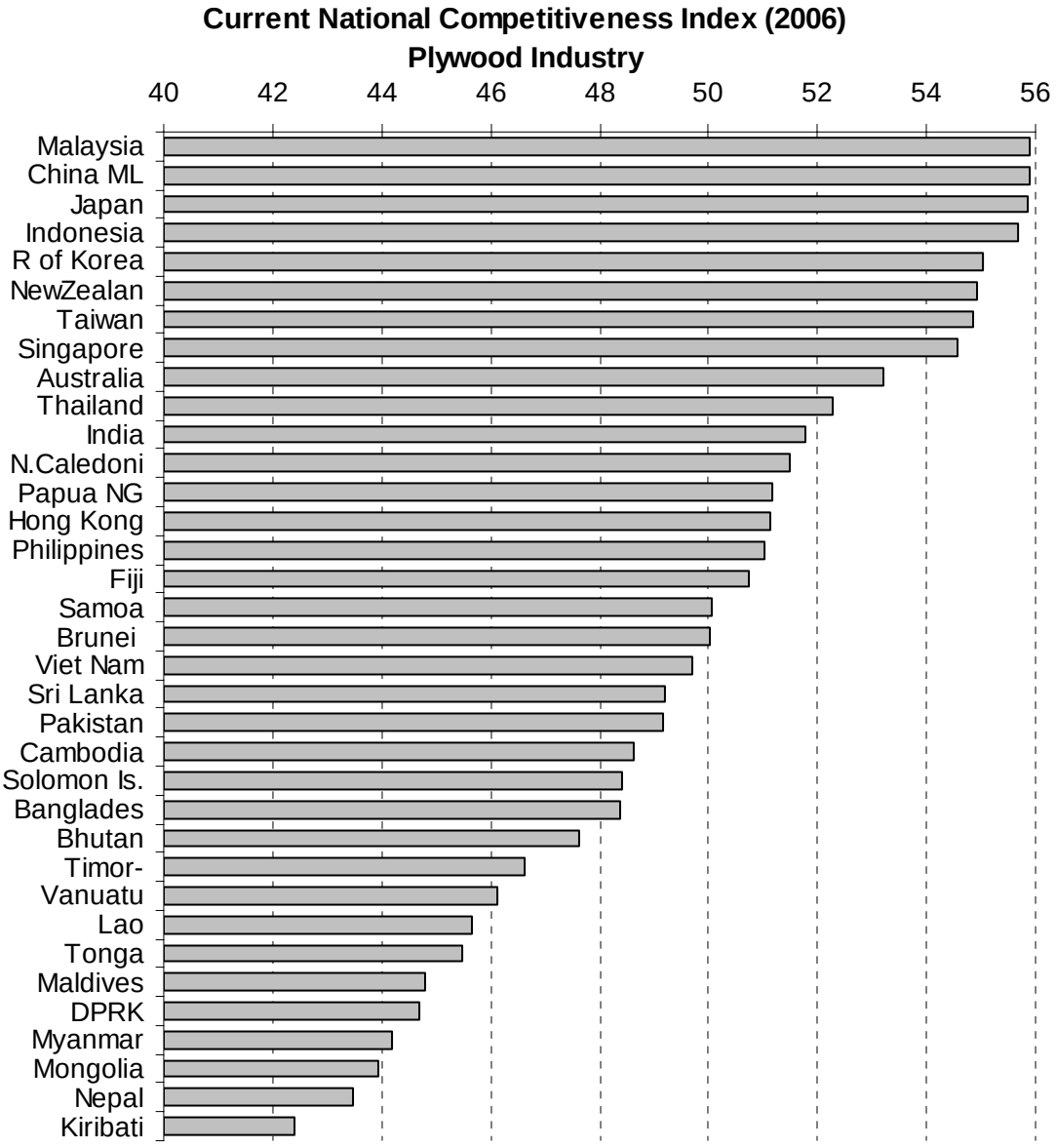



**Figure 58. Current NCI (2006) of the plywood industry**

*Fiberboard and particle board industry*

The factor components of the plywood industry are summarized and shown in relation with Porter's framework in Figure 59. Weightings to estimate the overall competitiveness of the fiberboard and particle board industry are shown in Table 12.

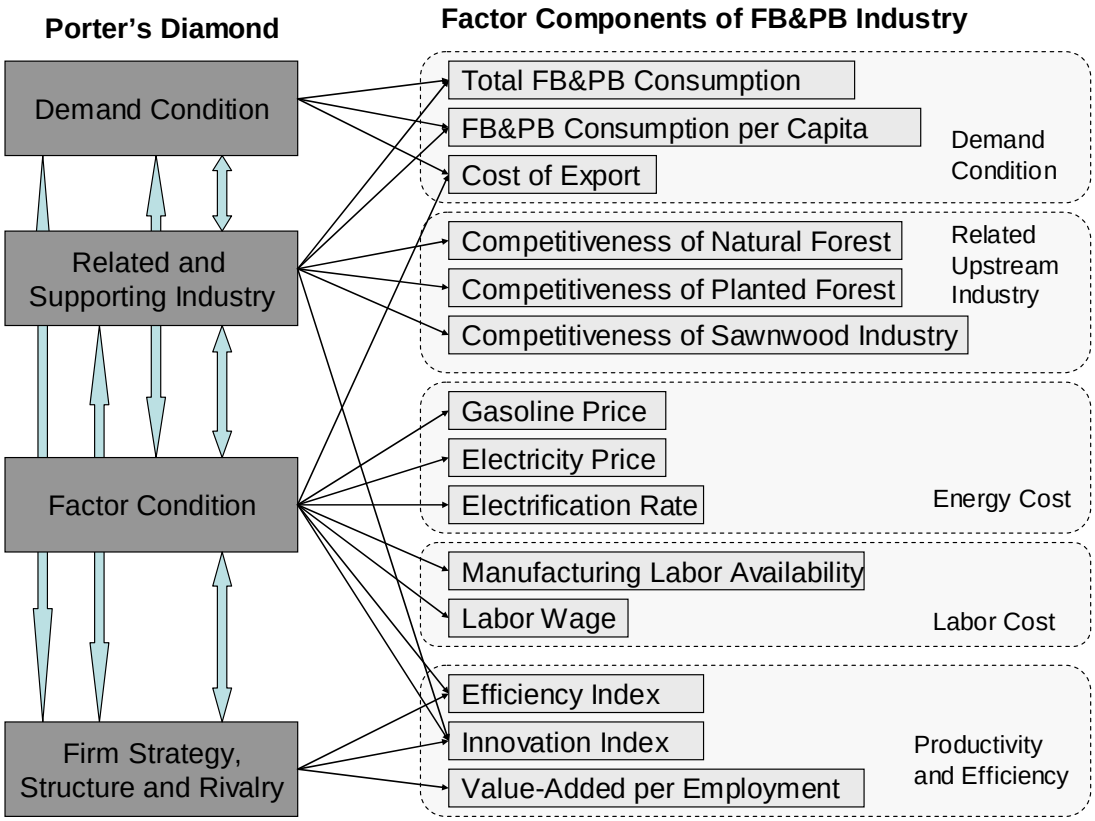



**Figure 59. Relationships between Porter's diamond and NCI factor components of the fiberboard and particle board industry**

**Table 12. Weightings to estimate the overall competitiveness of the fiberboard and particle board industry**

| | | | |
|---|---|---|---|
| 20% | Related Upstream Industry | Competitiveness of Natural Forest | 4% |
| | | Competitiveness of Planted Forest | 12% |
| | | Competitiveness of Sawnwood Industry | 4% |
| 30% | Demand Condition | Total Fiber Board Consumption | 10% |
| | | Fiber Board Consumption per Capita | 10% |
| | | Cost of Export | 10% |
| 10% | Energy Cost | Gasoline Price | 2.5% |
| | | Electricity Price | 5% |
| | | Electrification Rate | 2.5% |
| 10% | Labor Cost | Manufacturing Labor Availability | 3.3% |
| | | Hourly Labor Cost | 6.7% |
| 30% | Productivity | Value-Added per Employment | 10% |
| | | Innovation Index | 10% |
| | | Efficiency Index | 10% |

**Table 13. NCI (2006) of the fiberboard and particle board industry in the APR**

| | Overall Current Competitiveness of Fibreboard Industry (2006) | Related Upstream Industry | | | | Demand Condition | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Related Upstream Industry (20%) | Competitiveness of Natural Forest | Competitiveness of Plantation | Competitiveness of Sawnwood | Demand Condition (30%) | Total Fibreboard Consumption | Per Capita Fibreboard Consumption | Cost ofExport |
| Australia | 58 | 58 | 57 | 60 | 55 | 60 | 51 | 79 | 50 |
| Bangladesh | 47 | 49 | 50 | 49 | 49 | 48 | 48 | 45 | 52 |
| Bhutan | 48 | 48 | 52 | 48 | 47 | 49 | 48 | 53 | 45 |
| Brunei D | 52 | 49 | 49 | 49 | 51 | 52 | 48 | 49 | 59 |
| Cambodia | 47 | 50 | 55 | 49 | 48 | 49 | 48 | 45 | 55 |
| China ML | 60 | 56 | 53 | 58 | 56 | 75 | 107 | 56 | 62 |
| DPRK | 43 | 44 | 51 | 41 | 44 | 41 | 48 | 45 | 31 |
| Fiji | 51 | 54 | 53 | 56 | 52 | 53 | 48 | 52 | 58 |
| Hong Kong | 50 | 30 | 25 | 25 | 50 | 52 | 48 | 49 | 59 |
| India | 51 | 53 | 53 | 53 | 53 | 49 | 48 | 45 | 53 |
| Indonesia | 54 | 56 | 56 | 57 | 55 | 50 | 48 | 45 | 56 |
| Japan | 55 | 52 | 51 | 50 | 56 | 52 | 52 | 54 | 49 |
| Kiribati | 41 | 28 | 25 | 25 | 41 | 43 | 48 | 45 | 36 |
| Lao | 45 | 48 | 52 | 48 | 45 | 41 | 48 | 45 | 32 |
| Malaysia | 56 | 56 | 56 | 56 | 56 | 51 | 48 | 45 | 61 |
| Maldives | 43 | 29 | 25 | 25 | 43 | 46 | 48 | 45 | 44 |
| Mongolia | 44 | 47 | 50 | 47 | 45 | 41 | 48 | 45 | 31 |
| Myanmar | 43 | 48 | 53 | 47 | 44 | 41 | 48 | 45 | 31 |
| Nepal | 43 | 46 | 50 | 46 | 44 | 43 | 48 | 45 | 35 |
| New Caledonia | 50 | 49 | 46 | 49 | 51 | 50 | 48 | 47 | 55 |
| NewZealand | 58 | 58 | 49 | 60 | 58 | 61 | 48 | 79 | 55 |
| Pakistan | 49 | 50 | 51 | 50 | 49 | 51 | 48 | 45 | 59 |
| Papua NG | 50 | 51 | 54 | 51 | 51 | 50 | 48 | 45 | 58 |
| Philippines | 50 | 52 | 53 | 53 | 51 | 49 | 48 | 45 | 53 |
| R. Korea | 59 | 53 | 44 | 55 | 54 | 63 | 55 | 81 | 54 |
| Samoa | 49 | 49 | 49 | 48 | 51 | 48 | 48 | 47 | 48 |
| Singapore | 51 | 30 | 25 | 25 | 50 | 52 | 48 | 47 | 62 |
| Solomon Is. | 47 | 47 | 52 | 45 | 48 | 47 | 48 | 45 | 47 |
| Sri Lanka | 49 | 49 | 49 | 49 | 49 | 49 | 48 | 45 | 53 |
| Taiwan | 56 | 51 | 49 | 51 | 52 | 54 | 49 | 59 | 54 |
| Thailand | 53 | 56 | 54 | 59 | 52 | 51 | 48 | 47 | 57 |
| Timor-Leste | 45 | 46 | 48 | 45 | 47 | 47 | 48 | 45 | 49 |
| Tonga | 44 | 29 | 25 | 25 | 45 | 51 | 48 | 46 | 59 |
| Vanuatu | 45 | 45 | 47 | 44 | 46 | 41 | 48 | 45 | 31 |
| Viet Nam | 50 | 52 | 51 | 53 | 51 | 51 | 49 | 49 | 56 |

| | Energy Cost | | | | Labor Cost | | | Productivity | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Energy Cost (10%) | Electricity Price | Gasoline Price | Electrification Rate | Labor Cost (10%) | Hourly Labor Cost | Manufacturing Labor Availability | Productivity (30%) | Innovation | Efficiency | Value-Added per Employment |
| Australia | 57 | 58 | 49 | 62 | 28 | 15 | 55 | 67 | 60 | 67 | 74 |
| Bangladesh | 45 | 44 | 55 | 35 | 56 | 55 | 59 | 41 | 39 | 39 | 47 |
| Bhutan | 46 | 42 | 51 | 49 | 49 | 55 | 37 | 48 | 49 | 49 | 47 |
| Brunei D | 64 | 61 | 72 | 62 | 34 | 29 | 46 | 55 | 52 | 61 | 51 |
| Cambodia | 40 | 42 | 46 | 31 | 54 | 55 | 51 | 43 | 40 | 38 | 50 |
| China ML | 60 | 61 | 59 | 62 | 59 | 54 | 69 | 47 | 49 | 46 | 47 |
| DPRK | 37 | 25 | 58 | 41 | 56 | 55 | 58 | 41 | 40 | 40 | 42 |
| Fiji | 44 | 42 | 44 | 48 | 49 | 54 | 38 | 50 | 47 | 46 | 58 |
| Hong Kong | 50 | 60 | 20 | 62 | 48 | 48 | 48 | 61 | 64 | 66 | 54 |
| India | 50 | 54 | 46 | 45 | 59 | 55 | 66 | 51 | 59 | 54 | 42 |
| Indonesia | 57 | 61 | 63 | 44 | 58 | 56 | 62 | 54 | 52 | 52 | 58 |
| Japan | 47 | 42 | 43 | 62 | 40 | 28 | 62 | 69 | 76 | 66 | 65 |
| Kiribati | 44 | 42 | 45 | 46 | 48 | 55 | 34 | 43 | 46 | 46 | 38 |
| Lao | 57 | 67 | 52 | 43 | 52 | 55 | 45 | 41 | 42 | 43 | 38 |
| Malaysia | 60 | 58 | 65 | 61 | 54 | 52 | 57 | 58 | 62 | 61 | 51 |
| Maldives | 50 | 54 | 45 | 48 | 50 | 54 | 40 | 45 | 48 | 48 | 38 |
| Mongolia | 46 | 42 | 51 | 48 | 52 | 55 | 46 | 40 | 38 | 43 | 40 |
| Myanmar | 34 | 25 | 60 | 27 | 55 | 55 | 55 | 40 | 41 | 41 | 37 |
| Nepal | 42 | 42 | 49 | 36 | 54 | 55 | 51 | 38 | 38 | 37 | 40 |
| New Caledonia | 45 | 42 | 45 | 50 | 45 | 48 | 40 | 55 | 54 | 56 | 57 |
| NewZealand | 57 | 60 | 48 | 62 | 39 | 33 | 50 | 64 | 60 | 64 | 67 |
| Pakistan | 50 | 54 | 46 | 44 | 57 | 55 | 60 | 43 | 48 | 42 | 40 |
| Papua NG | 51 | 58 | 46 | 43 | 52 | 55 | 46 | 47 | 42 | 41 | 57 |
| Philippines | 53 | 50 | 56 | 55 | 56 | 55 | 58 | 48 | 46 | 49 | 48 |
| R. Korea | 50 | 59 | 22 | 62 | 41 | 33 | 57 | 66 | 64 | 62 | 74 |
| Samoa | 47 | 42 | 54 | 49 | 48 | 55 | 36 | 52 | 49 | 49 | 57 |
| Singapore | 55 | 55 | 50 | 62 | 46 | 44 | 51 | 64 | 65 | 69 | 57 |
| Solomon Is. | 43 | 42 | 45 | 42 | 50 | 55 | 39 | 46 | 41 | 41 | 57 |
| Sri Lanka | 52 | 54 | 51 | 49 | 55 | 56 | 55 | 45 | 46 | 45 | 44 |
| Taiwan | 59 | 60 | 53 | 62 | 51 | 48 | 57 | 61 | 69 | 66 | 48 |
| Thailand | 59 | 57 | 58 | 62 | 55 | 54 | 58 | 51 | 54 | 54 | 45 |
| Timor-Leste | 44 | 42 | 48 | 44 | 49 | 55 | 36 | 41 | 31 | 34 | 57 |
| Tonga | 45 | 42 | 46 | 49 | 47 | 55 | 33 | 45 | 49 | 49 | 38 |
| Vanuatu | 50 | 54 | 45 | 47 | 48 | 55 | 35 | 47 | 47 | 46 | 48 |
| Viet Nam | 57 | 57 | 60 | 56 | 57 | 55 | 60 | 43 | 43 | 44 | 42 |

Figure 60 shows the current competitiveness of the fiberboard and particle board industry. China is the most competitive nation in the region. Republic of Korea, New Zealand, and Australia follow China. Taiwan, Malaysia and Japan are also somewhat competitive.

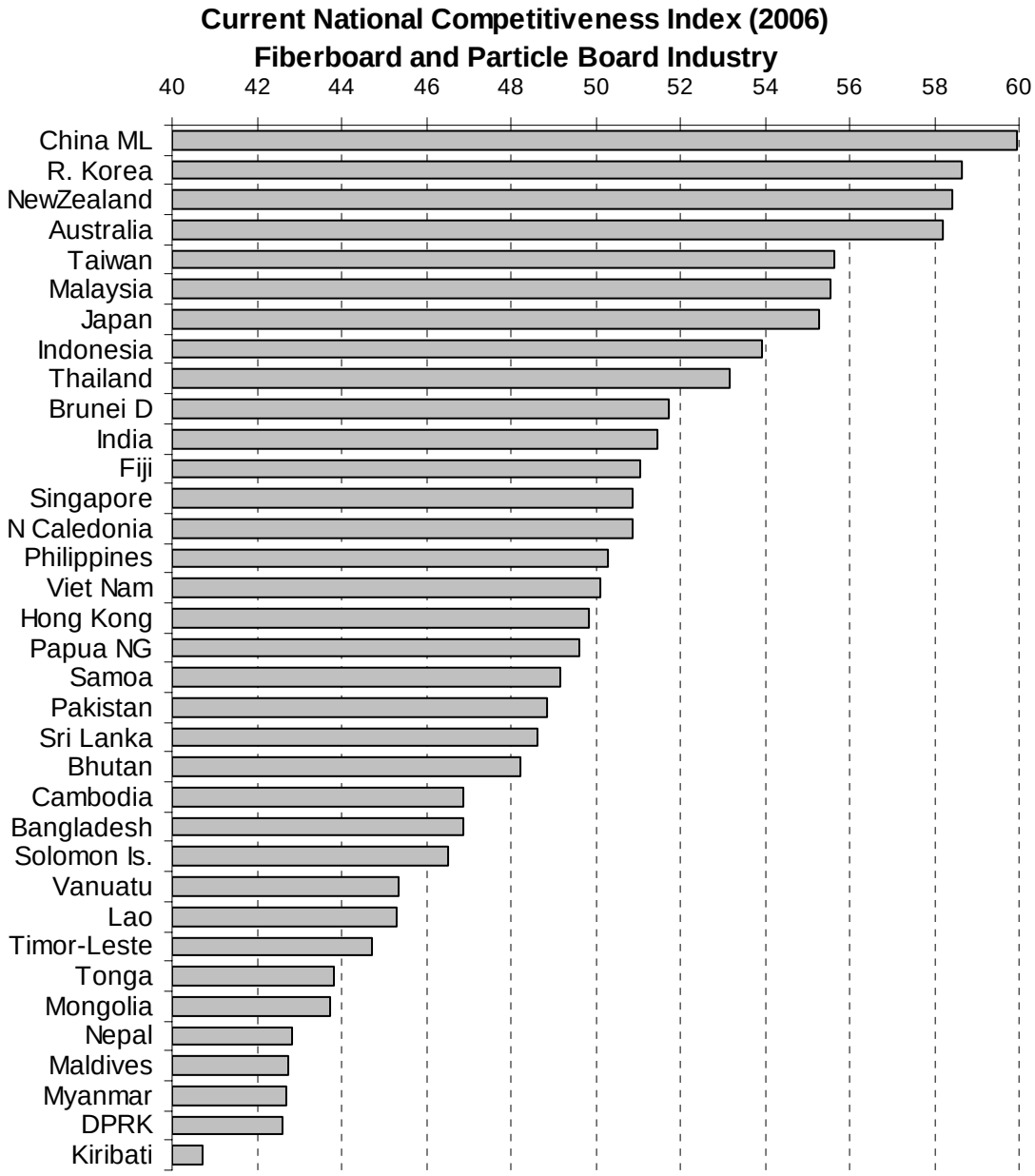



**Figure 60. Current NCI (2006) of the fiberboard and particle board industry**

**Pulp and paper production**

The pulp and paper industry is quite different from other labor-intensive wood product industries.

***Pulp and paper production in the global context***

Paper and paper board production in the APR increased from 58.6 million tonnes in 1990 to 123 tonnes in 2006 (Figure 61). So, the region's share in the globe increased from 24 to 34 percent in the same period. On the other hand, paper and paper board production in North America declined from 37 percent in 1990 to 28 percent in 2006 and that in Europe has hovered around 30 percent constantly.

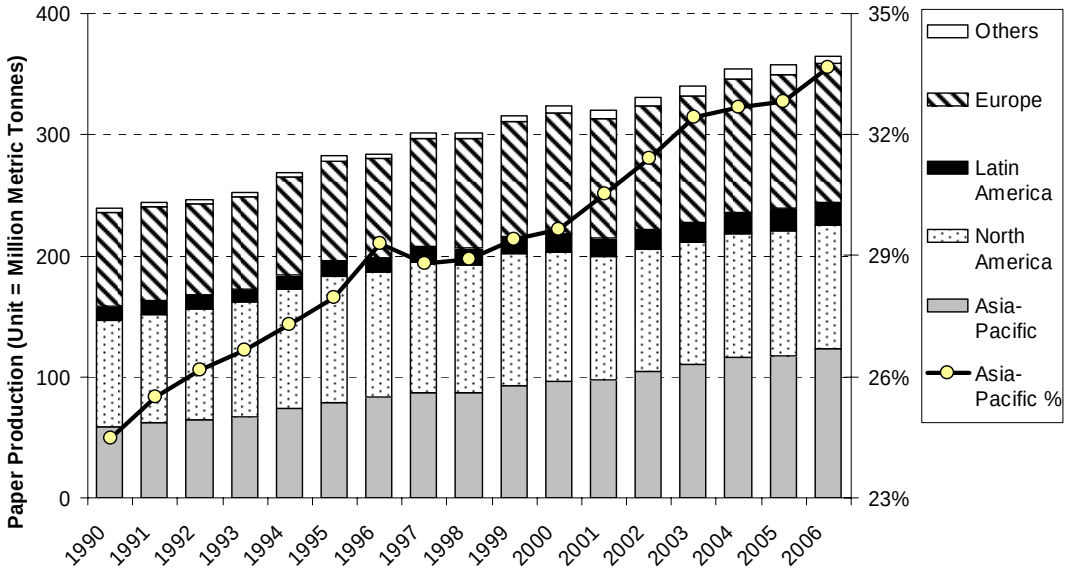



**Figure 61. World's paper and paper board production by region**
Source: FAOSTAT (2008).

In the APR (Figure 62), China increased the production of paper and paper board from 14 million tonnes in 1990 to 53.5 million tonnes in 2006, which means it has almost quadrupled its production capacity in the last 16 years. Paper and paper board production in Japan was ranked second in 2006 and has hovered constantly around 30 million tonnes since 1990. Republic of Korea is ranked number three and produced 11 million tonnes in 2006, which is 144 percent more than the production capacity in 1990.

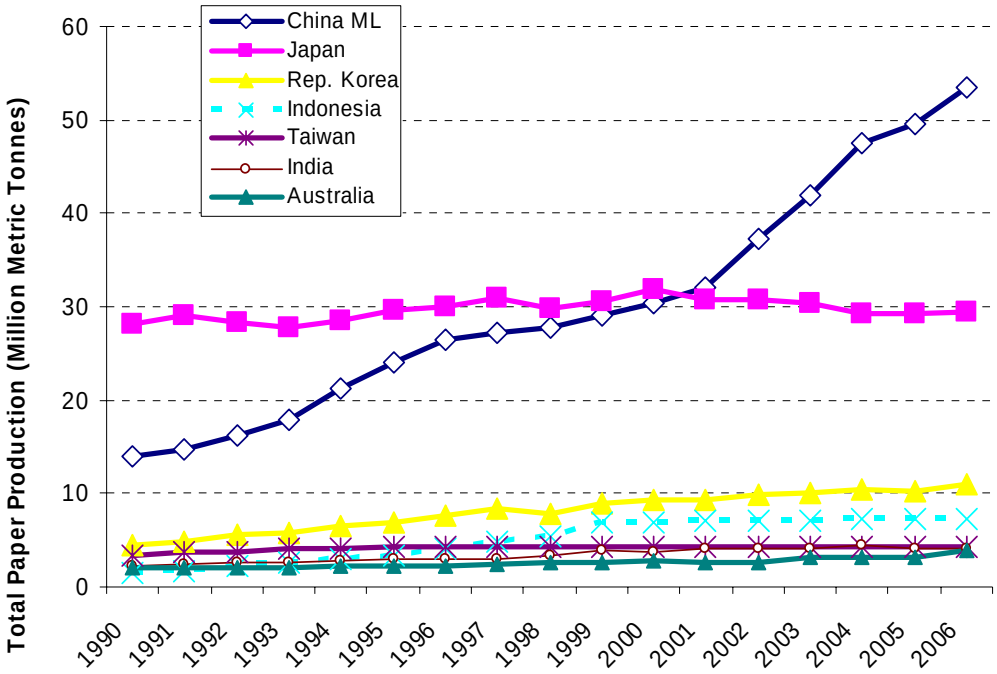



**Figure 62. Paper and paper board production by nation in the APR**
Source: FAOSTAT (2008)

There are several types of paper and paper board. FAOSTAT divided paper and paper board into three categories; graphic paper, sanitary paper and packaging material. Japan produced 13.7 million tonnes of graphic paper in 2006, which was the largest amount in the region (Figure 63). Japan also produced 12.2 tonnes of packaging material and 1.8 tonnes of sanitary paper in the same year. China produced 37.4 million tonnes of packaging material, which was the largest volume in the region.

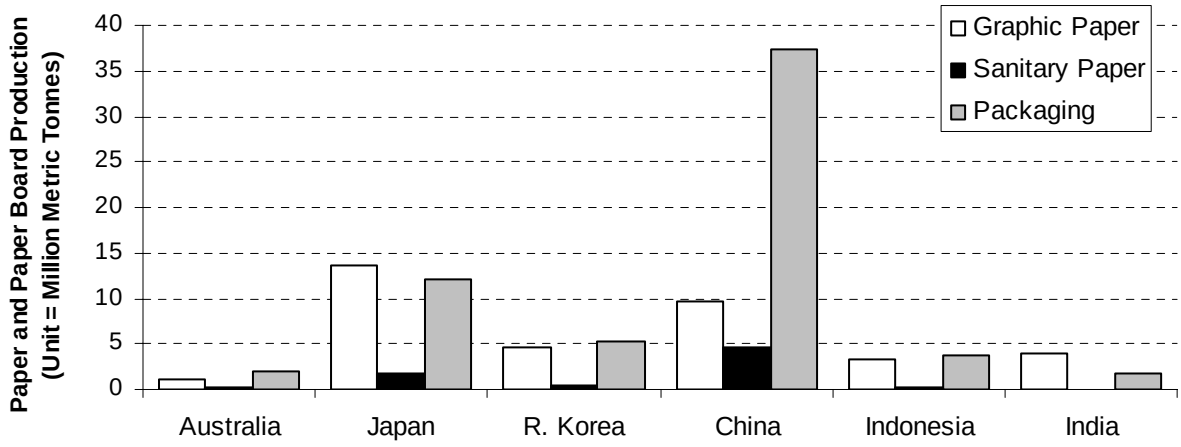



**Figure 63. Paper and paper board production by types in AP nations in 2006**
Source: FAOSTAT (2008)

As shown in Figure 64, during the 1990s, the production share of pulp sharply increased in the APR from 12 percent of the global share in 1990 to 16 percent in 2001, but compared with North America and the European region, the production of pulp in the APR is still smaller. After 2001, the share stumbled and the APR produced 28 million tonnes of pulp in 2006.

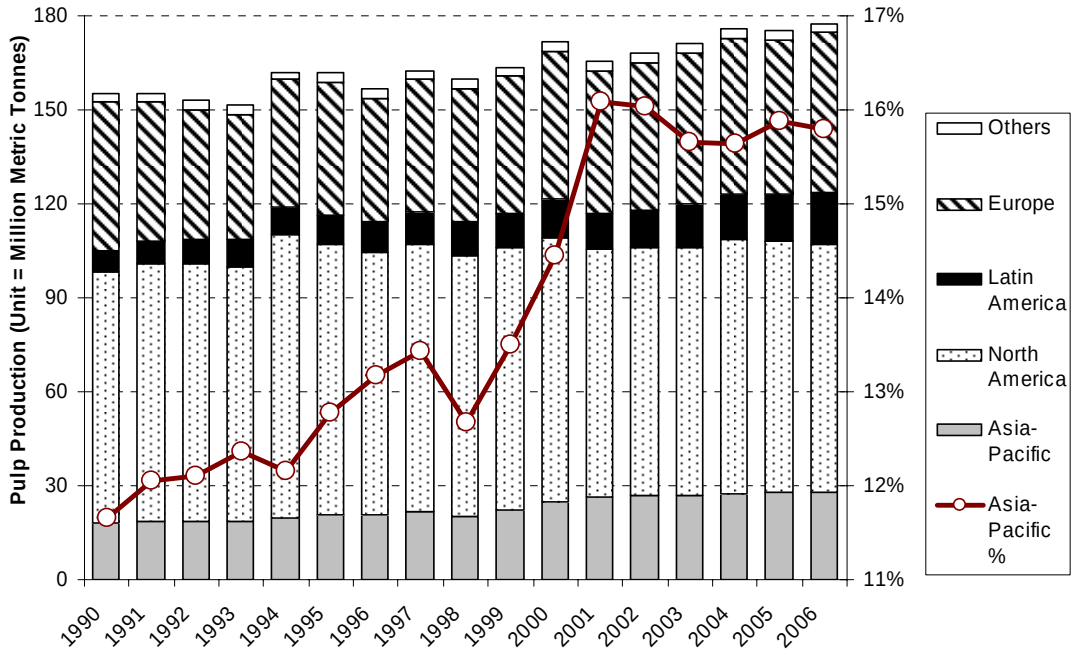



**Figure 64. World's pulp production by region**
Source: FAOSTAT (2008)

As shown in Figure 65, Japan's pulp production was ranked top in the region from 1990 to 2006. Japan produced 10.8 million tonnes in 2006, a drop of 4.7 percent since 1990. The production of pulp in Indonesia, China and India was 54.8, 37 and 23.1 million tonnes in 2006, an increase of 681, 118 and 133 percent since 1990, respectively.

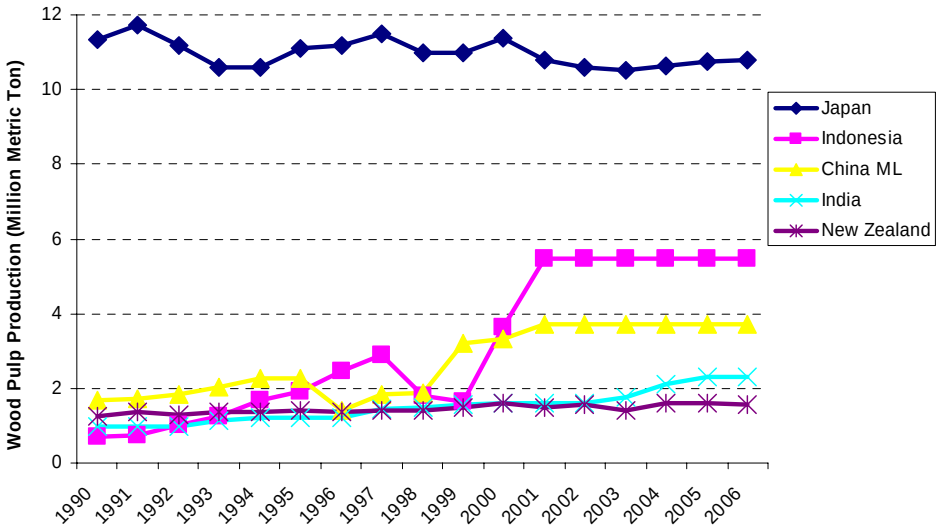



**Figure 65. Pulp production by nations in the APR**
Source: FAOSTAT (2008).

***Factors of paper and pulp production***

There are six factors concerning the current competitiveness of the pulp and paper industry: 1) related upstream industry, 2) demand condition, 3) electricity, 4) labor, 5) productivity and innovation and 6) country risk. In addition, water availability is a factor which may influence future competitiveness.

*Related upstream industry*

Related upstream industry is the first factor to determine a nation's competitiveness in the pulp and paper industry. Related industries contribute raw materials, knowledge, information and efficiency to the pulp and paper industry.

Raw material supply is a critical issue in pulp and paper production. Unlike other wood processing sectors, the pulp and paper industry obtains wood and fiber supplies from a wide variety of different sources. These include: pulpwood; wood residues (from the sawmilling and plywood industry and recovered wood products); non-wood fiber sources; and recovered paper.

For most developed countries, the price of raw material (wood and fiber) is the most significant operating cost in the pulp and paper industry, accounting for up to 50 percent of total operating costs (Industry Canada, 2002). Annual pulp consumption in the APR is estimated from FAOSTAT (production-exports + imports) and 55.8 million tonnes of pulp were utilized in 2006, which was a 60 percent increase from consumption in 1990. As shown in Figure 66, 56 percent of pulp consumption was chemical wood pulp and 7.3 percent was mechanical wood pulp in 2006.

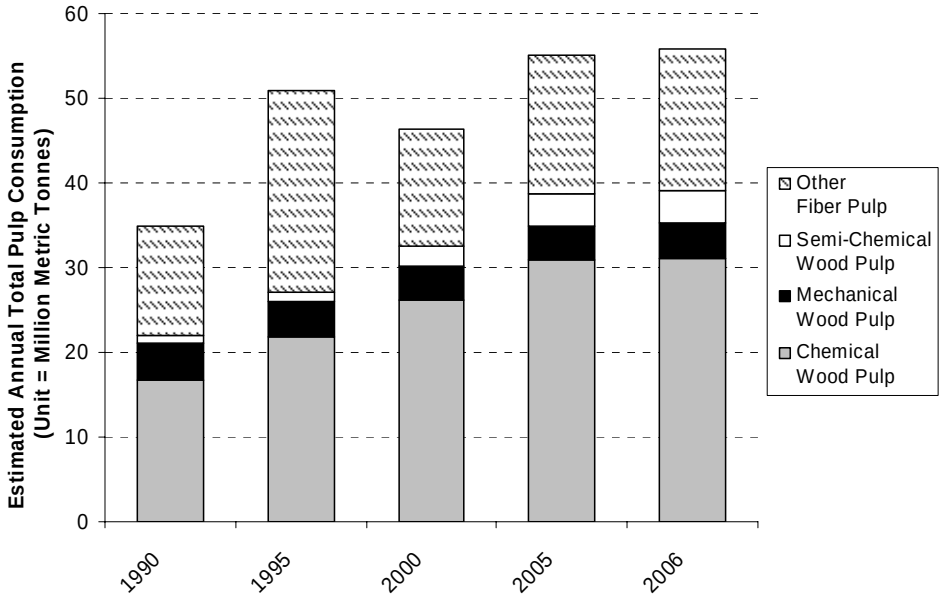



**Figure 66. Pulp consumption by type in the APR**
Source: FAOSTAT (2008)

Domestic fiber price statistics are not collected at the international level, but average trade prices could be derived from FAO's statistics. Import value and quantity were used to calculate the estimated price of pulp. Many factors contribute to the price differences of pulp fiber in each nation. Purchasing power between suppliers and buyers, exchange rate fluctuation, efficiency of traders, and the amount of pulp bought all influence the price.

However, it was not possible to estimate the domestic market price of pulp price in each nation. For example, if a firm has wood plantation, the firm may utilize the pulp much more cheaply than other firms in different countries.

Chemical pulp tends to cost more than mechanical pulp, because of the low yield from the original wood (only 40 to 50 percent). Since the process preserves fiber length, chemical pulp tends to make stronger paper. The average nominal unit value of chemical wood pulp in the region was US$674, 753, 634 and 550 per tonne in 1990, 1995, 2000 and 2006, respectively. Since chemical wood pulp is a well-used commodity, the price range is quite narrow in any nation because of price laws, as shown in Figure 67. Australia shows a one-year time lag from other nations, which may come from the different harvest season in the southern hemisphere. After 2000, Japan and Indonesia have imported relatively more expensive chemical wood pulp. On the other hand, China, Republic of Korea and India have imported relatively cheaper chemical wood pulp. As shown in Figure 68, China imported 47 percent of the total chemical wood pulp in the region in 2006.

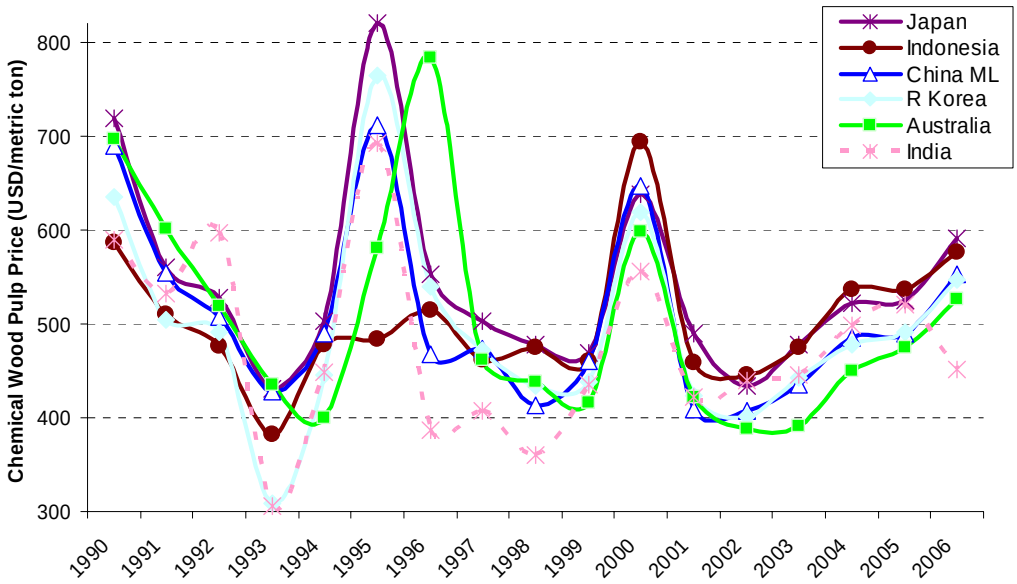



**Figure 67. Trends of chemical wood pulp import price in AP nations**
Source: FAOSTAT (2008).

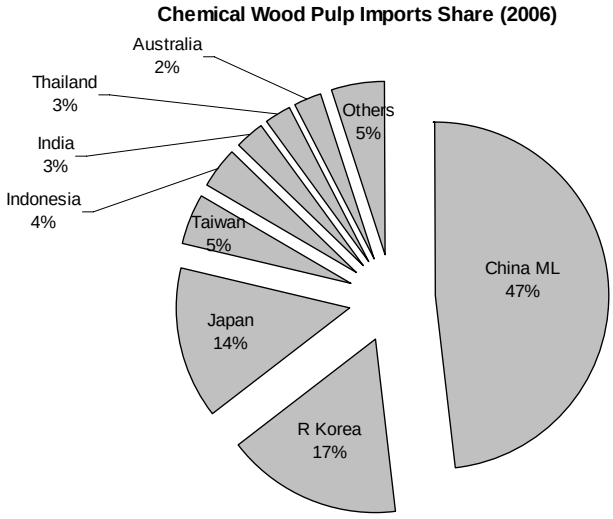



**Figure 68. Share of chemical pulp imports by nations in the APR**
Source: FAOSTAT (2008).

Mechanical pulp has rather short fiber lengths and produces weak paper. Though, large amounts of electrical energy are required to produce mechanical pulp, it generally costs less

than chemical pulp. Unlike chemical wood pulp, the mechanical wood pulp price varies widely among nations as shown in Figure 69. The average nominal unit price of mechanical wood pulp in the region was US$379, 458, 362 and 452 per tonne in 1990, 1995, 2000 and 2006, respectively. Interestingly, unlike chemical wood pulp, Japan's importing price of mechanical wood pulp is clearly lower than other nations, such as China, Indonesia, Taiwan and Australia. As shown in Figure 70, Japan imported 51 percent of mechanical wood pulp in the region in 2006.

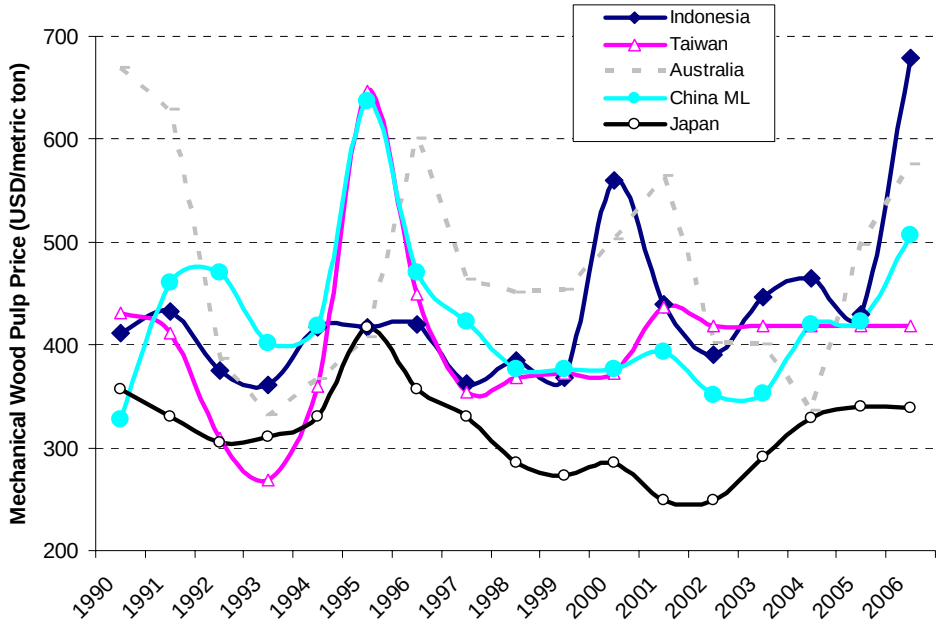



**Figure 69. Trends of mechanical wood pulp import price in AP nations**
Source: FAOSTAT (2008).

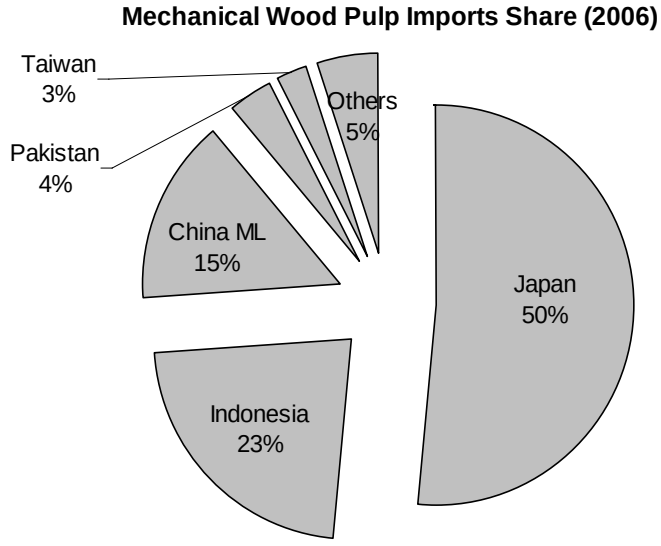



**Figure 70. Share of mechanical pulp imports by nations in the APR**
Source: FAOSTAT (2008)

Recovered paper is the pulp source for recycled paper. In many developed nations, governments have been promoting increasing the rate of using waste paper for paper products. Global paper recovery increased from around 25 percent in 1970 to 45 percent in

2004; however, paper recovery in most developing countries is generally lower and has not increased by as much, although paper recovery in China is currently around 33 percent (Whiteman, 2005). As shown in Figure 71, China's imports accounted for 66 percent of the total recovered paper imports in the region.

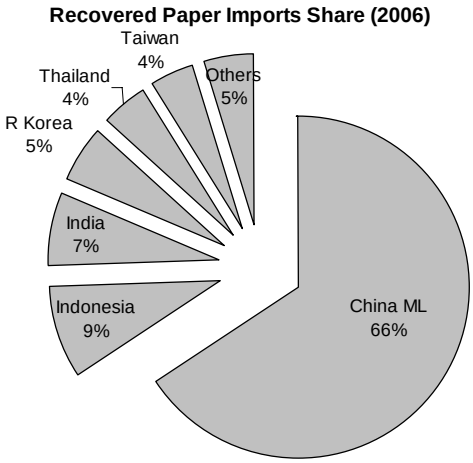



**Figure 71. Share of recovered paper imports by nations in the APR**
Source: FAOSTAT (2008).

The nominal unit price of recovered paper has the same trend as other pulp, more or less. As shown in Figure 72, Republic of Korea has recorded the highest unit price since 1995. On the other hand, Taiwan imports recovered paper relatively more inexpensively than other nations.

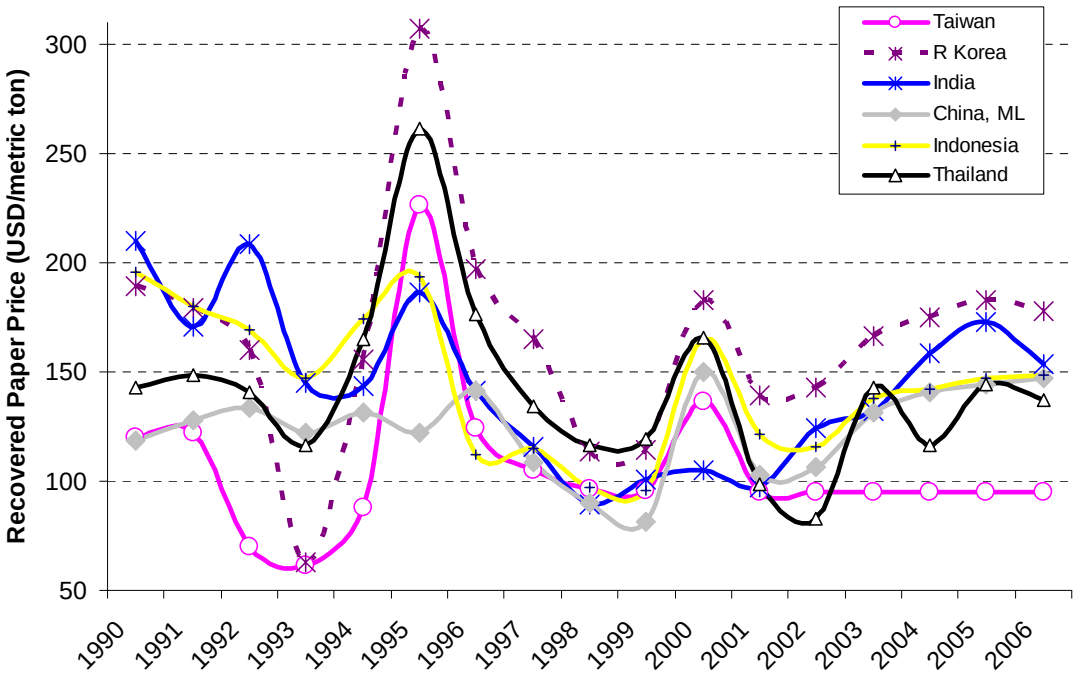



**Figure 72. Trends of recovered paper import price in AP nations**
Source: FAOSTAT (2008).

Import price is just a publicly available comparable indicator. However, the real price of wood pulp which a firm can acquire directly influences the competitiveness of the firm. Even within a nation, the acquisition price of raw material is quite different. Small differences of

acquisition price among competitors may critically influence their performance. In order to gain competitive edge, some firms address economic margins to gain purchasing power through merging and acquisition with other firms, for example. Some firms may take advantage of connections with government bodies or in other bodies to reduce acquisition costs or those of raw materials, although this approach may not achieve sustainable competitiveness. When a government help firms to purchase raw material lower than the market price, it will eventually harm national macroeconomics in the long-run. In order to maximize people's wealth in the nation, the government's role should be to help firms to operate their businesses efficiently.

Wood fiber from plantations has become popular in many nations. The success of fiber plantations comes from gaining competitiveness in the paper and pulp sector in the nation. As discussed in the previous section, forest plantation management has improved in many nations, mainly due to the wider application of existing knowledge about best practices. In addition, more recent research into tree growth and fiber properties has started to lead to increases in fiber quality and yield (Fenning and Gershenzon, 2002; Vichnevetskaia, 1997). These developments have resulted in greater success in forest plantation establishment and an increase in the economic viability of tree planting, especially in the tropics and subtropics. For example, *Eucalyptus* spp, indigenous to Australia, has become one of the most popular plantation species for paper. It grows fast, particularly when planted in tropical and sub-tropical regions, withstands low water conditions, is economical, sustainable and increasingly being used for paper manufacture. Although the *Eucalyptus* fiber is shorter than other species and lacks strength, it comprises an increasing portion of the fiber mix.

Those advances in knowledge result in increasing the competitiveness of the paper and pulp industry since firms in certain nations can access raw material inexpensively. Exuberant wood plantations in China, Viet Nam, New Zealand and Australia will likely lower the cost of raw material acquisition (real cost and opportunity cost) for the firms there and knowledge flows from plantations to the paper industry will enhance the competitive advantage of the paper industry, as well. This will likely bring competitiveness for those nations in the long run.

I assume that the competitiveness of upstream industry, including wood extraction from productive plantations, wood extraction from natural forests and the sawnwood industry (suppliers of wood residues) reflect the discussion in this section, such as raw material supply, knowledge and information. These NCI are used to estimate the factor score of upstream industry which influences the competitiveness of the pulp and paper industry.

*Demand condition*

Home demand condition influences the overall competitiveness of industry in the nation. The New Trade Theory (Krugman, 1986) emphasizes the importance of domestic demand via a network effect. Porter (1990) also emphasizes the importance of domestic demand, since sophisticated domestic demand spurs competition among firms in a country, so firms in a nation where sophisticated and high domestic demand exist can gain competitive advantages.

Figure 73, shows paper and paper board consumption in the APR. The total consumption in each county is derived from FAOSTAT (2008). Japan and Australia recorded 234 kg and 226 kg per capita paper and paper board consumption in 2006 and are ranked two of the highest consumers in the region. Regarding per capita consumption, New Zealand and former NIEs then follow. China's consumption per capita was 42 kg per person in 2006, but total consumption was the largest in the area with 554 million tonnes. In terms of total consumption, Japan, Republic of Korea, India, Australia, Taiwan and Indonesia follow China.

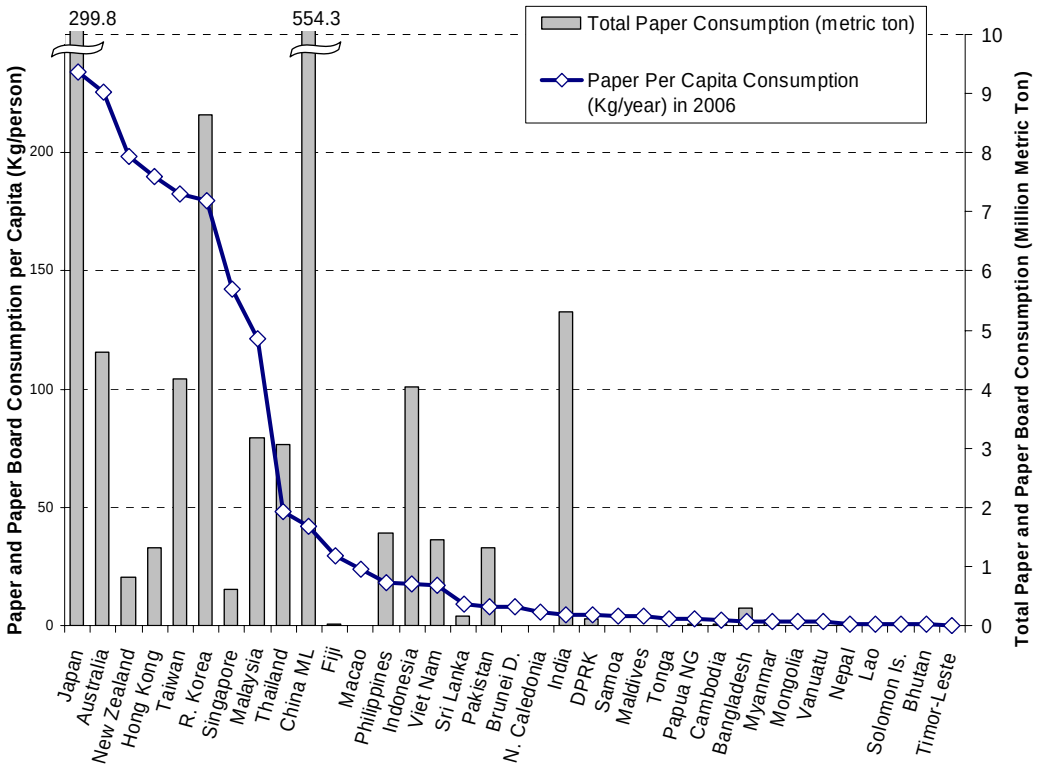



**Figure 73. Paper and paper board consumption by nations in the APR**
Source: FAOSTAT (2008).

*Electricity*

Electricity is the major source of energy for the pulp and paper industry. I used the component score of electricity price in a previous section, but waited until the pulp and paper industry section, because electricity is critically important for pulp and paper production.

Without major electricity output capacity, it is not possible to attract paper and pulp manufacturing facilities. Since electricity supply is necessary for pulp and paper production, firms require constant and huge output of energy. As shown in Table 14, the extent of electrification varies widely from nation to nation. Advanced nations and former NIEs have achieved 100 percent electrification. China, Thailand and Malaysia have close to 100 percent as well. Viet Nam and Philippines have higher electrification than other developing nations.

**Table 14. Electrification rate in AP nations**

| | |
|---|---|
| 100% | Australia, Hong Kong, Japan, New Zealand, R. Korea, Singapore, Taiwan |
| 99% | China ML, Thailand |
| 98% | Malaysia |
| 84% | Viet Nam |
| 81% | Philippines |
| 66% | Sri Lanka |
| 65% | Mongolia |
| 56% | India |
| 54% | Indonesia |
| 33% | Nepal |
| 32% | Bangladesh |
| 20% | Cambodia |
| 11% | Myanmar |

Source: IEA (International Energy Agency) (2006).

Besides electricity capacity, the cost of electricity for industrial usage varies in each nation and is another important component of operation cost. According to EIA (2008), Japan's electricity price for industrial usage has dropped since 1999, yet still is the most expensive in the region with US$0.117 per kilowatt hour in 2006 (Figure 74). Singapore's electricity price has sharply risen since 2002, and it was US$0.112 per kilowatt hour in 2007. Thailand, Republic of Korea, Australia, New Zealand, Taiwan and Indonesia have shown an upward trend in the last six to seven years, and prices ranged from around US$0.06 to 0.07 per kilowatt hour in 2007.

Unfortunately, many nations do not have publicly available comparable electricity prices for industrial usage data. Also, in some developing countries, electricity price is relatively higher than other nations. For example, India's electricity price in 2000 was US$0.08 per kilowatt hour, which was cheaper than Japan, but more expensive than other nations. Furthermore, it is reported that some nations experience severe electricity capacity shortage due to the economic boom. Shortage of electricity cannot be an acceptable environment for large paper firms. Missing values are estimated from Japan Electric Power Information Center (2002), which shows the electricity price statistic in Asian nations; yet, it is slightly different from EIA's electricity price for industrial usage data.

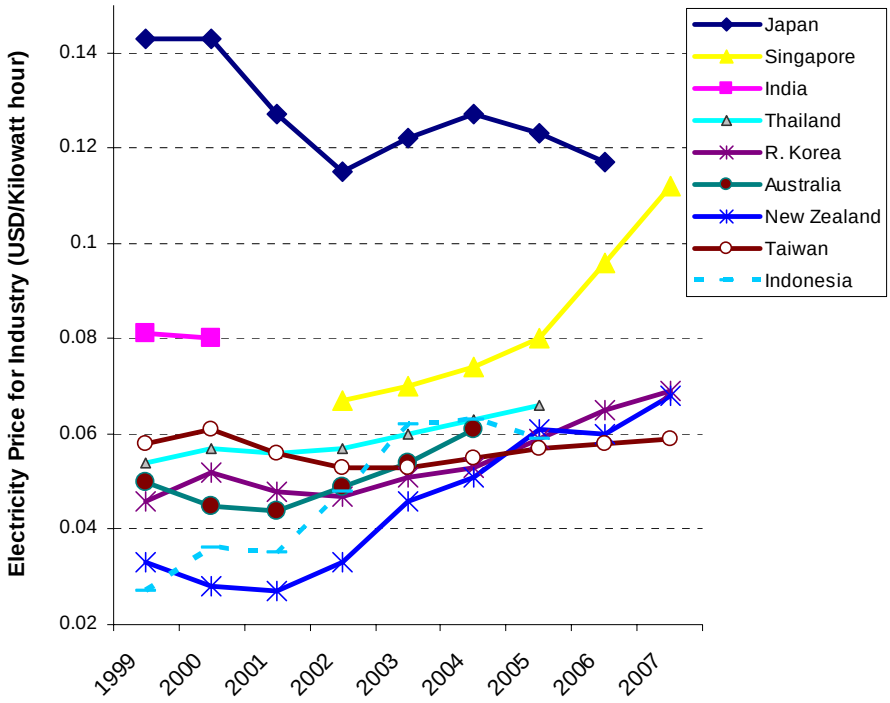



**Figure 74. Electricity price for industrial usage in the APR**
Source: EIA (2008).

*Operations*

Labor cost, labor availability and efficiency are the components of the operation factor which influences the competitiveness of the pulp and paper industry. The labor cost of paper production is not as important as the other labor-intensive forest product sectors. Hourly labor cost and manufacturing labor force data have been shown in a previous section. The Efficiency Index of the GCI is utilized to measure the component score of efficiency. These three component scores are used to estimate the factor score of operation.

*Capital investment*

The paper industry is a capital intensive sector. So, capital for paper and pulp industry is extremely important. When a firm introduces larger and more advanced machinery than other firms, it should gain competitive advantage against others for quite a long time. Capital is the fixed cost, while raw material, labor, energy, and water are operating costs. Actually, it is possible to introduce a very advanced competitive mill in any place in the world, but there are some especially attractive regions in the world for the pulp and paper industry. The initial investment price varies because of the land acquisition cost, construction labor cost, tax program, subsidy and so forth. Firms examine all factors comprehensively. Yet, the initial most important factor of deciding the location of capital investment is the risk of business operation in a particular nation. Since fixed capital will make continuous cash flow for quite a long period, firms need to discount the future cash flow to calculate their return of initial investment. A firm's discount rate is the weighted average cost of capital, but it is appropriate to use higher discount rates to adjust for risk and uncertainty for riskier operation in certain nations in order to compare the location of capital. Therefore, country risk is a component of the discount rate. The higher the risk, the higher the discount rate the firm calculates for its rate of return. Country risk refers to risks and uncertainties affecting all firms' business activities within a particular country. Political stability, macroeconomic stability (e.g. inflation), law enforcement (e.g. property rights), and social uncertainties are major factors of country risk.

*Productivity and innovation*

Over the last few decades, trends in wood fiber supply have been driven largely by changes in technology. Technological changes altered the location and the ability of the industry to utilize different types and volume of fiber (Whiteman, 2005).

Technological advances in processing techniques have been quite gradual but constant. New available innovative technologies have been developed in parallel to enable the industry to adapt to these changes in wood fiber supply. For example, innovative techniques have been developed to overcome some of the problems associated with the shorter and weaker fibers present in hardwood species. Furthermore, de-inking techniques (such as floatation and washing cells with adjunction of chemicals to maintain ink particle separation) have increased ink removal and improved the quality of pulp and paper manufactured from recovered paper (Lahaussois, 2000). The innovation index is utilized as a component of this factor.

The paper industry is a capital-intensive industry, so productivity directly reflects the degree of capital-intensiveness. For this purpose, per capita productivity is utilized to estimate the score of innovation and productivity factor score. Value-added per capita and production volume per capita are both used.

In Figure 75, Australia, New Zealand, Republic of Korea and Japan are the highest productive nations in the region. On the other hand, China's productivity is smaller compared to other nations, even though the production in terms of total volume is currently the largest in the region.

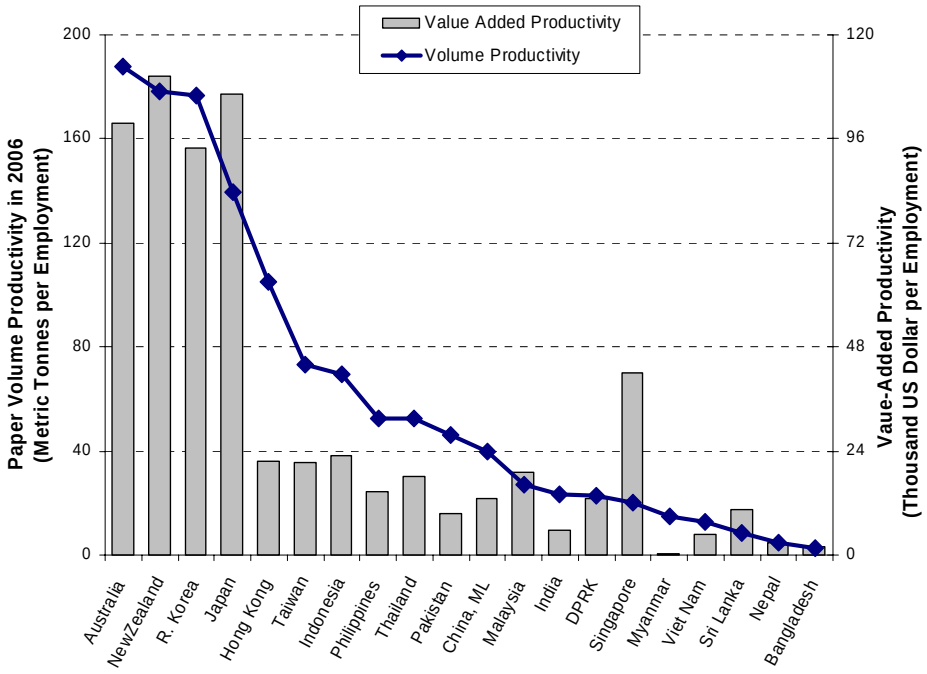



**Figure 75. Productivity per capita of the pulp and paper industry in the APR**
Source: Lebedys (2008) and FAOSTAT (2008).

In response to competitive pressures, pulp and paper manufacturers in especially Europe and North America have decreased capital expenditure and consolidated their operations in recent years. Spending decent fixed investment is critically important to gain competitive advantage in terms of the cost reduction through efficiency and technology, but firms eventually pursue the economy of size through consolidation for the commodity production, such as the pulp and paper sector. Consolidation in the pulp and paper industry is a global phenomenon that has reduced over capacity and increased the efficiency of operations. Consolidation improves a firm's financial performance. For example, from 1990 to 1995, the returns on capital employed in the North American pulp and paper industry were poor, averaging 4.8 percent in the USA and 1.7 percent in Canada. However, consolidation then became popular and for the period 1996 to 2001, average returns increased to 5.4 percent and 4.8 percent in the USA and Canada respectively (Whiteman, 2005).

Firms which already own advanced machinery need to consider consolidation to compete against giant corporations. In this stage, the role of the government to gain the competitiveness of the paper and pulp industry is to deregulate the protectionism regulations to promote the improvement of fair financial environments. Consolidation of the paper industry has been observed in Japan recently.

*Water availability*

Paper and pulp production utilizes great deal of water. Most APR are influenced by the monsoon system, so the area is relatively wetter than other parts of the world. However, several areas have experienced regional water shortage because of the climate or of the large population. For example, Singapore, Republic of Korea, Pakistan, some regions in India and some parts of China, especially in North East region will face some degree of water shortage. In 2007, Pakistan, India, Republic of Korea, and China withdrew 75, 34, 27, and 22 percent of renewable water resource, respectively (Table 15). This is the overall national average, and it is important to note that water resources are not evenly distributed in the nations.

Usually, the agriculture sector withdraws the most water, but the industrial sector also consumes a lot. In 2002, China withdrew the largest amount of industrial water, India, Viet

Nam, Japan, Pakistan and Republic of Korea then follow. Forty-two percent of withdrawn water was consumed by the industrial sector in Papua New Guinea, 27 percent in Mongolia, 26 percent in China, 25 percent in Democratic People's Republic of Korea and 24 percent in Viet Nam in 2002.

**Table 15. Water availability and withdrawal in AP nations**

| | Industrial Water Withdrawal [2002] ($km^3$/yr) | Industrial Water Withdrawal [2002] (%) | Renewable Water Resource [2007] ($km^3$/yr) | Renewable Water Per Capita [2007] ($m^3$/cap/yr) | Total Withdrawal Fresh Water [2007] ($km^3$/yr) | Withdrawal/ Renewable [2007] (%) |
|---|---|---|---|---|---|---|
| China ML | 162.0 | 26% | 2,829 | 2,138 | 617 | 21.8 |
| India | 35.2 | 5% | 1,897 | 1,719 | 646 | 34.1 |
| Viet Nam | 17.2 | 24% | 891 | 10,580 | 71 | 8.0 |
| Japan | 15.8 | 18% | 430 | 3,357 | 88 | 20.4 |
| Pakistan | 3.5 | 2% | 225 | 1,426 | 169 | 75.2 |
| R Korea | 3.1 | 16% | 70 | 1,458 | 19 | 26.7 |
| Philippines | 2.7 | 9% | 479 | 5,767 | 29 | 6.0 |
| Australia | 2.4 | 10% | 492 | 24,411 | 24 | 4.9 |
| DPRK | 2.3 | 25% | 77 | 3,430 | 9 | 11.7 |
| Thailand | 2.1 | 2% | 410 | 6,382 | 87 | 21.2 |
| Malaysia | 1.9 | 21% | 580 | 22,882 | 9 | 1.6 |
| Indonesia | 0.6 | 1% | 2,838 | 12,739 | 83 | 2.9 |
| Bangladesh | 0.5 | 1% | 1,211 | 8,536 | 79 | 6.6 |
| Sri Lanka | 0.3 | 2% | 50 | 2,410 | 13 | 25.2 |
| New Zealand | 0.2 | 9% | 327 | 81,182 | 2 | 0.6 |
| Myanmar | 0.2 | 1% | 1,046 | 20,697 | 33 | 3.2 |
| Laos | 0.2 | 6% | 334 | 56,305 | 3 | 0.9 |
| Mongolia | 0.1 | 27% | 35 | 13,152 | 0 | 1.3 |
| Nepal | 0.1 | 1% | 210 | 7,747 | 10 | 4.8 |
| Papua NG | 0.0 | 42% | 801 | 136,063 | 0 | 0 |
| Cambodia | 0.0 | 0% | 476 | 33,836 | 4 | 0.9 |
| Fiji | 0.0 | 14% | 29 | 33,667 | 0 | 0.2 |
| Bhutan | 0.0 | 1% | 95 | 43,920 | 0 | 0.4 |
| Maldives | | NA | 0 | 91 | NA | |
| Singapore | | NA | 1 | 139 | NA | |
| Brunei | | NA | 9 | 22,727 | NA | |
| Solomon Is | | NA | 45 | 93,515 | NA | |

Source: FAOSTAT (2008).

Besides the availability of renewable water resource, water costs for industrial usage directly affect the running cost of paper and pulp firms. However, it varies widely within nation, so it is not possible to show the comparable data among nations. Water cost is definitely one of the components of operation cost, though. Water shortage is expected in several nations in the APR. This issue may negatively affect the future competitiveness of the paper industry in those nations.

***Current competitiveness index of the pulp and paper industry***

Including all the factors discussed above, the current NCI of the pulp and paper industry was estimated. The factor components of the plywood industry are summarized and shown in relation with Porter's framework in Figure 76.

There were some missing values and those values were estimated by regression with other factors which should have high correlation or by averaging the number of similar nations. Each factor was standardized and calculated as the standardized T score (Normal Distribution with mean = 50 and standard deviation = 10 [X~N(μ=50, σ=10)]). Weightings were subjectively assigned due to the opinions from forest product experts in FAO and academia as shown in Table 16. Of course, some enterprises always find ways to maximize their competitive advantages strategically, so the NCI shown here is highly simplified compared to reality.

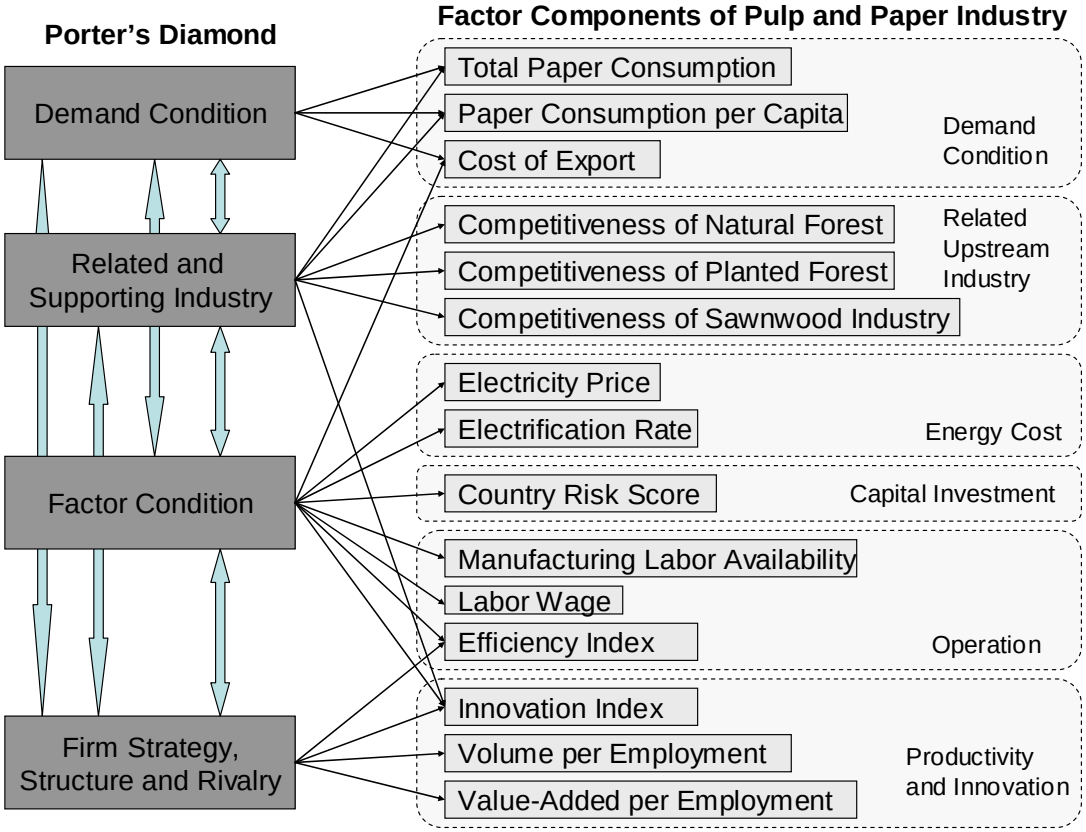



**Figure 76. Relationships between Porter's diamond and NCI factor components of the pulp and paper industry**

**Table 16. Weightings (2006) for the pulp and paper industry**

| | | | |
|---|---|---|---|
| 10% | Related Upstream Industry | Competitiveness of Natural Forest | 2% |
| | | Competitiveness of Planted Forest | 6% |
| | | Competitiveness of Sawnwood Industry | 2% |
| 25% | Demand Condition | Total Paper Consumption | 10% |
| | | Paper Consumption per capita | 10% |
| | | Cost of Export | 5% |
| 15% | Energy Cost | Electricity Price | 10% |
| | | Electrification Rate | 5% |
| 10% | Operation | Manufacturing Labor Availability | 1.7% |
| | | Hourly Labor Cost | 3.3% |
| | | Efficiency Index | 5% |
| 10% | Capital Investment | Country Risk Score | 10% |
| 30% | Productivity and Innovation | Value-Added Productivity per Employment | 10% |
| | | Volume Productivity per Employment | 10% |
| | | Innovation Index | 10% |

**Table 17. NCI (2006) for the pulp and paper industry in the APR**

| | Overall Current Competitiveness of Pulp and Paper Industry (2006) | Related Upstream Industry | | | | Demand Condition | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Related Upstream Industry (10%) | Competitiveness of Natural Forest | Competitiveness of Plantation | Competitiveness of Sawnwood | Demand Condition (25%) | Per Capita Paper Consumption | Total Paper Consumption | Cost of Export |
| Australia | 60 | 58 | 57 | 60 | 55 | 60 | 73 | 51 | 50 |
| Bangladesh | 46 | 49 | 50 | 49 | 49 | 47 | 44 | 47 | 52 |
| Bhutan | 46 | 48 | 52 | 48 | 47 | 45 | 44 | 47 | 45 |
| Brunei D | 51 | 49 | 49 | 49 | 51 | 48 | 45 | 47 | 59 |
| Cambodia | 43 | 50 | 55 | 49 | 48 | 47 | 44 | 47 | 55 |
| China ML | 60 | 56 | 53 | 58 | 56 | 72 | 49 | 100 | 62 |
| DPRK | 41 | 44 | 51 | 41 | 44 | 42 | 44 | 47 | 31 |
| Fiji | 47 | 54 | 53 | 56 | 52 | 49 | 47 | 47 | 58 |
| Hong Kong | 58 | 30 | 25 | 25 | 50 | 58 | 68 | 48 | 59 |
| India | 53 | 53 | 53 | 53 | 53 | 49 | 44 | 52 | 53 |
| Indonesia | 53 | 56 | 56 | 57 | 55 | 50 | 46 | 50 | 56 |
| Japan | 62 | 52 | 51 | 50 | 56 | 69 | 74 | 75 | 49 |
| Kiribati | 43 | 28 | 25 | 25 | 41 | 43 | 44 | 47 | 36 |
| Lao | 46 | 48 | 52 | 48 | 45 | 44 | 47 | 47 | 32 |
| Malaysia | 57 | 56 | 56 | 56 | 56 | 56 | 59 | 50 | 61 |
| Maldives | 45 | 29 | 25 | 25 | 43 | 45 | 44 | 47 | 44 |
| Mongolia | 43 | 47 | 50 | 47 | 45 | 42 | 44 | 47 | 31 |
| Myanmar | 40 | 48 | 53 | 47 | 44 | 42 | 44 | 47 | 31 |
| Nepal | 44 | 46 | 50 | 46 | 44 | 43 | 44 | 47 | 35 |
| New Caledonia | 48 | 49 | 46 | 49 | 51 | 47 | 44 | 47 | 55 |
| NewZealand | 60 | 58 | 49 | 60 | 58 | 58 | 69 | 47 | 55 |
| Pakistan | 49 | 50 | 51 | 50 | 49 | 49 | 45 | 48 | 59 |
| Papua NG | 47 | 51 | 54 | 51 | 51 | 48 | 44 | 47 | 58 |
| Philippines | 51 | 52 | 53 | 53 | 51 | 48 | 46 | 48 | 53 |
| R. Korea | 60 | 53 | 44 | 55 | 54 | 60 | 67 | 55 | 54 |
| Samoa | 46 | 49 | 49 | 48 | 51 | 46 | 44 | 47 | 48 |
| Singapore | 55 | 30 | 25 | 25 | 50 | 56 | 62 | 47 | 62 |
| Solomon Is. | 44 | 47 | 52 | 45 | 48 | 46 | 44 | 47 | 47 |
| Sri Lanka | 49 | 49 | 49 | 49 | 49 | 47 | 45 | 47 | 53 |
| Taiwan | 59 | 51 | 49 | 51 | 52 | 58 | 67 | 51 | 54 |
| Thailand | 54 | 56 | 54 | 59 | 52 | 51 | 50 | 49 | 57 |
| Timor-Leste | 42 | 46 | 48 | 45 | 47 | 46 | 44 | 47 | 49 |
| Tonga | 44 | 29 | 25 | 25 | 45 | 48 | 44 | 47 | 59 |
| Vanuatu | 45 | 45 | 47 | 44 | 46 | 42 | 44 | 47 | 31 |
| Viet Nam | 49 | 52 | 51 | 53 | 51 | 49 | 46 | 48 | 56 |

| | Energy Cost | | | Operation | | | | | Productivity | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Energy Cost (15%) | Electricity Price | Electrification Rate | Operation (10%) | Hourly Labor Cost | Manugfacturing Labor Availability | Efficiency | Country Risk (10%) | Productivity (30%) | Volume per Employment | Value-Added per Employment | Innovation |
| Australia | 59 | 58 | 62 | 48 | 15 | 55 | 67 | 58 | 67 | 77 | 63 | 60 |
| Bangladesh | 41 | 44 | 35 | 48 | 55 | 59 | 39 | 46 | 46 | 44 | 54 | 39 |
| Bhutan | 44 | 42 | 49 | 49 | 55 | 37 | 49 | 50 | 44 | 44 | 39 | 49 |
| Brunei D | 61 | 61 | 62 | 48 | 29 | 46 | 61 | 65 | 45 | 44 | 39 | 52 |
| Cambodia | 38 | 42 | 31 | 46 | 55 | 51 | 38 | 38 | 41 | 44 | 39 | 40 |
| China ML | 61 | 61 | 62 | 53 | 54 | 69 | 46 | 59 | 53 | 51 | 58 | 49 |
| DPRK | 30 | 25 | 41 | 48 | 55 | 58 | 40 | 25 | 46 | 48 | 51 | 40 |
| Fiji | 44 | 42 | 48 | 48 | 54 | 38 | 46 | 49 | 43 | 44 | 39 | 47 |
| Hong Kong | 61 | 60 | 62 | 57 | 48 | 48 | 66 | 67 | 62 | 62 | 59 | 64 |
| India | 51 | 54 | 45 | 56 | 55 | 66 | 54 | 55 | 54 | 48 | 57 | 59 |
| Indonesia | 55 | 61 | 44 | 55 | 56 | 62 | 52 | 46 | 56 | 56 | 60 | 52 |
| Japan | 49 | 42 | 62 | 53 | 28 | 62 | 66 | 62 | 69 | 69 | 63 | 76 |
| Kiribati | 44 | 42 | 46 | 47 | 55 | 34 | 46 | 51 | 43 | 44 | 39 | 46 |
| Lao | 59 | 67 | 43 | 47 | 55 | 45 | 43 | 46 | 41 | 44 | 39 | 42 |
| Malaysia | 59 | 58 | 61 | 57 | 52 | 57 | 61 | 58 | 57 | 48 | 59 | 62 |
| Maldives | 52 | 54 | 48 | 49 | 54 | 40 | 48 | 50 | 44 | 44 | 39 | 48 |
| Mongolia | 44 | 42 | 48 | 47 | 55 | 46 | 43 | 45 | 40 | 44 | 39 | 38 |
| Myanmar | 26 | 25 | 27 | 48 | 55 | 55 | 41 | 27 | 46 | 46 | 51 | 41 |
| Nepal | 40 | 42 | 36 | 46 | 55 | 51 | 37 | 44 | 46 | 44 | 55 | 38 |
| New Caledonia | 45 | 42 | 50 | 51 | 48 | 40 | 56 | 55 | 45 | 44 | 39 | 54 |
| NewZealand | 60 | 60 | 62 | 51 | 33 | 50 | 64 | 59 | 66 | 76 | 63 | 60 |
| Pakistan | 51 | 54 | 44 | 49 | 55 | 60 | 42 | 36 | 52 | 52 | 58 | 48 |
| Papua NG | 53 | 58 | 43 | 47 | 55 | 46 | 41 | 51 | 42 | 44 | 39 | 42 |
| Philippines | 52 | 50 | 55 | 52 | 55 | 58 | 49 | 50 | 53 | 53 | 59 | 46 |
| R. Korea | 60 | 59 | 62 | 52 | 33 | 57 | 62 | 59 | 67 | 75 | 62 | 64 |
| Samoa | 45 | 42 | 49 | 49 | 55 | 36 | 49 | 50 | 44 | 44 | 39 | 49 |
| Singapore | 57 | 55 | 62 | 58 | 44 | 51 | 69 | 66 | 58 | 47 | 61 | 65 |
| Solomon Is. | 42 | 42 | 42 | 45 | 55 | 39 | 41 | 44 | 41 | 44 | 39 | 41 |
| Sri Lanka | 52 | 54 | 49 | 50 | 56 | 55 | 45 | 44 | 50 | 45 | 58 | 46 |
| Taiwan | 61 | 60 | 62 | 58 | 48 | 57 | 66 | 64 | 62 | 57 | 59 | 69 |
| Thailand | 59 | 57 | 62 | 54 | 54 | 58 | 54 | 50 | 55 | 53 | 59 | 54 |
| Timor-Leste | 43 | 42 | 44 | 41 | 55 | 36 | 34 | 42 | 38 | 44 | 39 | 31 |
| Tonga | 44 | 42 | 49 | 48 | 55 | 33 | 49 | 50 | 44 | 44 | 39 | 49 |
| Vanuatu | 52 | 54 | 47 | 47 | 55 | 35 | 46 | 50 | 43 | 44 | 39 | 47 |
| Viet Nam | 57 | 57 | 56 | 50 | 55 | 60 | 44 | 41 | 48 | 46 | 56 | 43 |

Figure 77 shows the estimated current NCI of the pulp and paper industry in 2006. Japan was ranked the most competitive nation in terms of paper and pulp production. Republic of Korea,

Australia, New Zealand, China and Taiwan follow Japan. Even though Democratic People's Republic of Korea and Myanmar produce certain amounts of paper and paper board, the lower score of many components lowered the competitiveness of the sector, so they currently cannot attract private investors and the ability to add value for the nation is questionable.

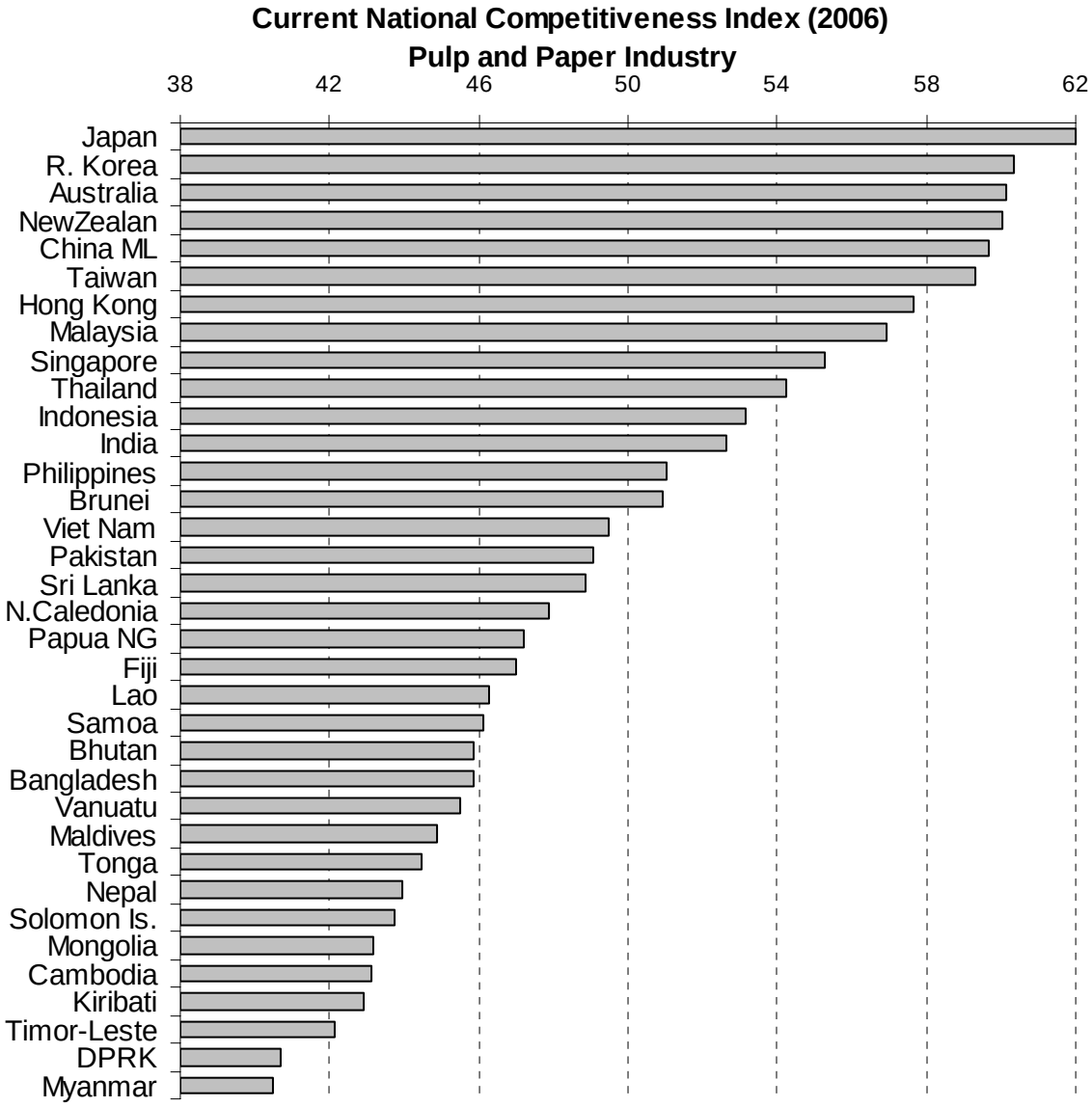



**Figure 77. Current NCI (2006) of the pulp and paper industry**

## 5. OUTLOOK

Competitiveness has dynamic characteristic. Many external factors influence a nation's future competitiveness, and outcomes of its current competitiveness level internally influence its future competitiveness as well. To predict the future competitiveness of the APR in 2020 is not an easy task. Scenario assessment is a useful tool in order to assess alternative future paths. The competitiveness of the forest sector is totally influenced by global and regional macroeconomics. There are three possible global macroeconomic scenarios: 1) business as usual, 2) economic down-turn in the developed nations but emerging countries will grow faster (global decoupling economic convergence hypothesis), and 3) severe global economic down-turn (global coupling hypothesis). A competitiveness outlook totally changes according to the scenarios.

Many variables move stochastically and it is extremely difficult to forecast the future trend. In this section, I will only focus on variables which can move along certain scenarios. Therefore, any risk and uncertain events are excluded from the forecast.

.

Because of the complexities, I will group several nations which have similar characteristic of competitiveness, and talk about the future competitiveness for each scenario. As explained in chapter 3, explanatory factor analysis is applied to reduce the dimension of competitiveness of nations, and several nations have been grouped subjectively based on the reduced dimensions. Although explanatory factor analysis can reduce the number of variables, reduced dimensions combining several commonalities of factors are usually not easy to translate. The goal of factor analysis is to classify countries into several groups, so that the degree of association is strong between inter-group nations and weak between intra-group nations in terms of competitiveness and groups are easier to visualize. Each group must face similar challenges in terms of future competitiveness. Borders of groups remain vague, so some nations possibly belong to multiple groups.

***Business as usual scenario***

Under this scenario, emerging markets of the APR rapidly grow in the next ten years, and consumers in most countries consume more than today. Efficiency, innovation, and productivity in emerging markets will improve dramatically. Also, environmental perception and corruption perception will improve as well. On the other hand, inflation rate will climb, and many emerging nations will face high wage, utility fee and raw material purchasing costs. Country risk of most nations will remarkably decline and foreign direct investment will continue to be very strong.

Former NIEs will become as rich as currently developed nations. Current advanced nations will lose their relative competitive edge in terms of efficiency, innovation and productivity since many developing countries will catch up very quickly.

Natural resource-wise, the region will experience difficulty. Depleting natural forests will reduce the competitiveness of current forest resource-rich nations. Water shortage will cause some difficulties for the pulp and paper industry. Electricity and energy cost will climb severely. The price of industrial roundwood and pulp will climb considerably.

***Global decoupling economic convergence scenario***

United States' economic downturn will initially bring difficulties for export-driven sectors, but the situation will simultaneously open up opportunities for the emerging nations in the APR. Consumption in emerging markets will increase and make up for the USA and other developed nations' consumption decline. Inter-APR trade will become more resilient. This

scenario is in the middle, between the business as usual scenario and global recession scenario. Since the USA and some other advanced economies are slowing down, the region will not experience severe inflation. Stable and resilient macroeconomics in the emerging markets will strengthen regional currencies, and it is easier for the emerging markets to access raw materials from other regions. Foreign investors continue investing in the APR to aim for higher return in the region.

***Global recession caused by the global coupling scenario***

Credit crunch, triggered by the USA's subprime mortgage problem, will expand all over the world. The globalized financial system does not allow the APR to escape from the global crisis. The slowing down of USA consumption will reduce production in the APR. Export-oriented industries in the APR will conduct inventories, and will be required to adjust. Economic adjustment will increase the unemployment rate and stop foreign direct investment. Since new investments will not flow in, technology will become outdated and productivity will decline. Country risk will rise and technology and efficiency will not improve in many emerging nations. However, inflation in emerging nations will slow down because of the economic slump, or maybe they will experience deflation of prices due to inventory adjustment. Currencies in emerging economies will depreciate against currencies in advanced nations. The USA and other advanced nations face recession, but emerging nations will face much more severe recession.

**Outlook for competitiveness of wood extraction from natural forest**

Four factors were utilized to estimate the current NCI of wood extraction from natural forest as discussed in the last chapter. Some of these components are correlated in Table 18.

**Table 18. Lower-triangle correlation matrix of factors (natural forest)**

| | Natural | Easiness | Operation |
|---|---|---|---|
| Natural Forest Availability | 1.000 | | |
| Easiness to Cut Trees | -0.196 | 1.000 | |
| Logging Operation | 0.522 | 0.119 | 1.000 |
| Demand Condition | 0.481 | -0.348 | 0.459 |

Explanatory factor analysis (with Varimax rotation) was applied to reduce the number of variables. Two latent dimensions were detected. According to the components matrix of reduced dimensions in Table 19, dimension 1 could embody the relative size of natural forest of a nation, which includes both population, natural resources and land area. Dimension 2 would be the degree of law compliance by people of a nation, which includes the environmental perception of the nation.

**Table 19. Components matrix of reduced dimensions (natural forest)**

| | Dimension | |
|---|---|---|
| | 1 (natural forest) | 2 (law compliance [reverse]) |
| Natural Forest Availability | 0.808 | -0.186 |
| Ease to Cut Trees | -0.035 | 0.958 |
| Logging Operation | 0.875 | 0.258 |
| Demand Condition | 0.720 | -0.451 |

Countries are finally grouped based on the perceptual map utilizing dimensions 1 and 2 as shown in Figure 78. Four groups were subjectively detected for the outlook.

Group 1. Relatively advanced nations with relatively rich natural forest resources
Group 2. Moderate law-abiding nations with relatively rich natural forest resources

Group 3. Countries with relatively rich natural forest resources where existing laws are not enforced
Group 4. Countries do not have enough forest natural resources

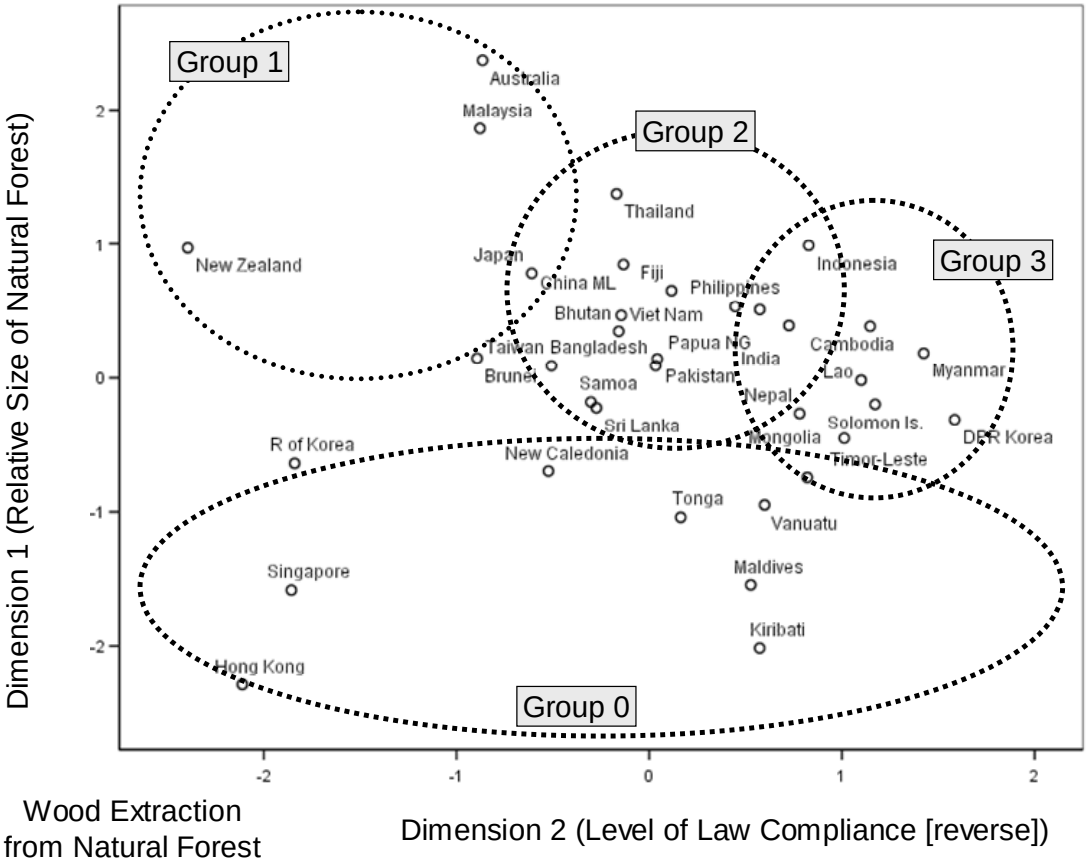



**Figure 78. Country grouping based on reduced dimensions of competitiveness (wood extraction from natural forest)**

Nations in group 1 are relatively advanced nations, where law is strictly enforced, with relatively rich natural forest resources. They will face difficulty with people's perception of natural forests. In many nations, people started putting more importance on environmental aspects of natural forest than on commodity producing aspects. Therefore, the opportunity cost of cutting trees from natural forest will become higher. Logging trees from plantations makes more sense than logging trees from natural forests. The shrinking labor force in rural areas and high wages become a problem as well. However, for example, natural stock in Japan has been increased, and the government has started encouraging cutting trees from natural forests in order to achieve the global warming $CO_2$ emissions treaty. These activities may change people's perception of natural forests.

Group 2 is moderate law-abiding nations with relatively rich natural forest resources. As nations develop, they will lose competitiveness sharply due to strong law enforcement. They will shift their wood extracting activities from natural forests to planted forests.

Group 3 is countries with relatively rich natural forest resources where existing laws are not enforced. These nations have short-term competitiveness against other nations. However, overlogging will eventually result in natural forest depletion, and they will lose competitiveness in the long run. As already mentioned in the last chapter, some nations have

already experienced severe forest stock loss in the last decade or so. Governments should enforce laws more strictly, and should address sustainable natural forest resource management for their future to bring prosperity for their citizens in the long run.

Nations in group 0 do not have any competitiveness in wood extraction from natural forests, and are totally out of the scope of this discussion.

Under the business as usual scenario, the world will face shortage of wood resources. Emerging countries and advanced countries' appetite for wood products will rise, and commodity prices will likely rise as well. Unsustainable logging activities in some developing nations will cause the depletion of natural forests. Then, logging pressure will be on rich natural forests in advanced nations. Sustainable logging activities from natural forests in some of these nations may become more competitive; the amount of natural forests they have is the key issue in this case. The nations belonging to group 2 and group 3 will keep competitiveness. The problem is the depletion of natural forests of nations in group 3. Governments should enforce strict regulations; otherwise, nations will lose the opportunity to create sustainable wealth from their natural resources. Hopefully nations advance as their business activities spur, and people in nations should pay more attention to the environmental service aspects of natural forest. However, simultaneously some nations face wage inflation and labor shortage in rural areas, which is likely to reduce competitiveness, so there is a need to increase productivity.

Under the economic convergence scenario, the emerging nations in Asia will consume a lot of wood resources as well. However, at the same time, advanced nations will reduce wood consumption. So, logging pressure in forest rich nations will not change dramatically. How forest rich nations in Asia can keep competitive advantage against other regions is the biggest challenge in this scenario.

When the world faces severe recession, global wood consumption will likely decline somewhat. Under this scenario, wood price will decline and there is no incentive to cut trees from natural forests in advanced nations. Advanced nations will lose competitiveness against other developing nations. Wages will stagnant and competitiveness against other developed nations will relatively increase. Wood extraction for commercial usages will moderate somewhat overall, but the world should keep an eye on wood extraction for non-commercial uses (e.g. firewood) in poor nations to conserve biodiversity.

For wood extraction from national forest, the exchange rate would be the most significant risk for competitiveness. Whenever the exchange rate of a nation becomes relatively weaker than other nations, it creates arbitrage opportunity. Weaker currency will attract more foreign customers who would like to earn arbitrage profits, but the nation will not be able to cumulate further investment for its citizen. Exploitation of natural forest even damages the social benefit of the citizen. For example, the weak Indonesian rupiah could be a part of the reason why Indonesian natural forests were exploited after the Asian financial crisis. Nations and NGOs should monitor obvious arbitrage opportunities. Increasing exports of wood because of exchange rate arbitrage opportunities cannot create competitive advantage for a nation, but harms its long-term prosperity. Table 20 shows the summary of the NCI outlook in 2020 in three different scenarios. Smaller arrows indicate factors will lower overall competitiveness, and vice versa. Bold and multiple arrows indicate sharp changes.

**Table 20. NCI outlook (2020) of wood extraction from national forest**

| Dimensions | Group 1 | Group 2 | Group 3 | Group 0 |
|---|---|---|---|---|
| Forest Resource | Yes | Yes | Yes | None |
| Law-Enforcement | Good | Moderate | Poor | - |
| Business as Usual | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 0 |
| Natural Forest Availability | ↓ | ↓ | ↓↓↓ | N.S. |
| Easiness to Cut Trees | ↓ | ↓ | ↓ | N.S. |
| Logging Operation | ↑ | ↑ | ↑ | N.S. |
| Demand Condition | ↑ | ↑↑ | ↑↑↑ | N.S. |
| Economic Convergence | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 0 |
| Natural Forest Availability | - | ↓ | ↓↓ | N.S. |
| Easiness to Cut Trees | ↑ | ↓ | ↓ | N.S. |
| Logging Operation | - | ↑ | ↑ | N.S. |
| Demand Condition | - | ↑ | ↑↑ | N.S. |
| Global Recession | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 0 |
| Natural Forest Availability | ↑ | - | ↓ | N.S. |
| Easiness to Cut Trees | ↑ | ↑ | ↑ | N.S. |
| Logging Operation | - | ↑ | ↑ | N.S. |
| Demand Condition | ↓ | ↓ | ↓ | N.S. |

**Outlook for competitiveness of wood extraction from planted forest**

Four factors were utilized to estimate the current NCI of wood extraction from planted forest as discussed in the last chapter. Some of these components are correlated in Table 21.

**Table 21. Lower-triangle correlation matrix of factors (planted forest)**

| | Land Avail. | Land Invest. | Demand |
|---|---|---|---|
| Availability of Land | 1.000 | | |
| Land Investment | -0.208 | 1.000 | |
| Demand Condition | 0.199 | 0.102 | 1.000 |
| Managerial Competencies | 0.574 | -0.151 | 0.643 |

Explanatory factor analysis (with Varimax rotation) was applied in order to reduce the number of variables. Two dimensions were detected. According to the components matrix of dimensions in Table 22, dimension 1 could embody the integrated relative size of a nation, which includes both population, natural resources, people's demand and land area. Dimension 2 would be the degree of easiness to invest in land of each nation.

**Table 22. Components matrix of reduced dimensions (planted forest)**

| | Dimensions | |
|---|---|---|
| | 1 (Integrated Size) | 2 (Land Investment) |
| Availability of Land | 0.603 | -0.531 |
| Land Investment | 0.047 | 0.895 |
| Demand Condition | 0.849 | 0.270 |
| Managerial Competencies | 0.910 | -0.215 |

Countries are finally grouped based on the perceptual map utilizing dimensions 1 and 2 as shown in Figure 79. Four groups were subjectively detected for the outlook.

Group 1: Demand conditions is satisfied and land is available
Group 2: Demand conditions is satisfied and but land availability is lower
Group 3: Land investment is challenging
Group 0: Too small or too dense for plantations

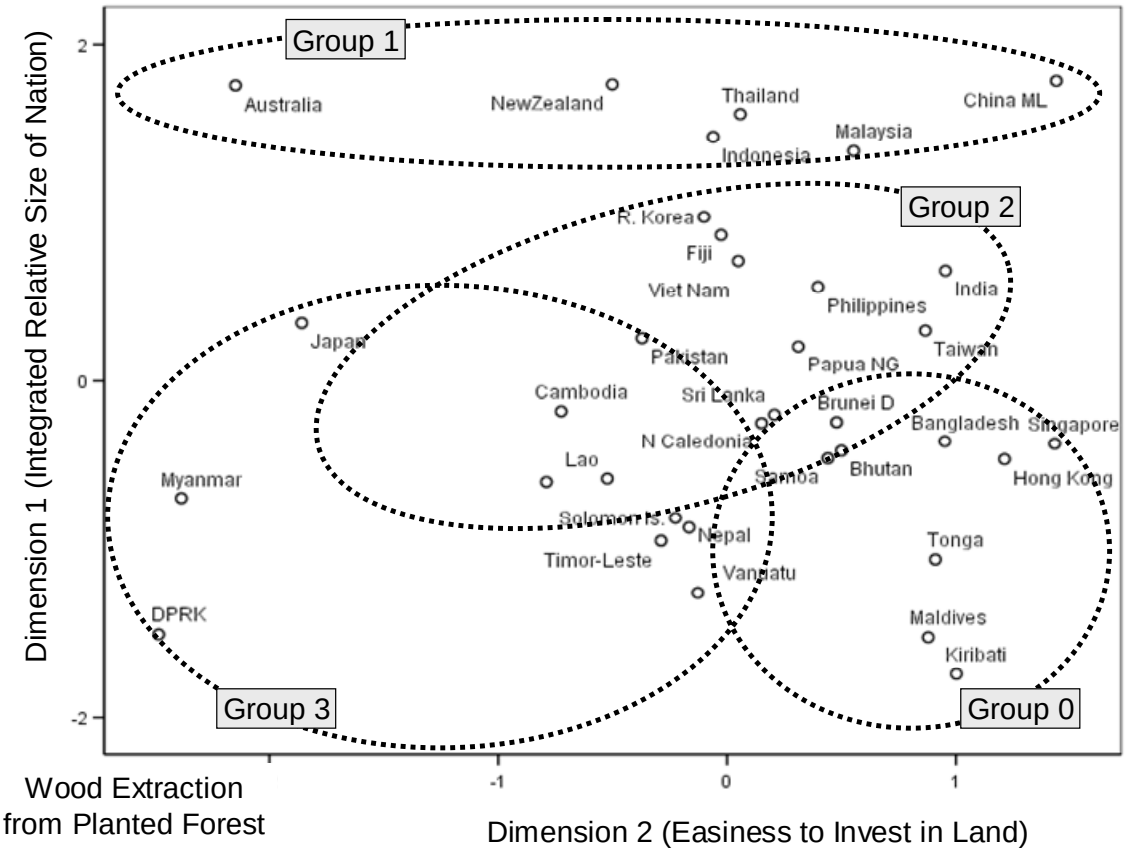



**Figure 79. Country groupings based on reduced dimensions of competitiveness (wood extraction from planted forest)**

Group 1 is the nations where people's demands for wood products are high, and there are plenty of land to plant. They are currently very competitive. Group 2 has some opportunities for forest plantations, but they do not have so much land availability as nations in group 1. Group 3 may have a potential future, but they currently experience difficulties in attracting investments. Some of them have very high country risk, so they, first of all, need to reduce the risk and to increase the wealth of nations. Some nations in the APR have opened up their economy to attract foreign investments to improve the wealth of the nation in past several decades, so those nations can imitate their success paths. Some nations in group 3 are not competitive because their lands are too expensive and regulations of investment in forest land are too complicated. Group 0 is nations with low competitiveness in terms of wood extraction from planted forests partially because of low land availability, high population or productivity from forests is too low. Group 0 cannot gain competitiveness in the next ten years.

Under the business as usual scenario, the world will face shortage of wood resources. Emerging countries' and advanced countries' appetite for wood products will rise, and commodity price will likely rise as well. Unsustainable logging activities from natural forests in some developing nations will cause the depletion of natural forests, but they may also open up some opportunities for new planted forests. Existing plantations can earn more money due to the high wood fiber price, and they can improve managerial competencies. On the other

hand, there are many uncertainties facing new additional investments in planted forest. The rate of return from planted forests will rise due to the expectation of increasing the wood price. However, as nations develop, the land price will likely inflate simultaneously, which is not good for additional investment. Furthermore, the interest rate is expected to rise when the economy is strong, and consequently future value will be discounted further, so long-term investment will not be attractive compared to short-term investments. Therefore, the direction of investment inflow for forest plantation is very difficult to predict. Probably, governments and NGOs also gain a lot of available capital when the economy is strong, and will invest in planted forests wherever land is available. Under this scenario, the APR will consume a lot of forest resources, so policy makers need to take actions to create a system to maintain in forest plantations.

Under the global decoupling economic convergence scenario, the emerging nations in Asia will consume a lot of wood resources as well. However, fiber price is not expected to rise substantially since advanced nations face economic downturn. In this scenario, the rate of return from planted forests will be lower than that of the economy as usual scenario because of inflated land price in emerging markets, and the soft wood fiber price in the near future.

The biggest factor of competitiveness is available land for forest plantations, which will not change significantly in the next ten years. So, the most important changing factor is long-term land investment. Predicting the competitiveness of wood extraction from planted forest is the trickiest in the six sectors, since the attractiveness of long-term investment is not simply correlated with economic growth. Nations should carefully arrange long-term steady economic growth to attract long-term investment from public sectors. Long-term investment dislikes any risk factors, so volatility should be minimized. Table 23 shows the summary of future NCI changing by scenarios. Smaller arrows indicate factors will lower the overall competitiveness, and vice versa. Bold and multiple arrows indicate sharp changes.

**Table 23. NCI (2020) outlook of wood extraction from planted forest**

| **Dimensions** | **Group 1** | **Group 2** | **Group 3** | **Group 0** |
|---|---|---|---|---|
| Size of Land | Very Large | Large | Medium | Too Small |
| Land Investment | Good | Easier | Challenging | Easier |
| Business as Usual | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 0 |
| Availability of Land | - | ↓ | - | N.S.. |
| Land Investment | ↓ | ↓↓ | ↑(?) | N.S. |
| Demand Condition | ↑↑ | ↑↑ | ↑ | N.S. |
| Managerial Competencies | ↑ | ↑ | ↑ | N.S. |
| Economic Convergence | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 0 |
| Availability of Land | - | ↓ | - | N.S. |
| Land Investment | ↓ | ↓↓↓ | ↑(?) | N.S. |
| Demand Condition | ↑ | ↑ | ↑ | N.S. |
| Managerial Competencies | ↑ | ↑ | ↑ | N.S. |
| Global Recession | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 0 |
| Availability of Land | - | - | - | N.S. |
| Land Investment | ↑ | ↑ | ? | N.S. |
| Demand Condition | ↓ | ↓ | ↓ | N.S. |
| Managerial Competencies | - | - | - | N.S. |

**Outlook for competitiveness of the sawnwood industry**

Five factors were utilized to estimate the current NCI of the sawnwood industry as discussed in the last chapter. Some of these components are correlated in Table 24.

**Table 24. Lower-triangle correlation matrix of factors (sawnwood industry)**

| | Upstream | Demand | Energy | Labor |
|---|---|---|---|---|
| Upstream Related Industry | 1.000 | | | |
| Demand Condition | 0.234 | 1.000 | | |
| Energy Cost | 0.375 | 0.192 | 1.000 | |
| Labor Cost | 0.112 | -0.392 | 0.076 | 1.000 |
| Productivity | 0.108 | 0.693 | 0.086 | -0.707 |

Explanatory factor analysis (with Varimax rotation) was applied in order to reduce the number of variables. Two dimensions were detected. According to the components matrix of dimension in Table 25, dimension 1 could embody the advancement of a nation. Dimension 2 would be the degree of backward linkage for the sawnwood industry, since upstream related industry has the higher correlation.

**Table 25. Components matrix of reduced dimensions (sawnwood industry)**

| | Dimension | |
|---|---|---|
| | 1 (Advancement) | 2 (Backward Linkage) |
| Upstream Related Industry | 0.040 | 0.824 |
| Demand Condition | 0.779 | 0.331 |
| Energy Cost | 0.028 | 0.798 |
| Labor Cost | -0.841 | 0.244 |
| Productivity | 0.939 | 0.083 |

Countries are finally grouped based on the perceptual map utilizing dimensions 1 and 2 as shown in Figure 80. Four groups were subjectively detected for the outlook. The groups are subjectively named according to the characteristics of the groups.

Group 1: Advanced nations
Group 2: Emerging nations with a strong backward linkage for the sawnwood industry
Group 3: Emerging nations with a moderate backward linkage for the sawnwood industry
Group 4: Nations without backward linkage

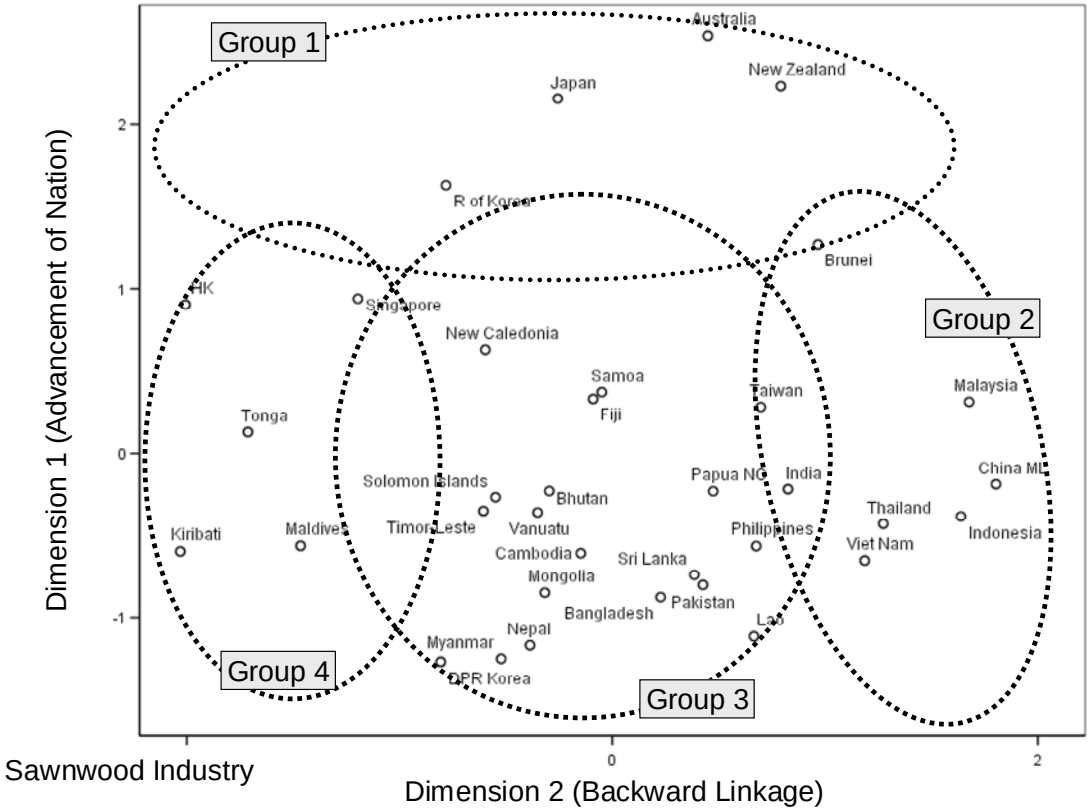



**Figure 80. Country grouping based on reduced dimensions of competitiveness (sawnwood industry)**

Nations belonging to group 1 have strong home demand and efficient technology. Their challenges are how to cancel out relatively higher wage labor wages; nations have been striving to improve their productivity already. Nations belonging to group 2 have a friendly supportive environment for the sawnwood industry. Some of them have relatively competitive wood producing sectors. However, advanced nations always try to improve productivity since they have high labor costs. So nations belonging to group 2 should not wallow in factor endowments and need to improve their productivity in order not to fall behind from advanced nations' productivity. Nations in group 3 need much effort to improve their competitiveness.

With the high demand in the APR, under the business as usual and the world decoupling scenarios, nations in group 3 will slowly improve their competitiveness with their lower labor costs due to their relatively rich forest resources and their cheap operation costs. MNCs always find the cheapest places to operate their manufacturing centers, and some nations in group 3 can be the candidates. However, if the world experiences severe recession, nations in group 3 will not keep their competitiveness. Nations in group 4 do not have any supportive industry and demand condition is low, so do not have competitiveness at this moment.

Under the business as usual scenario, since many emerging markets will increase the capacity of the value-added process, the competitive advantage of advanced nations will go down. Advanced nations without rich forest resources, especially, will face real difficulties to secure raw material. The way to secure competitive advantage is to improve the competitiveness of wood production from forests (related industry). If something lowers the competitiveness of related industry in a nation, the sawnwood sector also will suddenly lose competitiveness. For example, forest cover in Indonesia has decreased significantly in the last decade or so. If this trend continues in the future, Indonesian wood extracting sectors will face difficulties, so the

Indonesian sawnwood industry will face difficulties as well. As the economy develops, wage and energy prices will likely inflate, which can reduce the competitiveness of emerging nations compared to already advanced nations.

Under the decoupling economic convergence scenario regarding resource deficits, struggling advanced nations will experience forest stock increases. On the other hand, emerging nations will face scarcity of resource. In this situation, excess lumber may flow from advanced nations to emerging nations. Hence, saw mills in advanced nations possibly sell their high quality sawnwood to emerging markets in the region. Putting efforts into improving the quality of products becomes more important.

If the world enters long and deep recession, advanced nations can acquire raw materials relatively easier from anywhere in the world. Efficient mills in advanced nations can keep their relative competitiveness under this scenario. The demand condition of emerging nations will deteriorate, and the competitiveness of the sawnwood industry in group 2 nations will go down. Yet, rich factor endowment will secure competitiveness in the long run, so as the world's economy recovers, they will slowly regain competitiveness again.

Table 26 summarizes the NCI outlook of the sawnwood industry. Smaller arrows indicate factors will lower the overall competitiveness, and vice versa. Bold and multiple arrows indicate sharp changes.

**Table 26. NCI outlook (2020) of the sawnwood industry**

| **Dimensions** | **Group 1** | **Group 2** | **Group 3** | **Group 4** |
|---|---|---|---|---|
| Advancement | Advanced | Mid | Mid | Mid |
| Support Industry | - | High | Low | None |
| Business as Usual | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Upstream Related Industry | ↓ | ↓↓ | ↓↓↓ | N.A. |
| Demand Condition | ↑ | ↑↑ | ↑↑ | ↑↑ |
| Energy Cost | ↓ | ↓↓ | ↓↓ | ↓↓ |
| Labor Cost | ↓ | ↓↓ | ↓↓ | ↓↓ |
| Productivity | ↑ | ↑ | ↑ | ↑ |
| Economic Convergence | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Upstream Related Industry | ↑ | ↓ | ↓↓ | N.A. |
| Demand Condition | ↓ | ↑ | ↑ | ↑ |
| Energy Cost | ↓ | ↓ | ↓ | ↓ |
| Labor Cost | - | ↓↓ | ↓↓ | ↓↓ |
| Productivity | - | ↑ | ↑ | ↑ |
| Global Recession | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Upstream Related Industry | ↑ | - | ↓ | N.A. |
| Demand Condition | ↓ | ↓ | ↓ | ↓ |
| Energy Cost | ↑ | ↑ | ↑ | ↑ |
| Labor Cost | ↑ | - | - | - |
| Productivity | - | ↑ | ↑ | ↑ |

**Outlook for competitiveness of the plywood industry**

Five factors were utilized to estimate the current NCI of the plywood industry as discussed in the last chapter. Some of these components are correlated in Table 27.

**Table 27. Correlation matrix of factors (plywood)**

| | Upstream | Demand | Energy | Labor |
|---|---|---|---|---|
| Upstream Linkage | 1.000 | | | |
| Demand Condition | -0.290 | 1.000 | | |
| Energy Cost | 0.205 | 0.296 | 1.000 | |
| Labor Cost | 0.467 | -0.165 | 0.076 | 1.000 |
| Productivity | -0.362 | 0.623 | 0.064 | -0.674 |

Explanatory factor analysis (with Varimax rotation) was applied in order to reduce the number of variables. Two dimensions were detected. According to the components matrix of reduced dimensions in Table 28, dimension 1 could embody the friendliness environments for small and medium-sized low-tech plywood manufacturers. So, when dimension 1 is higher, the nation has strong backward linkage support to supply large dimension logs and usually labor cost is cheaper there. Dimension 2 would be the degree of forward linkage of the plywood industry, since it relates to demand condition.

**Table 28. Components matrix of reduced dimensions (plywood)**

| | Dimension | |
|---|---|---|
| | 1 (SME Friendliness) | 2 (Forward Linkage) |
| Upstream Linkage | 0.765 | 0.140 |
| Demand Condition | -0.444 | 0.736 |
| Energy Cost | 0.269 | 0.833 |
| Labor Cost | 0.833 | 0.001 |
| Productivity | -0.800 | 0.430 |

Countries are finally grouped based on the perceptual map utilizing dimensions 1 and 2 as shown in Figure 81. Four groups were subjectively detected for the outlook.

Group 1: Advanced nations where large dimension trees are scarce
Group 2: Nations which have high demand for plywood and easier to access large dimension trees
Group 3: Nations where large dimension trees are somewhat available, but operation is challenging
Group 4: Nations where raw materials are not available and demand for plywood is low

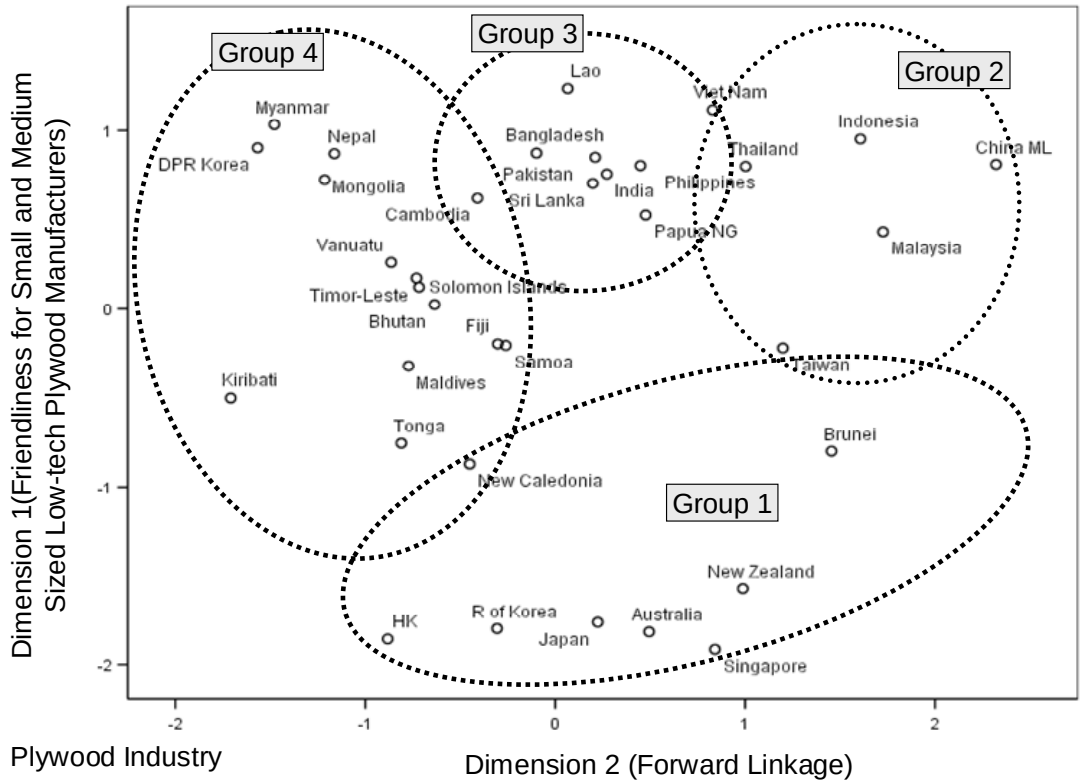



**Figure 81. Country groupings based on reduced dimensions of competitiveness (plywood)**

Nations belonging to group 1 have difficult challenges for the plywood industry in the future. They will likely be unable to access large dimension logs under any scenarios. People's environmental perception is high in these advanced nations, and usually they hesitate to import large dimension logs from other countries. The only way to keep competitiveness is to invest in technology. How much productivity they can achieve from small-and medium diameter trees is the key factor for their competitiveness. They even may need to shift capital investment in substitution sectors rather than in the plywood industry. Substitution includes fiberboard and particle board. It is easier to get raw materials for fiberboard and particle board, so retreating from the plywood business and concentrating on other wood-based board cannot be a bad strategy for nations belonging to group 1. Nations belonging to group 2 have high demand for plywood and they can currently access large dimension trees. However, their competitiveness is not going to be secured in the future as they advance. As they advance, government and citizen's environmental perception will probably get higher, and accessing large demension raw logs will be harder. Nations belonging to group 3 currently do not have competitiveness because of their low demand condition. They need to improve their national efficiency to raise downstream value-added industries, such as the furniture industry, to join group 2. Group 4 includes nations where demand for plywood is low. Hence, investments in plywood sectors in these nations are not really attractive. They need to lift up the wealth of citizen and raise related downstream industries.

Under the business as usual scenario, strong global demand for plywood will contribute further depletion of natural old growth. It will lower the score of upper related industry and access to raw materials and will lower the overall competitiveness. However, facing difficulties in accessing large diameter logs will result in investments in technology, which will somewhat offset the competitiveness downturn. Labor wages and energy costs will inflate considerably in emerging markets, and they will damage the overall competitiveness as well. In order to keep competitiveness in these emerging nations, they have to invest in capital

to improve their productivity. Otherwise, they will face serious adjustment when their competitive advantage of raw material becomes unstable. As the economy grows globally, some nations currently not having strong demand for plywood will gain national efficiency and successfully raise upstream value-added industry, so then demand fpr plywood will increase. Those nations will gain competitiveness relative to other advanced nations and emerging nations.

Under the decoupling economic convergence scenarios, strong regional demand from emerging markets will challenge the supply of large dimension logs. Nations can invest in capital and can improve their competitiveness, and they can narrow the current differences of technological efficiencies compared to advanced nations.

Under the global deep recession scenario, demand contraction occurs. Demand contraction first of all lowers the overall competitiveness of the plywood industry. Also, slow demand will contribute to shortage of investments in technology. Most nations cannot improve efficiency and productivity because of the shortage of investment. However, slowing demand all over the world will generate excess available natural forest resources. Labor cost and energy cost will not increase because of the global recession. If that happens, the productivity of emerging nations may drop further since they can easily access large diameter trees and utilize the low cost labor, which may make managers ignore the efficiency factor.

Table 29 summarizes the future outlook of the plywood industry by different scenarios. Smaller arrows indicate factors will lower overall competitiveness, and vice versa. Bold and multiple arrows indicate sharp changes.

**Table 29. Outlook of future NCI (2020) of plywood industry**

| **Dimensions** | **Group 1** | **Group 2** | **Group 3** | **Group 4** |
|---|---|---|---|---|
| Friendliness for Small and Mid-Sized Manufacturers | Low | High | High | High |
| Demand | - | High | Med | Low |
| Business as Usual | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Related Industry | ↓↓↓ | ↓↓ | ↓↓ | ↓ |
| Demand Condition | ↑ | ↑↑↑ | ↑↑ | ↑ |
| Energy Cost | ↓ | ↓↓ | ↓↓ | ↓↓↓ |
| Labor Cost | ↓ | ↓↓ | ↓↓ | ↓↓↓ |
| Productivity | ↑↑ | ↑ | ↑ | - |
| Economic Convergence | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Related Industry | ↓↓ | ↓↓ | ↓ | ↓ |
| Demand Condition | ↓ | ↑↑ | ↑ | ↑ |
| Energy Cost | ↓ | ↓ | ↓ | ↓ |
| Labor Cost | - | ↓↓ | ↓↓ | ↓↓ |
| Productivity | ↑ | ↑ | ↑ | - |
| Global Recession | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Related Industry | ↓ | - | ↑ | ↑ |
| Demand Condition | ↓↓ | ↓ | - | - |
| Energy Cost | ↑ | ↑ | ↑ | ↑ |
| Labor Cost | ↑ | - | - | - |
| Productivity | - | - | ↓ | ↓ |

**Outlook of competitiveness for the fiberboard and particle board industry**

Five factors were utilized to estimate the current NCI of the fiberboard and particle board industry as discussed in the last chapter. Some of these components are correlated in Table 30.

**Table 30. Lower-triangle correlation matrix of factors (fiberboard and particle board)**

| | Upstream | Demand | Energy | Labor |
|---|---|---|---|---|
| Upstream Industry | 1.000 | | | |
| Demand Condition | 0.376 | 1.000 | | |
| Energy Cost | 0.321 | 0.533 | 1.000 | |
| Labor Cost | 0.043 | -0.265 | -0.180 | 1.000 |
| Productivity | 0.184 | 0.574 | 0.474 | -0.639 |

Explanatory factor analysis (with Varimax rotation) was applied in order to reduce the number of variables. Two dimensions were detected. According to the components matrix of dimensions in Table 31, dimension 1 could embody the related industry's supportiveness since both backward (upstream industry) and forward (demand side) linkage show high correlation. Dimension 2 would be the reverse dimension of labor intensiveness since labor cost and availability are negatively correlated, and productivity matters.

**Table 31. Components matrix of reduced dimensions (fiberboard and particle board)**

| | Dimension | |
|---|---|---|
| | 1 (Related Industries Supports) | 2 (Labor Intensiveness [reverse]) |
| Upstream Industry | 0.811 | -0.191 |
| Demand Condition | 0.729 | 0.415 |
| Energy Cost | 0.722 | 0.308 |
| Labor Cost | 0.054 | -0.907 |
| Productivity | 0.392 | 0.830 |

Countries are finally grouped based on the perceptual map utilizing dimensions 1 and 2 as shown in Figure 82. Four groups were subjectively detected for the outlook.

Group 1: Advanced nations
Group 2: Nations where labor is available and related industries are strong
Group 3: Nations which have weak related industry and labor is somewhat challenging
Group 4: Nations where inexpensive labor is available, but related industries are very weak

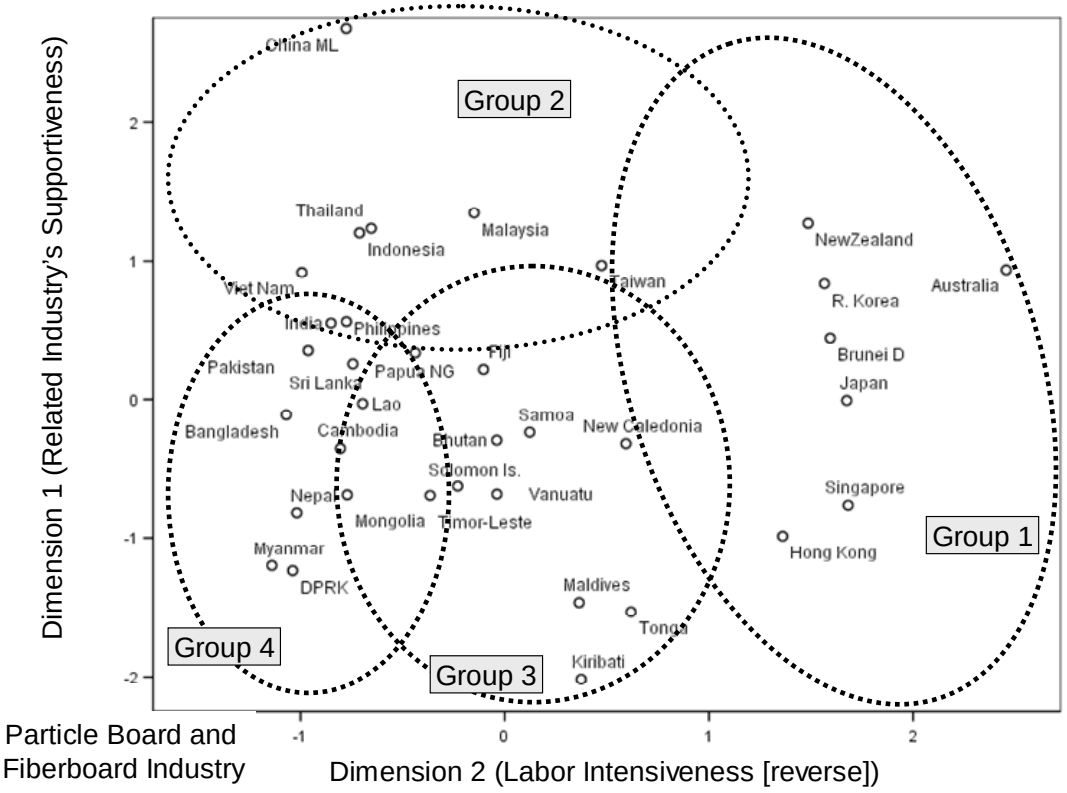



**Figure 82. Country groupings based on reduced dimensions of competitiveness (fiberboard and particle board)**

Nations in group 1 are advanced countries. Since labor cost is higher, they tend to invest in capital intensive facilities to increase productivity per labor. Group 2 nations have currently cheaper labor cost and strong related industries, such as plantations and furniture industry. They are quite competitive at this moment, but many difficulties will lie ahead. The nations belonging to group 3 do not have competitiveness currently compared with nations belonging to group 2 since their related industry is relatively weaker. Also, fundamentally, the labor condition of those nations is not good for small-sized labor-intensive panel production, which cannot improve in the next ten years. The nations belonging to group 4 do have inexpensive labor, but the related industries are very weak. Those nations need to holistically develop the industrial environment.

Under the business as usual scenario, the world will face shortage of wood resources. Emerging countries and advanced countries' appetite for wood products will rise, and commodity prices will likely rise as well. If a nation does not have its own raw resource supply source, it will face shortage of raw material supply, and lose competitiveness. Nations in group 2 have currently strong related industries, such as wood processing from plantations and furniture industry and their labor cost is cheaper right now. The furniture industry in group 2 relies on numerous and inexpensive labor forces in these nations. As nations get wealthier and labor cost inflates, some furniture firms may move to other nations where the labor cost is much cheaper. If this trend starts, demand will suddenly start declining, and the fiberboard and particle board industry will eventually lose competitiveness. Industries are all connected and competitiveness is very dynamic. On the other hand, some nations in group 3 will raise related industry as the nations develop and will gain relative competitiveness.

Under the global decoupling economic convergence scenario, domestic demand conditions of emerging nations will rise. However, foreign demand condition from advanced nations will decrease, and many countries in group 2 which primarily target the end-users in advanced

nations (e.g. exporting furniture as final product to advanced nations) will face difficulties. Regional demand may be able to offset the demand declining from the advanced nations, but it depends on the current structure of marketing strategies of the nation. Nations in group 2 may face labor cost inflation as well. They want to shift from labor-intensive ways to manufacture fiberboards and particle boards in more capital intensive ways. Temporally, some nations will face adjustment from the transitional shocks. Those transitional shocks will not only affect the particle board and fiberboard industry, but also affect related industries such as the furniture industry. How government help to smoothly shift from labor-intensive manufacturing to capital intensive manufacturing is the key. In order to avoid the transitional shock, if the government mistakenly attempts to subsidize firms which do not have competitiveness, those policies may reduce the long-term competitiveness of the nation. Nations in group 3 will gradually increase competitiveness over other nations as they develop related industries. Many firms in advanced nations will face difficulties if the government lets the situation go because of shrinking markets. However, industry itself may gain competitiveness in the long run because of the consolidation and it will eventually benefit the citizens of the nation.

Under the severe recession scenario, global demand for fiberboard and particle board will shrink dramatically. As consumption of durable goods cools down, furniture production and construction will slow down all over the world. Then, demand for fiberboard and particle board will slow down, and the nations which currently produce large volumes of wood-panels will face severe adjustment. If some nations attempt to help firms which do not have competitiveness, those actions will harm the overall competitiveness of the nations in the long run as well. However, wood material prices will come down and wood raw material can be accessed easily. This may open up opportunities for new entrepreneurs in the future.

Table 32 summarizes the changing of the future NCI based on the different scenarios. Competitiveness is the most important driver for the nation to achieve wealth. In order to lift up the competitiveness of the wood-panel industry, advanced nations need consolidation, nations that utilize labor intensively need capital investment and less developed countries need social infrastructure.

**Table 32. NCI outlook (2020) for the fiberboard and particle board industry**

| Dimensions | Group 1 | Group 2 | Group 3 | Group 4 |
|---|---|---|---|---|
| Related Industry Supports | Med | High | Low | Med-Low |
| Labor Intensiveness | Low | High | Med | High |
| Business as Usual | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Upstream Industry | ↑ | ↓ | N.S. | ↑ |
| Demand Condition | ↑ | ↑↑ | ↑ | ↑ |
| Energy Cost | ↓ | ↓↓ | ↓↓ | ↓↓ |
| Labor Cost | ↓ | ↓↓ | ↓ | ↓ |
| Productivity | ↑ | ↑(?) | N.S. | ↑ |
| Economic Convergence | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Upstream Industry | - | ↓ | N.S. | ↑ |
| Demand Condition | ↓ | -(?) | ↑ | ↑ |
| Energy Cost | ↓ | ↓ | ↓ | ↓ |
| Labor Cost | - | ↓↓ | ↓ | ↓ |
| Productivity | - | ↑ | N.S. | ↑ |
| Global Recession | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Upstream Industry | ↓ | - | ↑ | ↑ |
| Demand Condition | ↓↓ | ↓ | ↓ | ↓ |
| Energy Cost | ↑ | ↑ | ↑ | ↑ |
| Labor Cost | ↑ | - | - | - |
| Productivity | - | - | - | - |

**Outlook for competitiveness in the pulp and paper industry**

Six factors were utilized to estimate the current NCI of the pulp and paper industry as discussed in the last chapter. Some of these components are highly correlated in Table 33.

**Table 33. Lower-triangle correlation matrix of factors (pulp and paper)**

| | Upstream | Demand | Energy | Operation | Risk |
|---|---|---|---|---|---|
| Related Upstream Industry | 1.000 | | | | |
| Demand Condition | 0.279 | 1.000 | | | |
| Energy Cost | 0.206 | 0.590 | 1.000 | | |
| Operation | 0.076 | 0.564 | 0.564 | 1.000 | |
| Country Risk | -0.048 | 0.651 | 0.747 | 0.561 | 1.000 |
| Productivity | 0.281 | 0.791 | 0.565 | 0.694 | 0.555 |

Explanatory factor analysis (with Varimax rotation) was applied in order to reduce the number of variables. Two dimensions were detected. According to the components matrix of dimensions in Table 34, dimension 1 could embody the degree of development in the nation since it relates to demand condition, energy cost, efficiency, country risk and productivity. Dimension 2 would be the degree of backward linkage in each nation because it shows high correlation with related upstream industry.

**Table 34. Components matrix of reduced dimensions (pulp and paper)**

| | Dimension | |
|---|---|---|
| | **1 (Investment Attractiveness)** | **2 (Backward Linkage)** |
| Related Upstream Industry | 0.066 | 0.968 |
| Demand Condition | 0.825 | 0.300 |
| Energy Cost | 0.825 | 0.089 |
| Operation | 0.807 | 0.023 |
| Country Risk | 0.876 | -0.189 |
| Productivity | 0.822 | 0.324 |

Countries are finally grouped based on the perceptual map utilizing dimensions 1 and 2 as shown in Figure 83. Four groups were detected for the outlook purpose.

Group 1: Advanced nations attractive for investment
Group 2: Backward linkage is strong but needs some improvement for the investment environment
Group 3: Backward linkage is strong but too risky for investment
Group 4: Backward linkage is weak and riskier for investment

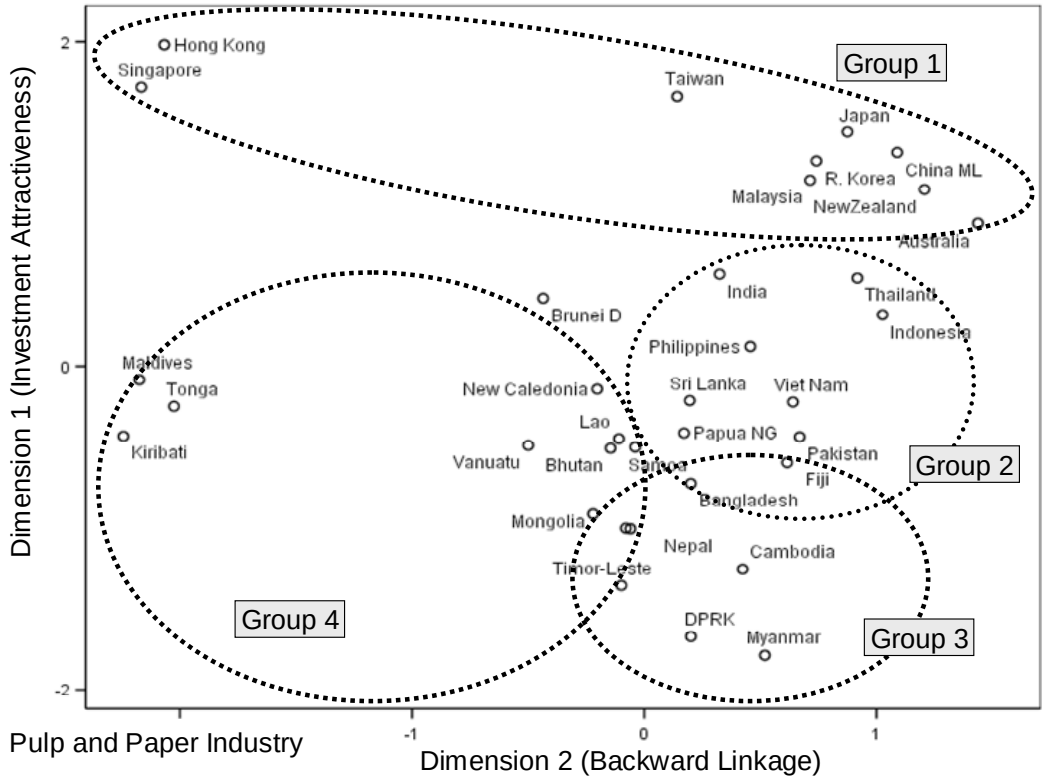



**Figure 83. Country groupings based on reduced dimensions of competitiveness (pulp and paper)**

Nations in group 1 have higher productivity and lower country risk for investment. Nations in group 2 have relatively constant raw material supply, but need more improvement for their productivity to attract investment and increase competitiveness. Nations in group 3 have raw material sources, but are currently too risky to invest in huge paper production facilities. They must improve the social and political situation; otherwise they cannot attract investment in any kinds of scenario. Nations in group 4 neither have constant raw material supply nor high

productivity. Therefore, they are out of the scope of paper competitiveness in the next ten years.

Under the business as usual scenario, the world will face shortage of wood resources. Emerging countries and advanced countries' appetite for paper will go up, and commodity prices will likely go up as well. If a nation does not have its own wood fiber supply source, it will face shortage of raw material supply, and lose competitiveness. Consolidation would be the key for advanced nations in group 1 since economy of size is the most important factor to cut the cost structure. Paper demand in nations in group 2 will increase, so they have to establish facilities with advanced technology to gain competitiveness against other nations. If nations in group 3 would like to lift up the competitiveness of the paper sector, they, first of all, need to reduce country risk. Foreign direct investment is always risk sensitive. Sustainable water supply would become a constraint for additional investment because pulp and paper factories consume huge amounts of water as mentioned in the previous chapter.

Under the global decoupling economic convergence scenario, the emerging nations in Asia will consume a lot of paper as well. On the other hand, paper demand of advanced nations will slow down somewhat, but not dramatically like durable goods. Of course, decreasing demand for paper from advanced nations will reduce the foreign demand in emerging nations, but the damage is not as severe as the wood-panel industry. There is more stable paper demand in emerging nations as their economy is strong. Those emerging nations will be able to import raw material wood fiber easily from resource rich developed nations.

When the world faces severe recession, paper consumption will likely decline as well especially in less developed nations. Under this scenario, the wood price will come down and wood raw material can be accessed anywhere. Although overall demand will go down somewhat, advanced nations will retain competitiveness relatively against developing nations. Nations producing packaging materials rather than graphic paper may face severe downturn. Nations in group 2 may face some difficulties in attracting additional investment and lose competitiveness. As the relative country risk increases as the economy gets worse, capital will come back to advanced nations and be invested in the defensive sectors, such as paper facilities.

Table 35 summarizes how the competitiveness landscape will change by the scenarios. Competitiveness will not change dramatically in any scenarios since paper demand is more stable than other forest products. Water supply, social infrastructure and raw material supply are key variables to attract additional investments in emerging nations. In advanced nations, competitiveness may come from consolidations and the economy of scale.

**Table 35. NCI outlook (2020) for the pulp and paper industry**

| Dimensions | Group 1 | Group 2 | Group 3 | Group 4 |
|---|---|---|---|---|
| Investment Attractiveness | High | Mid | Low | Mid-Low |
| Backward Linkage | - | High | High | Low |
| Business as Usual | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Upstream Industry | ↓ | ↓↓ | ↓ | N.S. |
| Demand Condition | ↑ | ↑↑ | ↑↑ | N.S. |
| Energy Cost | ↓ | ↓↓ | ↓↓↓ | N.S. |
| Operation | ↑ | ↑ | ↑ | N.S. |
| Country Risk | - | ↑ | ↑ | N.S. |
| Productivity | ↑↑ | ↑ | ↑ | N.S. |
| Economic Convergence | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Upstream Industry | ↑ | ↓ | ↓ | N.S. |
| Demand Condition | - | ↑ | ↑ | N.S. |
| Energy Cost | ↓ | ↓ | ↓↓ | N.S. |
| Operation | - | ↑ | ↑ | N.S. |
| Country Risk | - | ↑ | ↑ | N.S. |
| Productivity | - | ↑ | ↑ | N.S. |
| Global Recession | | | | |
| Factors | Group 1 | Group 2 | Group 3 | Group 4 |
| Upstream Industry | ↑ | - | ↑ | N.S. |
| Demand Condition | ↓ | ↓ | ↓ | N.S. |
| Energy Cost | ↑ | ↑ | ↑↑ | N.S. |
| Operation | - | - | - | N.S. |
| Country Risk | ↓ | ↓ | ↓↓ | N.S. |
| Productivity | - | ↓ | ↓ | N.S. |

**Risk and uncertainty of outlook**

Many variables move stochastically and it is extremely difficult to forecast the future trend. They include exchange rate and input material price. Those are risk factors. Also, some events happen unpredictably, and cannot be predicted in advance. These events include governmental structural change, sudden policy change (e.g. subsidy program, tax deduction), war, and natural disaster (e.g. fire and tsunami). These are uncertainties. Unfortunately, these risk factors and uncertain events will change the map of competitiveness dramatically especially in the short run. The three scenarios in this chapter try to consider the direction of risk factors.

Some readers may be interested in special risk factor, such as the appreciation of the Chinese renminbi. Technically, the currency exchange rate moves stochastically, so it is not easy to capture the future trend. Even though the Chinese renminbi will appreciate against the US dollar, it is not clear whether it will strengthen against other currencies in the APR or not. If the Chinese renminbi appreciates against most other major currencies in the future, the competitiveness landscape of the APR will change dramatically. First of all, Chinese labor cost will become relatively more expensive than other nations. This forces China to change from labor-intensive operations to capital-intensive operations. On the other hand, Chinese purchasing power will go up, so Chinese domestic demand will go up. However, foreign demand for Chinese goods will come down at the same time. These two incompatible factors will decide the future competitiveness of Chinese manufacturers. Currently, many Chinese forest products firms are targeting end users in advanced nations. Appreciation of the Chinese

renminbi will force them to adjust their marketing strategies and business operations. Overall, Chinese industry may face very difficult temporary shocks, which even reduce direct investments to the sector. Policy makers have multiple interests, but if they would like to prioritize the wealth of citizens in the long run, they should carefully assess what kinds of action will affect the long-term competitiveness of the nation.

## 6. CONCLUSION

Competitiveness is the nation's ability to create wealth. Competitiveness is the alternative view to assess the attractiveness of foreign direct investments and flows of international trade. Price theory is necessary to analyze the vigorousness of a nation's industry, but this is not sufficient. Competitiveness can compensate the limitations of price theory.

Today's strong competitiveness does not necessarily promise future competitiveness. Today's success may change the future competitiveness landscape. Policy makers in each nation should carefully assess the competitiveness of industry and strategically help firms to operate their own businesses efficiently to create wealth for citizens.

### *Limitation of the study*

This study is a bold attempt to create a simple NCI to compare the conditions of the competitiveness of forestry sectors in the APR. The limitations of this study include the methodology, data accuracy and the scope of study.

This study only focuses on competitiveness in the next ten years and in the APR. Hence, the interaction between nations in other regions is not considered in this study, although these interactions are extremely important in the current globalized world.

Since this study oversimplified reality, so weighting is systematically assigned based on the opinions of experts. Of course, there were many more potential factors concerning the competitiveness of industry; but only some important factors were chosen to estimate the competitiveness of industry. In order to compare the factors, all factors were standardized, but these factors may not be distributed normally among nations. Also, weightings should be different nation by nation since a nation with a cheap labor force may focus more on labor. Vice versa, a nation where labor cost is higher should focus more on capital. This kind of strategic choice could not be included in the study. Also, competitiveness in the industry of a planned economy nation tends to be smaller in this study. Partially, the idea of competitiveness is to attract investment. It is true that all nations do not necessarily prioritize the return from investments.

Related downstream industries of forest products definitely include the furniture industry and construction industry. However, the comparable available data are not available, so the overall demand data were substituted for those downstream industries.

The accuracy of data is really troublesome. FAO statistics are totally dependent on national reports. However, data from many nations, especially from developing nations, are sometimes inaccurate. Also, availability of data was a problem. There are many missing data for publicly available information, so estimation by using regression was applied to estimate the missing values in this study.

This outlook study is based on the scenarios of grouped nations. Risk and uncertainty were excluded from the prediction. Each nation has a different environment, and some of them are critical for future competitiveness. However, individual idiosyncratic factors were intentionally ignored in the outlook section to keep the discussion straightforward. If readers are interested in these unique idiosyncratic factors which may affect future competitiveness, how those factors influence each factor of the NCI can be seen by using the table.

This pilot study opens up much room for improvement in the future with more resource input. Since Michael Porter published his book *The competitive advantage of nations*, competitiveness has been regarded as a panacea for national wealth creation. Consequently,

this competitiveness study of the wood processing and forest product industry is critically important.

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