JARQ 41 (1), 85 – 93 (2007) http://www.jircas.affrc.go.jp

Analysis on the Development of China's Wood Processing Industry

Yufu ZHANG[1]*, Satoshi TACHIBANA[1] and Shin NAGATA[2]

[1] Department of Forest Policy and Economics, Forestry and Forest Products Research Institute (Tsukuba, Ibaraki 305–8687, Japan)

[2] Department of Forest Science, Graduate School of Agricultural and Life Sciences, University of Tokyo (Bunkyo, Tokyo 113–8657, Japan)

Abstract

This paper analyzes the development of China's wood processing industry since the start of the economic reform in 1979. The paper examines self-sufficiency rates and trade specialization coefficients of wood products and undertakes a correlation analysis for the period from 1979 to 2004, and specifies production functions of wood products from 1990 to 2004. The paper finds that self-sufficiency rates for wood products have a similar course of development as they decreased first and then increased later with increases in production, imports and exports. Within the wood processing industry, plywood holds the highest self-sufficiency rate, but sawnwood holds the lowest. The industry has a low international competitiveness, except for plywood which has a comparative advantage in international trade, as shown by trade specialization coefficients. The correlation analysis shows that there is a high correlation between the production of plywood, fibreboard, and particle board panels. The production functions show that in decreasing order, sawnwood, plywood, fibreboard, and particle board have proportional increases in production with each unit of roundwood supply at the shares of the domestic supply of roundwood, 34, 33, 19, and 14%, respectively. Furthermore, in this analysis imported roundwood helps the production of wood panels grow faster than the domestic roundwood supply does.

Discipline: Forestry and forest products
Additional key words: correlation analysis, production function, self-sufficiency rate, trade specialization coefficient, wood products

Introduction

Recognizing the scarcity of forest resources, with only 8.6% of the land area covered by forest in 1948[7] and 18.21% in 2003[16], China has been striving to use wood efficiently and to develop the wood processing industry since the 1950s. However, because of political reasons, limitations of forest resources, and little assistance from foreign technology and investment, the wood processing industry grew slowly before December 1978 when China decided to implement a policy of economic reform[3,6].

As with other industries in China, the economic reforms and open-door policies have accelerated the development of the wood processing industry. Since the beginning of the 1980s, privately owned enterprises and those with foreign investment have played an important role in the wood processing industry. However, state-owned enterprises have been facing a lack of capital to invest in new equipment and technology. Many state-owned wood processing enterprises have also had to serve social and governmental functions, such as running elementary schools, middle schools, police stations, etc., which have placed a heavy burden on the enterprises. In order to develop the wood processing industry, the central government initiated a strategy to support those enterprises that are considered well managed and had significant market share in 1995[19].

The supply of raw materials is another problem facing the wood processing industry in China, and the dependence on foreign wood has been increasing. The self-sufficiency rate for wood was about 90% or more until 1998, but decreased to 60% in 2003[24]. Since 1999, the import of roundwood has been encouraged and imports have increased 4.45 times from 4.823 million m^3 in 1998 to 26.296 million m^3 in 2004[4].

At 53.650 million ha in 2003, China has the largest area of planted forests in the world[16]. Among all the

*Corresponding author: e-mail zhangyf@affrc.go.jp
Received 30 June 2005; accepted 19 June 2006.

planted forests, 40% are economic forests including fruit trees and edible oil trees, while 60% are timber forests. It offers hope of an increase in the supply of domestic roundwood.

The objectives of this research are (1) to examine the development of the wood processing industry in China by applying an analysis of the self-sufficiency rate and trade specialization coefficient; (2) to clarify the internal relationships between wood processing industries by applying correlation analysis; and (3) to clarify the mechanism of production development of the industry by estimating production functions for wood products in China. Because the wood processing industry is mainly divided into the sawnwood industry, plywood industry, fibreboard industry and particle board industry, we chose the sawnwood, plywood, fibreboard, and particle board industries as our research objects. Since 1979, the wood processing industry has witnessed big changes, we therefore undertook the analysis of the period from 1979 to 2004. Because the market system began to play a more important role since the early 1990s than before, we adopt the production function analysis to those four component industries for the period from 1990 to 2004.

Review of the development of the wood processing industry

1. The sawnwood industry

Sawnwood is wood that has been produced, either by sawing lengthways or by a profile-chipping process and that, with a few exceptions, exceeds 5 mm in thickness[12]. The sawnwood industry using modern machinery began in the 1860s[22]. Total production reached 3.44 million m^3 in 1950 and 12.71 million m^3 in 1979[15].

Fig. 1 shows the increase in sawnwood production prior to 1985. In the early 1980s Southern China had a cutting boom when farmers got forests from villages or towns for management by contract. Regulations for harvesting were ignored and cutting for cash became popular for farmers. As a result the production of sawnwood also increased during this period. Since 1986, the production of sawnwood decreased. The Forest Law was enacted in 1985 followed by a system of timber harvesting quotas enacted in 1986. In addition, a tight national finance policy was implemented at the end of the 1980s to calm down the over-heated economy and to control the double digit inflation index (the general consumer price index increased at a rate of 118.8% in 1988 and 118.0% in 1989)[5].

At the beginning of the 1990s, the macroeconomic control loosened and the production of sawnwood increased again. China obtains and issues annual statistical data through a reporting system from production units to government, but China undertook the third national industrial census in 1995 and the census data became statistical data for the year. This causes the data in 1995 to lose its comparability with other years. In 1996, China raised the added-value tax from 13% to 17% and made the sawnwood production unprofitable, so production of sawnwood decreased from 1996[13]. However since 2001, with the growth in demand for construction, furniture-manufacturing and interior decoration, and with the increase in imports of sawnwood, the production of sawnwood also increased[2]. In 2000, because of the increase in demand, the price of sawnwood increased 29.5% to that in 1999[17].

Fig. 1 shows that the import of sawnwood has generally been increasing from 1981, and the increase is faster since 1999 when the natural forest protection project had started and the policy of encouraging imports of timber implemented[23]. Due to limited domestic supply of roundwood of large diameter or of good quality, some high quality sawnwood was imported, such as *Fagus longipetiolata*, oak, cherry wood, black walnut, etc. These were mainly used for interior decoration and furniture production[18]. The growth in the architecture industry and furniture manufacturing industry caused the development of the sawnwood and wood panel industries. China exported 49.94 million pieces or US$ 0.86 billion of furniture in 1998, with an increase of 19.02% in US$ compared with that in 1997[1], while the export has reached to 128.50 million pieces or US$ 3.68 billion, with increases of 20.24% and 29.69% respectively, in 2004[4].

The central government strictly controlled exports because of the scarcity of forest resources. In the 1980s, only several tens of thousands of cubic meters of sawnwood were exported annually. From 1990, exports increased due to their higher international prices. The sawnwood was exported at an average price of US$ 437.71/m^3, while the domestic price was about US$ 150/

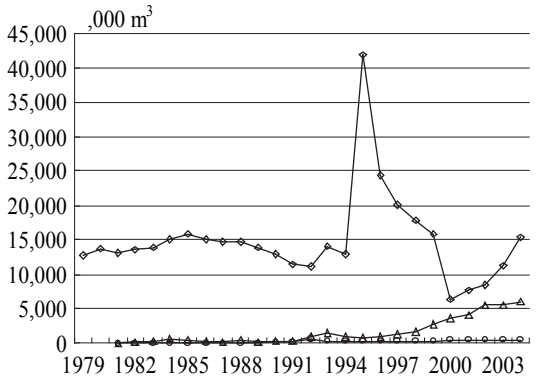

Fig. 1. Production, import and export of sawnwood in China

—◇—: Production, —△—: Import, —○—: Export.

m^3 in 2001[18]. Many sawnwood enterprises use imported roundwood as their raw materials and some of their production is exported. In the two largest Chinese ports for Russian roundwood imports, Manzhouli in Inner Mongolia and Suifenhe in Heilongjiang Province, many sawmills were built to produce sawnwood from Russian roundwood by Chinese and some foreign investors[23]. Both production and exports have increased, but imports increased faster, as imports increased from 0.253 million m^3 in 1990 to 1.413 million m^3 in 1993, increasing further to 6.004 million m^3 in 2004[4].

2. The plywood industry

Plywood is a panel consisting of an assembly of veneer sheets bonded together with the direction of the grain in alternate plies generally at right angles[12]. Plywood has been welcomed as it maintains the timber's natural characteristics, being even, smooth, artistic, and strong. In the 1920s, a group of Russians and French set up a plywood factory in Tianjin. The production of plywood was on a low level for a long time. From the 1980s, more foreign equipments were imported, and production increased as well. In the 1990s, small private factories and foreign investment factories played an important role in the increase of production. The production of plywood increased from 4.465 million m^3 in 1998 to 20.986 million m^3 in 2004[15].

China has been importing plywood since the 1980s. Fig. 2 shows that imports increased until 1993 and decreased from 1994. Exports have been increasing since 1994; in 2001, exports of plywood exceeded imports for the first time and have continued to do so ever since.

Most foreign enterprises and joint ventures with Chinese and foreign investment can produce high quality plywood, but most small and private factories do not. In order to expand exports, the Chinese plywood industry needs to meet other international requirements, such as low formaldehyde content in glue and international forest certification standards. As forest certification becomes increasingly recognized, it is also necessary for Chinese exporters to learn to cope with the forest certification issue. As Chinese plywood has a price advantage on the international market, there is also a possibility of being sued for dumping. Indeed, the EU decided to impose anti-dumping duties ranging from 8.5% to 23.9% on four enterprises and 48.5% on all other enterprises exporting China-made Okoume plywood (only outer faces made of Okoume for the Okoume plywood made in China) from May 19, 2004[11]. Accession to the WTO (World Trade Organization) provides opportunities for the development of Chinese enterprises, but challenges as well.

3. The fibreboard industry

Fibreboard is a panel manufactured from fibres of wood or other ligno-cellulosic materials with the primary bond deriving from the felting of the fibers and their inherent adhesive properties[12]. Because the raw material for fibreboard is mainly residue wood generated by the roundwood harvest and sawnwood processing, its usage is welcome in China. Production of fibreboard by wet processing uses similar raw materials as wood pulp papermaking, so some of the raw materials used have been gradually transferred to the paper industry. Because fibreboard production by the wet processing approach causes water pollution in China today, hard fibreboard constitutes only a small part of the total fibreboard production, as most of it is Medium Density Fibreboard (MDF) now. Taking 2002 as an example, of 7.64 million m^3 of fibreboard production, 6.95 million m^3 was MDF.

As shown in Fig. 3, the production of fibreboard did not increase much until the end of the 1990s. Since 1999, the production of fibreboard has accelerated driven by the

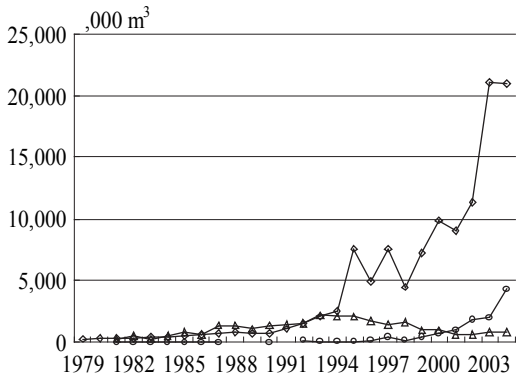

Fig. 2. Production, import and export of plywood in China

: Production, : Import, : Export.

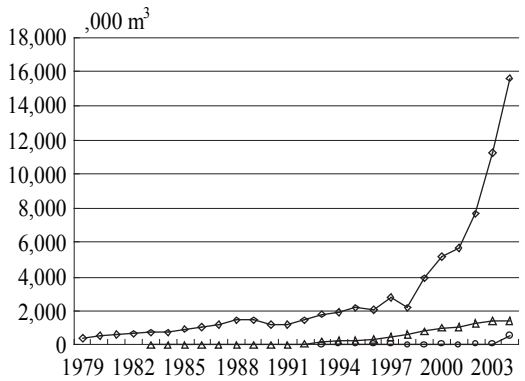

Fig. 3. Production, import and export of fibreboard in China

: Production, : Import, : Export.

accumulation of economic development at a level of over 7% annual GDP growth[5], demand from furniture production and interior decorations has been similar to other wood products. Imports increased in the 1990s, and there is a very small annual export of fibreboard which is also increasing. The small scale of fibreboard enterprises, the poor quality, and the high unit cost caused by small scale are the reasons why they are not internationally competitive. According to the third industrial census in 1995, the average annual capacity of hard fibreboard factories was only 3,700 m^3, while 50,000 m^3 is the world average[1].

4. The particle board industry

Particle board is a panel manufactured from small pieces of wood or other ligno-cellulosic materials (e.g. chips, flakes, splinters, strands, shreds, shives, etc.) bonded together by using an organic binder together with one or more of the following agents: heat, pressure, humidity, a catalyst, etc[12]. The production of particle board does not emit as much wastewater as fibreboard production does, and does not need as high quality raw materials as plywood production does.

China has produced particle board since 1956 mainly by using domestic equipments and the products were of low quality and high cost because of problems with the quality of equipments[22]. In the early 1980s, China introduced a complete set of equipment with an annual capacity of 30,000 m^3 from Germany, and also introduced advanced equipment from other countries later. Due to the imported equipments, and with the demand from the development of the furniture and internal decoration industry, the production of particle board increased to 6.429 million m^3 in 2004 from 53,000 m^3 in 1979, i.e. 120 times, as shown in Fig. 4. The peak for the data in 1995 is similar to that of sawnwood which is difficult to compare with those in the other years.

Progress in the import and export of particle board is very similar to that of fibreboard. Both imports and exports are increasing, with imports remaining larger than exports.

Self-sufficiency rate and trade specialization coefficient for the wood processing industry

Even though China has a large area of forested land, 175 million ha in 2003, it is very small relative to China's large population and to China's large land area, with per capita forest area of 0.132 ha, ranking 134th, and with forest coverage ranking 130th in the world[16]. For a long time, China consumed few wood products, and the production of wood products also developed slowly. After the economic reforms started, more and newer equipment was introduced and, except for sawnwood, the wood processing industry has grown rapidly as shown in Figs. 1 to 4. Among these, the plywood industry is the most advanced as it is the only one that has exports that exceed imports.

1. Self-sufficiency rate

Self-sufficiency rate (SSR) is the share of the domestic production in the total consumption. It reflects how much a country or an area meets its own demand for some product(s). China closed its door to the outside world and concentrated on domestic production for 30 years before the economic reform in 1979. China did not import many wood products, so SSR was nearly 100% during that period.

More sawnwood and plywood, compared with that in the centralized economic system period, were imported in the early 1980s. As shown in Fig. 5, SSR for plywood dropped sharply to 41% in 1982 from 100% in 1980, and stayed at a level of less than 60% until 1994. Since 1991, the production of plywood increased both in quantity and

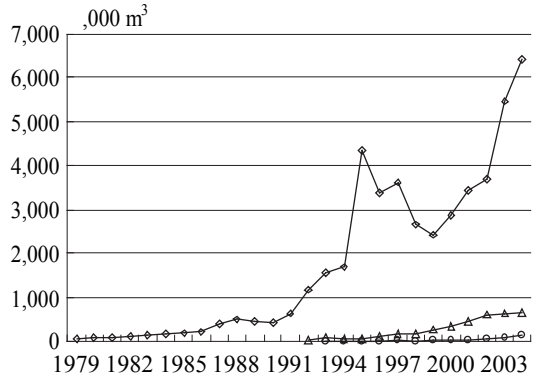

Fig. 4. Production, import and export of particle board in China
—◇—: Production, —△—: Import, —○—: Export.

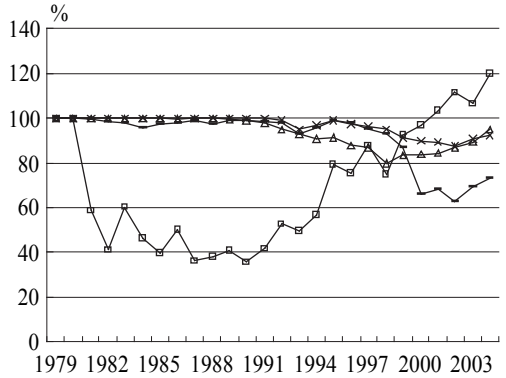

Fig. 5. Self-sufficiency rates (SSR) for wood products
—•—: Sawnwood, —□—: Plywood,
—△—: Fibreboard, —×—Particle Board.

quality. To 2004, more than one hundred sets of plywood-making machines were imported[1]. Foreign veneer and high quality roundwood also provide raw materials for China's plywood production. Therefore, SSR for plywood has reached to 120% in 2004, which makes the plywood industry the most advanced in China among all the wood processing industries. There were some sawnwood imports, but very small in quantity compared with the level of its production, so SSR did not decrease much, only 2 or 3 percentage points, in the 1980s. China has imported more sawnwood and SSR for sawnwood has decreased since 1998 when China started to implement a natural forest protection project. The import of fibreboard and particle board started in the 1990s, and SSR decreased since then, but increased in the last two or three years. So, the wood products have a similar course of development. In 2004, all SSR increased due to the increase in domestic production and export, but SSR for sawnwood is still the lowest.

2. Trade specialization coefficient

The trade specialization coefficient (TSC) is the share of net exports in the total of imports and exports. TSC is an index showing the comparable advantage of a country[21]. TSC, also called international competence capacity (ICC), is calculated based on the following formula: TSC = (exports – imports) / (exports + imports). When there are no exports but only imports, it takes the value of –1, i.e. specialization in imports; when there are no imports but only exports, it takes the value of +1, i.e. specialization in exports; when TSC equals 0, it means that there is a high degree of specialization among countries within the industry. The closer the scale of the coefficient is to 1, the stronger the competitiveness is and the industry has stronger comparative advantages. There exists the inequality $-1 \leq TSC \leq +1$.

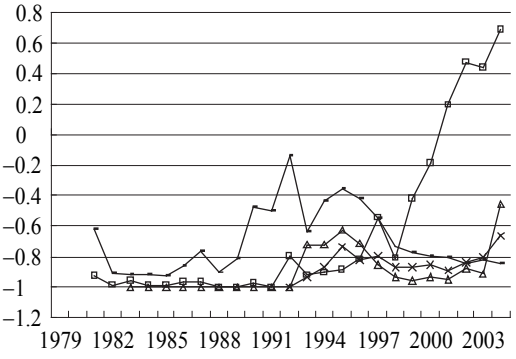

Fig. 6. Trade specialization coefficients (TSC) for wood products
—•—: Sawnwood, —□—: Plywood,
—△—: Fibreboard, —×—: Particle Board.

Fig. 6 shows the shift of trade specialization coefficients for wood products in China since 1979. Even though there are some ups and downs in TSC for plywood, it has been positive since 2001, and has increased since then. TSC for plywood in 2004 reached 0.69. It can be stated that the plywood industry has the strongest competitiveness within the industry in China. As to TSC for sawnwood, it increased until the early 1990s, but decreased from 1996, and increased from 2001, but remains at a very low level. TSC for sawnwood has decreased to as low as –0.85 in 2004. The shift of TSC for fibreboard and particle board is similar and TSC are very low due to their low exports. However, it should not be ignored that there were increases in all TSC except for sawnwood in 2004, because exports for all these wood products increased, but imports did not increase or only increased a little in 2004.

Correlation analysis

Since the 1950s, China has been trying to develop the wood processing industry, including sawnwood, plywood, fibreboard, particle board, etc., but only after the 1979 reforms did it develop rapidly. Correlation analysis was undertaken to clarify the relationships within the wood processing industry in this research. We calculated two sets of matrices of correlation coefficients for these four wood products, one for the period from 1979 to 1989, and another from 1990 to 2004, as shown in Tables 1 and 2, because 1979 is the first year when economic reform began, while the market system began to play a more important role since the early 1990s than before.

Both Tables 1 and 2 show that there are high correlation coefficients between the productions of wood panel products; the null hypothesis of no correlation is rejected when testing at the 1% level of significance. The strong complementary relations among them account for this result. Plywood production needs raw materials of high quality, at least for facial veneers, while fibreboard and particle board production do not require such strictly controlled raw materials, and the core wood residuals from plywood production are also good for the production of fibreboard and particle board. Similarly, the three wood panel products increased steadily from 1979 to 1995, had some decreases and increases from 1996 to 1999, and increased very fast from 2000, as shown in Figs. 1 to 4. The fast increase in house building, furniture exports, and the interior decoration boom have made the productions of all wood panels increase quickly since 2000. Because plywood has a better decoration effect, and better physical characteristics, such as intensity and rigidity, than fibreboard and particle board, its production is the highest in

Table 1. Matrix of correlation coefficients (1979–1989)

	Sawnwood	Plywood	Fibreboard	Particle board
Sawnwood	1.000			
Plywood	0.578*	1.000		
Fibreboard	0.490	0.972**	1.000	
Particle board	0.413	0.965**	0.981**	1.000

When degree of freedom (df) = 9, critical value = 0.735 at the 1% level of significance, while the critical value = 0.521 at the 10% level of significance.
**: Significant at the 1% level, *: Significant at the 10% level.

Table 2. Matrix of correlation coefficients (1990–2004)

	Sawnwood	Plywood	Fibreboard	Particle board
Sawnwood	1.000			
Plywood	–0.074	1.000		
Fibreboard	–0.232	0.951**	1.000	
Particle board	0.252	0.917**	0.825**	1.000

When df = 13, critical value = 0.641 at the 1% level of significance.
**: Significant at the 1% level.

the wood processing industry. High added-value for plywood is another reason for its high growth.

Tables 1 and 2 give a different picture for the correlations between the production of sawnwood and that of plywood. Table 1 shows that there is a correlation between them, but Table 2 shows that no correlation exists. In the period from 1979 to 1989, sawnwood production increased in the first half of the 1980s, but decreased later, while plywood production developed at a slow pace compared with other wood panels in the 1980s. Both sawnwood and plywood require high quality roundwood as their raw materials to be profitable. The technology of utilizing small diameter roundwood from plantation forests and utilization of foreign veneer helped plywood production develop since the latter half of the 1980s. In the period from 1990 to 2004, the production of sawnwood experienced ups and downs, but wood panel products increased from 1990 to 2004.

Modeling the production of the wood processing industry

A production function is a function that reflects the relations of "a real-valued, m-dimensional vector containing both inputs used and outputs produced in a given time period"[8]. Inputs could include capital, labor, land, and others. Egaitsu and Shigeno discussed the relations among inputs and summarized that inputs have complementary or substitution relations[9,10]. Tachibana specified production functions for sawnwood using cross sectional data from 47 prefectures in Japan by taking the number of sawmills, average horsepower kilowatt per sawmill, and average number of employees per sawmill into consideration[20]. Tachibana also specified production functions, at a high level of significance and coefficients of determination, for sawnwood by using only the arrival quantity of roundwood to sawmills in the second step of the modeling.

Because there is no systematic labor and capital data for China's wood processing industry, and because supply of raw material for the wood processing industry has key impacts on development of the production, in this research, we try to specify production functions with only raw materials as the inputs, i.e. by taking supply of roundwood as the input of the production. As imported roundwood became important in China, we take both domestic roundwood supply and imported roundwood into consideration. In this research, we specify production functions for the period of 1990 to 2004 because from 1990 the market system began to play an important role in China. Of course, in these production functions there is much room to be improved. Our research is a step or an effort towards establishing complete production functions for China's wood processing industry.

We specify the production functions as linear models. The results are shown as follows.

$$Y_{SW} = -10{,}640.70 + 0.43RWP + 23{,}290.40D \qquad (1)$$
$$(-1.46) \quad (3.35)^{***} \quad (5.68)^{***}$$
$$F = 32.97;\ DW = 0.95;\ R^2 = 0.85;$$

$$Y_{PW} = -25{,}453.30 + 0.41RWP + 0.95RWI \quad (2)$$
$$(-2.72)^{**} \quad (2.84)^{**} \quad (7.17)^{***}$$
$$F = 41.19;\ DW = 1.92;\ R^2 = 0.87;$$

$$Y_{FB} = -15{,}951.60 + 0.24RWP + 0.62RWI \quad (3)$$
$$(-3.76)^{***} \quad (3.78)^{***} \quad (10.39)^{***}$$
$$F = 91.89;\ DW = 1.42;\ R^2 = 0.94;$$

$$Y_{PB} = -10{,}627.90 + 0.18RWP + 0.27RWI \quad (4)$$
$$(-3.05)^{***} \quad (3.52)^{***} \quad (5.63)^{***}$$
$$F = 18.00;\ DW = 1.19;\ R^2 = 0.75;$$

$$Y = YSW + YPW + YFB + YPB$$
$$= -62{,}673.5 + 1.26RWP + 1.84RWI + 23{,}290.4D \quad (5)$$

where Y stands for outputs, RWP for domestic roundwood supply, RWI for imported roundwood, D for dummy variable, SW for sawnwood, PW for plywood, FB for fibreboard, and PB for particle board; *** means it is significant at the 1% level, and ** means it is significant at the 5% level. All the quantities are in 1,000 m^3.

The linear equations show the relations between inputs and outputs in their physical units. Because China undertook the third national industrial census in 1995 and makes the data in 1995 incomparable to those in other years, the dummy variable takes the value of 1 for 1995 and 0 for other years. The F test statistics show that all the regressions are significant for they are larger than the critical value of 6.93 at 1% level of significance. The Durbin-Watson (DW) statistic for eq. (2) is 1.92, which shows that the null hypothesis of no autocorrelation is accepted for it stands in the region of 1.54 to 2.46; while other DW statistics are in the region of 0.95 to 1.54, i.e. in the grey area where the null hypothesis of no autocorrelation can be neither accepted nor rejected. The coefficients of determination for these regressions are also accepted, even though the 4th equation has the lowest coefficient.

The sawnwood equation (1) shows that an increase in domestic roundwood supply of 1 m^3 would bring a sawnwood production increase of 0.43 m^3, while the import of roundwood in the equation is not significant. The plywood equation (2) shows that 1 m^3 of domestic roundwood supply would bring about a plywood production increase of 0.41 m^3, while 1 m^3 of imported roundwood would increase the production of plywood by 0.95 m^3. The fibreboard equation (3) and particle board equation (4) show that 1 m^3 of domestic roundwood supply would help the fibreboard production and particle board production increase by 0.24 m^3 and 0.18 m^3, respectively, while a 1 m^3 increase in imported roundwood would make fibreboard production and particle board production increase by 0.62 m^3 and 0.27 m^3, respectively. The coefficient for the import of roundwood in the plywood equation is higher than the coefficient for RWP, and the same is true for the other two wood panel functions. This means that 1 m^3 of imported roundwood would help to produce more wood panels than 1 m^3 of domestic roundwood does. Coefficients of domestic roundwood supply for the four equations are 0.43, 0.41, 0.24, and 0.18. These coefficients describe the proportion of the production of the wood processing industry caused by domestic roundwood supply at shares of 34, 33, 19, and 14%. As for the proportion of production by imported roundwood it is not yet clear. These coefficients also reflect the fast growth of the industry since the end of the 1990s.

When adding the left sides and right sides in equations (1) to (4), respectively, we got equation (5). Equation (5) shows high coefficients and a negative constant, similar to the other four. The negative constant mathematically shows that when RWP or RWI is lower than some quantity, Y can be negative.

Firstly, due to the existence of illegal logging, illegal trade[14,15], and the roundwood production which is not or cannot be totaled in the formal statistics in China, all the coefficients appear to be high. The exclusion of foreign veneer used to process plywood in the equation has also made the coefficients of RWI appear to be high. Even though there are some limitations due to the quality of data, these functions describe a general view of the wood processing industry in China.

Secondly, the fact that the total output Y might be negative when RWP and RWI stay at a low level, or simply speaking, the existence of a negative constant, shows that China's wood processing industry relies on raw materials, domestic and foreign, to maintain its present scale of production or the present way of the production development. In the early period of the 1990s, the industry did not grow fast, but since China began to implement the policy of utilization of foreign wood in 1999, production of the wood processing industry has increased very rapidly. This fact can be seen in the scatter graph and regression line drawn to describe the development, it is easy to notice that the function has a high slope (coefficients) but low intercept, even a negative intercept.

The lower the intercept, the more the wood processing industry relies on raw materials. When describing this concept in the figure, the surface of the upper part of the triangle should shift to the right side as the break-even line moves further to the right side, as in Fig. 7. Fig. 7 shows the relationships between the total wood processing output and domestic roundwood supply and imported roundwood. According to equation (5), the break-even line for Y being positive or negative is 1.26RWP + 1.84RWI

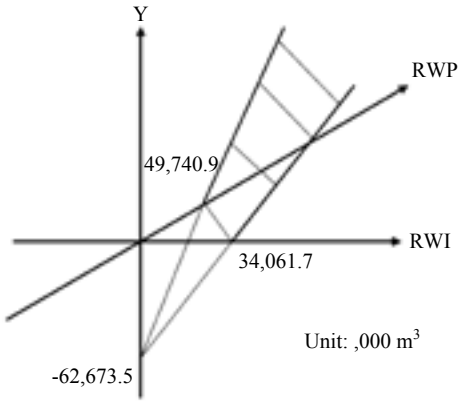

Fig. 7. Domestic roundwood, imported roundwood and total wood processing output

– 62,673.5 = 0, in which D is ignored. The quantity of Y should be within the surface of the upper part of the triangle determined by the three points: (0, 0, –62,673.5), (34,061.7, 0, 0) and (0, 49,740.9, 0); while RWP and RWI have to meet the following constraints: RWP ≥ 0, RWI ≥ 0, 1.26RWP + 1.84RWI – 62,673.5 ≥ 0.

Conclusions

In general, production, imports and exports have all been increasing, albeit exports at a very low level, for the wood processing industry in China since 1979, with the exception of sawnwood, whose production did not change much, and plywood whose imports have decreased since 1994. The analysis of the self-sufficiency rate shows that all the wood products experienced a similar course of development by first decreasing when China started to import wood products, and then increasing later as the production and exports increased. However, plywood witnessed a deep decrease until the middle of the 1990s, and then, became the most advanced industry as its self-sufficiency rate has reached to 120% in 2004, while all the other products still have more imports than exports, with the SSR for sawnwood being the lowest at only 73% in 2004. It can be said that the traditional focus of the wood processing industry on sawnwood has shifted to plywood. In addition, correlation analysis shows that there is a high correlation between wood panels, with the production of fibreboard and particle board increasing rapidly, followed by plywood, and lastly sawnwood which has been left behind.

The production functions reveal that domestic roundwood could help the wood processing industry increase production at the shares of the domestic roundwood supply are 34, 33, 19, and 14%, for sawnwood, plywood, fibreboard and particle board, respectively, while the same quantity of foreign roundwood could make the production of wood products increase faster than domestic roundwood does.

In the course of meeting the increasing domestic demand and exports, foreign direct investment (FDI) is an important factor in the development of the wood processing industry. This research has not done an analysis of FDI in the wood processing industry in China because of the unavailability of the data. The supply of raw materials has been another important factor in the development. In 2000, China started the fast growing trees project, and its total planting area reached 88,870 ha in 2001. Through planting forests of fast growing trees and importing raw materials for processing, China's wood processing industry is expected to grow further in the near future. Exporters of roundwood for sawnwood and plywood, such as Russia and Malaysia, also inevitably face export limits in the future due to criticism of the environmental impact. Therefore, China needs to develop its own forest resources.

Acknowledgment

This study was supported by a Grant-In-Aid for Scientific Research (Tokubetsu Kenkyuin Shorei-hi) from Minister of Education, Culture, Sports, Science and Technology of Japan.

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