

Comparative Analysis of Primary Forest Products Export in the United States and China Using a Constant Market Share Model

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Abstract

The export changes of primary forest products in the United States and China from 2005 through 2012 were compared, and a constant market share model was applied to analyze the impact factors on the export variations of the two countries. The results showed that the decline of import scale and structural changes of the target markets had a negative impact on the wood products export of the two countries. The export variations of primary forest products in the two countries were significantly different. While a small increase in the export of primary forest products was demonstrated in the United States, China's export increased significantly, especially to the major export markets. The change in competitiveness of forest products exports during this time period differed in these two countries. The competitiveness of forest products from the United States remained stable with slight variation; however, the forest products exported by China showed a strong increasing competitive trend.

Wood products trade plays an important role in the balance of international trade in many countries (Peck 2002; Wang et al. 2010a, 2010b). It can be affected by both national and international supply-and-demand forces as well as wood procurement policies. An enhanced knowledge and understanding of both national and international markets is required in order to analyze the wood products trade (Luppold and Sendak 2004, Bragg et al. 1999). As the two largest economic entities in the world, the United States and China are highly complementary in the forest products market (Ye and Xiong 2009). Recently, China has surpassed Japan and Canada, becoming the largest overseas buyer of US logs, sawn wood, and pulp. The United States is also a large buyer of China's forest products, such as unnamed furniture, plywood, and paper products.

Owing to the outbreak of the global financial crisis in 2008, the forest products trade in many countries was impacted. For instance, the import value of primary forest products in Canada and Japan in 2009 decreased by 27.46 and 15.31 percent, respectively, compared with 2008 (UN Commodity Trade Statistics Database 2014). The US timber industry was severely impacted, and the domestic demand for wood was dramatically reduced (UN Economic Commission for Europe 2009). As an adaptive strategy, US timber producers have been making adjustments to the variety of products they put on the market and actively seeking products

catering to major overseas markets. On the contrary, China's forest products trade was also affected but recovered quickly. Therefore, it is necessary to analyze the export changes of primary forest products for the United States and China before and after the financial crisis in order to further promote the development of forest products trade between them.

Several studies have been conducted to analyze the trade variations and export competitiveness of forest products in a country by using the constant market share (CMS) model. For example, Djaja (1992) applied the CMS model to analyze the export performance and export demand of Indonesian forest products over the period 1970/1974 to 1985/1989. He found that the major drivers of the remarkable export growth of forest products at that time in Indonesia were competitiveness and world trade effects,

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while the commodity composition and market distribution were somewhat unfavorable. Further suggestions were also made to help get more benefits from the world trade in forest products. Liu and Tian (2007) used the CMS model to analyze the factors influencing China's forest products exports based on the data of China's forest products trade between 1992 and 2004. They found that the competitiveness of China's forest products changed from negative to positive during this time period and dramatically promoted the increase of market scale. Meanwhile, the commodity structure effect was always positive. However, both market scale and commodity structure effects gradually decreased. Fan and Song (2010) applied the CMS model to analyze the export growth factors based on the export of six main types of timber products (i.e., sawn wood, particleboard, fiberboard, plywood, paper/paper products, and wooden furniture) in China. The results indicated that the most important factors influencing the export growth of forest products in China were the competitive effects and the demand increase of timber products in the world markets, while the other factors contributed less to the export fluctuation.

The purposes of this study were to investigate the changes in the export of primary forest products in the United States and China from 2005 through 2012 and to analyze the factors (demand, structure, competitiveness, etc.) impacting the export variation of the two countries using the CMS model. The results presented in this article will help forest products producers in the two countries have a better understanding of the forest products trade and possibly make adjustments and apply countermeasures to increase the competitiveness of their products in the target markets.

Methods

Mathematical model

The CMS model was first introduced to international trade by Tyszynski in 1951 (Tyszynski 1951, Batista 2008) and has been continuously refined by many researchers, such as Leamer and Stern (1970), Richardson (1971), Jepma (1986), and Chen and Duan (2000). In this article, the expanded constant market share model improved by Jepma (1986) is applied to analyze the export performance of forest products in the United States and China, respectively. The export changes are deconstructed at two classification levels. In the first-order decomposition, the variable factors of export products can be decomposed into structural effect ($\sum_i \sum_j s_{ij}^0 \Delta Q_{ij}$), competitiveness effect ($\sum_i \sum_j Q_{ij}^0 \Delta s_{ij}$), and second-order effect ($\sum_i \sum_j \Delta s_{ij} \Delta Q_{ij}$) (Eq. 1; Hu and Qiu 2008). The structural effect reflects the export variation caused by the changes of import scale (import value) of the target markets and import structure (i.e., market structure and commodity structure). The competitiveness effect evaluates the adaptation of a country's export growth to the import structure of the target market. The second-order effect is the residual term, reflecting the average correlation between export growth and market share growth:

$$\Delta q = \sum_i \sum_j s_{ij}^0 \Delta Q_{ij} + \sum_i \sum_j Q_{ij}^0 \Delta s_{ij} + \sum_i \sum_j \Delta s_{ij} \Delta Q_{ij} \quad (1)$$

In the second-level decomposition (Eq. 2), the structural effect is further decomposed into growth effect, market

effect, commodity effect, and structure interaction effect. The competitiveness effect is split into general competitiveness effect and specific competitiveness effect. The second-order effect is divided into pure second-order effect and dynamic structural effect (Muhammad and Yaacob 2008). Through an analysis of the shares of various effects in the change of export commodities, it is possible to study and reveal the factors fostering export growth and factors restricting it in both the United States and China (Hu and Qiu 2008):

$$\Delta q = s^0 \Delta Q + \left(\sum_i \sum_j s_{ij}^0 \Delta Q_{ij} - \sum_i s_i^0 \Delta Q_i \right) + \left(\sum_i \sum_j s_{ij}^0 \Delta Q_{ij} - \sum_j s_j^0 \Delta Q_j \right)$$

(growth effect, market effect, and commodity effect)

$$+ \left[\left(\sum_i s_i^0 \Delta Q_i - s^0 \Delta Q \right) - \left(\sum_i \sum_j s_{ij}^0 \Delta Q_{ij} - \sum_j s_j^0 \Delta Q_j \right) \right] + \Delta s Q^0$$

(structural interaction effect and general competitive effect)

$$+ \left(\sum_i \sum_j \Delta s_{ij} Q_{ij}^0 - \Delta s Q^0 \right) + \left(\frac{Q^1}{Q^0} - 1 \right) \sum_i \sum_j \Delta s_{ij} Q_{ij}^0$$

(specific competitive effect and pure second-order effect)

$$+ \sum_i \sum_j \Delta s_{ij} \Delta Q_{ij} - \left(\frac{Q^1}{Q^0} - 1 \right) \sum_i \sum_j \Delta s_{ij} Q_{ij}^0 \quad (2)$$

(dynamic structural effect)

where 0 represents the base period, 1 represents the report period, i is the product type (log, sawn wood, veneer, particleboard, fiberboard, plywood, pulp, paper/paperboard, paper products), j is a target market, q is the total export value of the forest products of a country, Δ represents the change between the two periods, s represents the share of a country in the entire target market, s_i is the share of product i in all imported forest products in the entire target market, s_j is the share of country j 's export in the import of the entire target market, s_{ij} is the share of product i of country j in all imported product i of target market j , Q is the total import value of the target market, Q_{ij} is the import value of product i in target market j , Q_i is the total import value of product i of the target market, $Q_i = \sum_j Q_{ij}$, and Q_j is the total import value of target market j , $Q_j = \sum_i Q_{ij}$.

Data sources

The export value of primary forest products in the United States and China was collected from the UN Commodity Trade Statistics Database (2014) during the period between 2005 and 2012. According to the Harmonized Commodity Description and Coding System (HS code), primary forest products include HS 4403 logs, HS 4407 sawn wood, HS 4408 veneer, HS 4410 particleboard, HS 4411 fiberboard, HS 4412 plywood, HS 47 pulp, HS 48 paper/paperboard, and HS49 paper products (Liu and Tian 2007, Fan and Song 2010).

The CMS analysis for primary forest products exports was categorized into two periods: 2005 to 2008 and 2009 to 2012. The year 2008 was treated as a breaking point because

the 2008 financial crisis had a significantly negative impact on the export of the US primary forest products, and the impact was shown mostly in 2009. The year 2005 was a normal year in the international forest products trade with no influence of any major world events. The year 2012 represents one of the latest years for which the trade statistics are available for our analytical purpose. The most important forest products trading partners for the United States and China were selected based on their share of the overall US and China primary forest products exports and are summarized in Table 1. Based on the previously mentioned results of the statistical data analysis, the nine forest products were exported by the United States to eight major countries, including Canada, China, Mexico, Japan, the United Kingdom, Germany, Italy, and the Republic of Korea and were taken as a whole to find the driving factors for the change in export of US primary forest products. Similarly, the nine forest products were exported by China to eight major markets, including the United States, Hong Kong, Japan, the United Kingdom, the Republic of Korea, Canada, Germany, and The Netherlands. Those markets were taken as a whole to find the driving factors for the change in export of China's primary forest products.

Results and Discussion

Comparative analysis of primary forest products exports

Trade scale of forest products.—The export changes of primary forest products in the United States and China from 2005 to 2012 are illustrated in Figure 1. During 2005 to 2012, the total export value of forest products in the United States increased from US\$28.43 billion to US\$38.69 billion, an increase of 36.08 percent, or an annual growth rate of 4.5 percent. From 2005 to 2008, the US export of primary forest products grew rapidly, with an average annual growth rate of 8.0 percent. However, the forest products export in 2009 was seriously affected by the financial crisis with a decline rate of 13.61 percent compared with 2008. Forest products export did not begin recovering its scale until 2010, but its growth rate was much slower.

During the period 2005 to 2012, the total export value of forest products in China increased from US\$14.66 billion to US\$42.70 billion, an increase of 191.25 percent, or an annual growth rate of 16.5 percent. From 2005 to 2008, China's export of primary forest products (excluding wooden furniture) grew rapidly, with an average annual

growth rate of 25.8 percent. Owing to the international financial crisis, China's export of primary forest products in 2009 declined by 10.25 percent compared with 2008. The export of primary forest products gradually restored itself in 2010 and continued increasing in a steady fashion through 2012.

Export region of forest products.—The export regions of major forest products in the United States and China from 2005 to 2008 and from 2009 to 2012 are presented in Table 2. The US primary forest products were exported mainly to Canada, China, Mexico, Japan, and the European countries. During the period 2009 to 2012, China became the largest country to import logs, sawn wood, and pulp from the United States. It is noted that Vietnam also became a new major buyer of US logs and sawn wood. China's primary forest products were exported mainly to the United States, Hong Kong, Japan, the United Kingdom, the Republic of Korea, and Vietnam. The United States is a leading country importing fiberboard, plywood, paper/paperboard, and paper products from China.

Export structure of forest products.—The forest products exported by the United States were mainly paper/paperboard, pulp, paper products, logs and sawn wood (Fig. 2). In general, the forest products exports in the United States showed an upward trend during 2005 to 2012. The rankings of forest products exports in terms of growth rate were plywood (95.62%), pulp (80.24%), logs (32.38%), paper/paperboard (29.98%), and sawn wood (27.79%). There was no significant change in the export value of veneer during 2005 to 2007. However, the export value has been dropping continuously since 2008. The export of other primary forest products was severely affected by the global financial crisis that occurred in 2008. Compared with 2008, the export value of particleboard, veneer, and plywood declined most significantly, by 45.58, 30.99, and 26.17 percent, respectively. Other forest products also showed obvious drops, such as 20.28 percent for logs, 15.57 percent for sawn wood, 14.35 percent for pulp, and 12.10 percent for paper/paperboard.

The major forest products exported by China were paper/paperboard, paper products, plywood, and fiberboard (Fig. 3). In general, China's export of forest products showed an ascending trend from 2005 to 2012. With regard to the growth rate, fiberboard and paper/paperboard ranked top, being 307 and 249 percent, respectively, followed by paper products (202%) and plywood (155%). Owing to the impact of the global financial crisis, the export of primary forest

Table 1.—Major export markets of primary forest products and their proportions.^a

Export country	United States		Export country	China	
	First period (2005–2008) (%)	Second period (2009–2012) (%)		First period (2005–2008) (%)	Second period (2009–2012) (%)
Canada	21.71	18.20	USA	41.43	29.01
China	19.84	10.03	Hong Kong	18.43	12.27
Mexico	16.46	15.06	Japan	10.45	10.37
Japan	6.76	5.98	UK	7.43	6.05
UK	4.58	3.91	ROK	4.48	3.68
Italy	3.05	2.47	Canada	4.35	3.84
ROK	3.03	2.80	Germany	3.77	3.28
Germany	2.89	2.58	The Netherlands	1.73	1.46
Total	78.32	61.03	Total	92.07	69.96

^a Data source: UN Commodity Trade Statistics Database (<http://comtrade.un.org>).

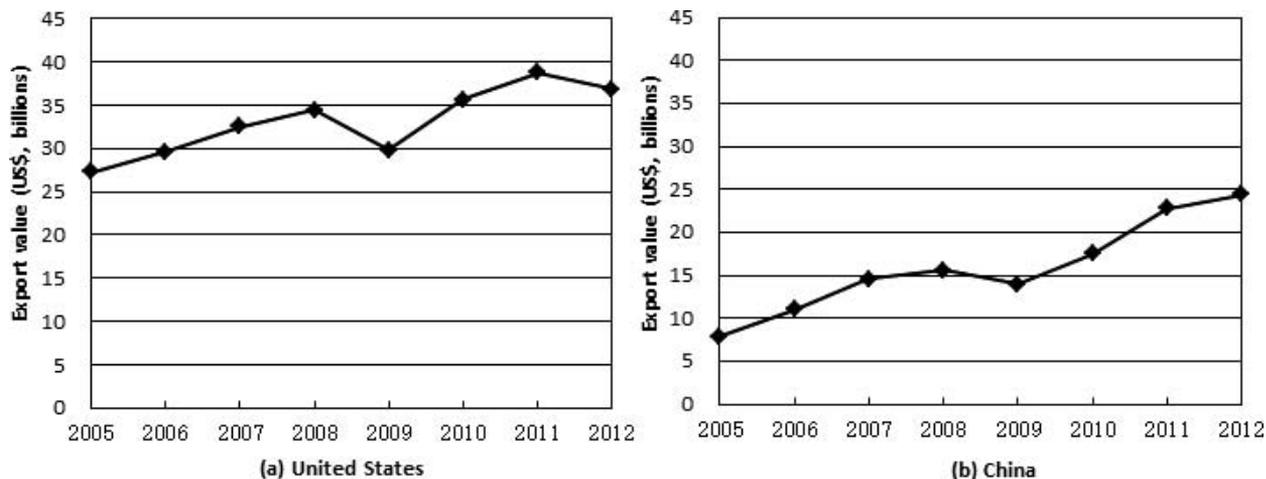


Figure 1.—Primary forest products export (excluding wooden furniture) in the United States (a) and China (b) from 2005 to 2012.

products in China dropped down by 10.25 percent in 2009 over the results from 2008. The export of particleboard, veneer, and plywood dropped dramatically by 29.49, 29.21, and, 25.78 percent, respectively. At the same time, the impact of this crisis on export of paper/paperboard was minimal, with a decline of only 2.30 percent. Since 2009, the export value of paper/paperboard kept continuously increasing.

Comparison of the export difference during the two periods.—The export value and proportions of the primary forest products exported to the world by the United States and China during the two periods (2005 to 2008 and 2009 to 2012) are summarized in Tables 3 and 4, respectively. It was noted that pulp, paper/paperboard, and paper products accounted for a significant proportion of the US-exported primary forest products. The total value of the primary forest products exported by the United States to the world was

US\$30.97 billion in the first period and US\$35.26 billion in the second period. Paper/paperboard, paper products, and plywood were the major forest products exported by China. The total value of the primary forest products exported by China to the world was US\$12.23 billion and US\$19.65 billion in the two periods, respectively.

The import value of the primary forest products from the United States and China by the major import countries and the total import value of forest products during the two periods are summarized in Tables 5 and 6, respectively. The US sales of the primary forest products to the eight major countries accounted for US\$2.43 billion and US\$2.15 billion during the two periods, respectively. Among them, Mexico and Canada imported most of their forest products from the United States. China exported US\$11.26 billion and US\$13.74 billion worth of primary forest products to eight major countries during the two periods, respectively.

Table 2.—Export regions of major forest products in the United States and China.^a

Product type	United States		China	
	First period (2005–2008)	Second period (2009–2012)	First period (2005–2008)	Second period (2009–2012)
Logs	Japan, Canada, China, ROK, UK	China, Japan, Canada, ROK, Vietnam	Japan, ROK, Thailand, other Asian countries	Vietnam, Japan, other Asian countries, Malaysia, ROK
Sawn wood	Canada, China, Mexico, Japan, Italy	China, Canada, Mexico, Japan, Vietnam	Japan, ROK, Italy, Germany, USA	Japan, ROK, USA, Germany, Vietnam
Veneer	Canada, Germany, Spain, China, Italy	Canada, Germany, Mexico, Spain, China	ROK, Japan, USA, Malaysia, Russian Federation	ROK, Japan, Mexico, Russian Federation, USA
Particleboard	Canada, Mexico, Russian Federation, Chile, Turkey	Canada, Mexico, Russian Federation, ROK, Chile	Russian Federation, USA, ROK, Uzbekistan, Hong Kong	Russian Federation, Tajikistan, Japan, USA, Malaysia
Fiberboard	Canada, Mexico, UK, China, Israel	Canada, Mexico, Russian Federation, Australia, UK	USA, Canada, Turkey, ROK, Saudi Arabia	USA, Canada, Russian Federation, Iran, Saudi Arabia
Plywood	Canada, Mexico, Bahamas, Australia, Dominican Republic	Canada, Mexico, Australia, Germany, Haiti	USA, Japan, UK, ROK, United Arab Emirates	USA, Japan, UK, ROK, United Arab Emirates
Pulp	China, Mexico, Canada, Italy, Japan	China, Mexico, Japan, India, ROK	ROK, The Netherlands, Japan, Germany, USA	ROK, Indonesia, The Netherlands, Thailand, Japan
Paper/paperboard	Canada, Mexico, Japan, China, UK	Canada, Mexico, China, Japan, UK	USA, Hong Kong, Japan, Australia, ROK	USA, Japan, Hong Kong, Australia, ROK
Paper products	Canada, UK, Mexico, Japan, Australia	Canada, UK, Mexico, Japan, Australia	Hong Kong, USA, UK, Japan, Germany	USA, Hong Kong, UK, Japan, Germany

^a Data source: UN Commodity Trade Statistics Database (<http://comtrade.un.org>).

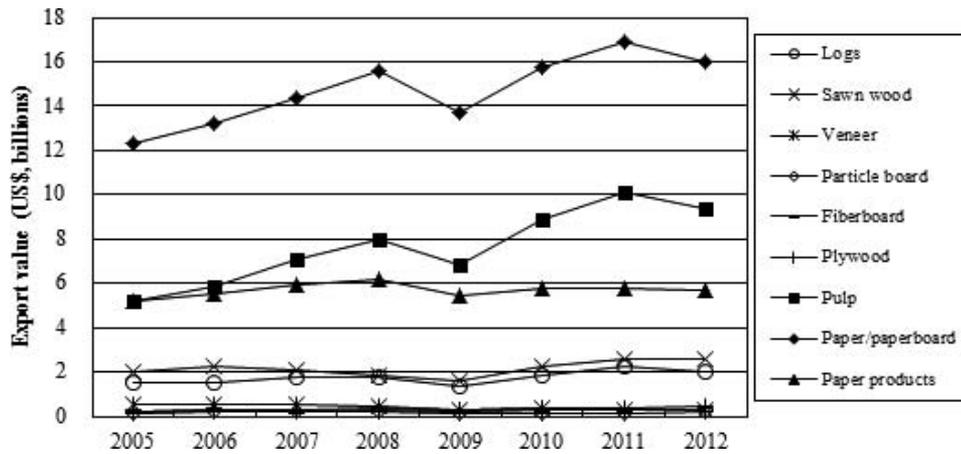


Figure 2.—Export structure of primary forest products in the United States from 2005 to 2012.

Analysis of the change of US exports during the two periods

The annual export of primary forest products from the United States to the world increased by US\$4.29 billion during the second period compared with the first period; however, the total export to the eight major countries decreased by US\$2.77 billion. The causes of export reduction were decomposed at two classification levels, as shown in Table 7.

First-level decomposition results.—In the first-order decomposition, the growth of aggregated forest products export shares was decomposed into a structural change effect, a competitiveness effect, and a second-order effect. The reduction of the export of primary forest products from the United States to the eight countries was a result of joint action of the structural effect of the world market, its own competitiveness effect, and the secondary effect. The structural effect was the dominant effect, accounting for –88.33 percent of the total contribution rate (–100%). The reduction of the US export of primary forest products to the eight countries (first period, US\$24.28 billion; second period, US\$21.52 billion) showed an obvious trend of strong structure and weak competitiveness, indicating that it was the reduction of import scale and import structure in the eight countries that led to the decrease of exports by the

United States. The competitiveness effect was low and negative in value (–2.28%), indicating that there was no significant impact on the competitiveness of US forest products. Although the export value to the eight countries decreased and the competitiveness declined somewhat, the competitiveness enabled the United States to maintain certain superiority in export, and there was little change in its position in the international forest products market. The secondary effect as a result of the joint action of the structural effect and the competitiveness effect also had some influence on the reduced export with a contribution rate of –9.39 percent.

Second-level decomposition results.—Based on the decomposition results of the structural effect, the growth effect, the market effect, and the commodity effect were negative, and the structure interaction effect was positive. The growth effect was the most influential effect with a contributing rate of –88.86 percent, indicating that the reduced market scale of the eight analyzed countries led to the decreased export of the major US forest products. The market effect had only a slight impact, indicating that the structure of the export market had less influence. The proportion of the commodity effect was the smallest, indicating that there was almost no impact of the commodity structure of the major forest products exported by the United

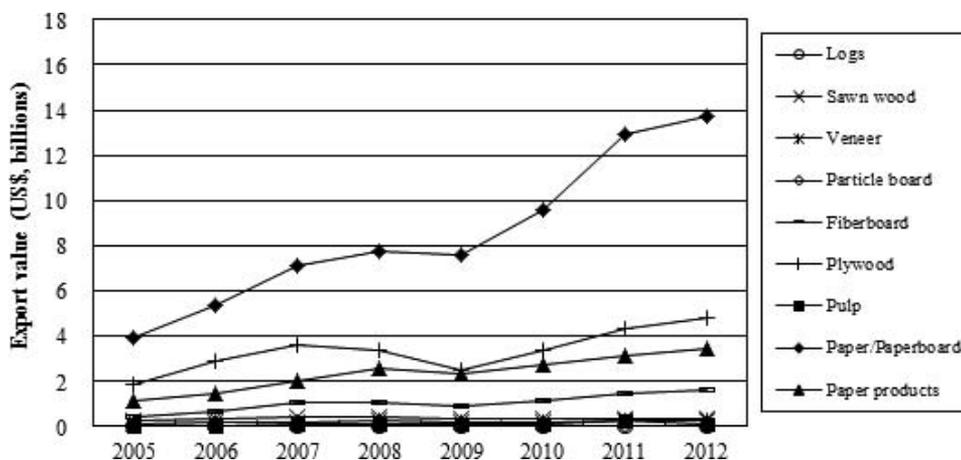


Figure 3.—Export structure of primary forest products in China from 2005 to 2012.

Table 3.—Exports of primary forest products in the United States and their proportions.^a

Forest products	First period (2005–2008)		Second period (2009–2012)	
	Export value (US\$, billions)	%	Export value (US\$, billions)	%
Pulp	6.511	21.03	8.777	24.89
Paper/paperboard	13.862	44.76	15.596	44.23
Paper products	5.688	18.37	5.668	16.07
Logs	1.633	5.27	1.879	5.33
Sawn wood	2.071	6.69	2.241	6.36
Veneer	0.502	1.62	0.316	0.89
Particleboard	0.177	0.57	0.152	0.43
Fiberboard	0.247	0.80	0.260	0.74
Plywood	0.275	0.89	0.370	1.05
Total	30.967	100.00	35.258	100.00

^a Data source: UN Commodity Trade Statistics Database (<http://comtrade.un.org>).

States on the export value. The smaller structure interaction effect indicated that the interaction effect of the specific commodity and market effect had little influence.

In view of the competitiveness effect, the comprehensive competitiveness effect was negative, indicating that the comprehensive competitiveness had declined to some extent. The specific competitiveness effect was positive, indicating that in a specific market, the specific commodity had an increased share, and this could compensate for the reduced export value to some extent. Therefore, in general, the primary US forest products had stable competitiveness in the international forest products market.

The decomposition of the secondary effect showed that the proportion of the pure secondary structure was very small, indicating that the interaction between the change of the US export structure and the change of the world's import scale had little impact on the variation of the export change in the United States. The dynamic structural effect accounted for a large contribution rate, indicating that the change of the secondary effect was attributed mainly to the change of the dynamic structural effect. The export value of primary forest products to the eight countries was influenced by the interaction of the change of the US export structure and the change of the world's import structure.

Analysis of the change of China's exports during the two periods

Compared with the first period, China's export of primary forest products to the world and to the eight major markets during the second period increased by US\$7.42 billion and US\$2.487 billion, respectively. The decomposition results of the increase factors are presented in Table 8.

First-level decomposition results.—The increase of China's export of primary forest products to the eight markets was a result of the joint action of the structural effect, the competitiveness effect, and the second-order effect. The competitiveness effect was the major factor driving the growth of forest products export, accounting for 147.24 percent of the total contribution. Even though the financial crisis in 2008 caused a dramatic decrease of forest products trade in the world, China's forest products export increased in general, indicating that the primary forest products in China have a certain competitiveness in the

Table 4.—Exports of primary forest products in China and their proportions.^a

Forest products	First period (2005–2008)		Second period (2009–2012)	
	Export value (US\$, billions)	%	Export value (US\$, billions)	%
Pulp	0.071	0.58	0.147	0.75
Paper/paperboard	6.048	49.47	10.939	55.68
Paper products	1.787	14.62	2.911	14.82
Logs	0.001	0.01	0.006	0.03
Sawn wood	0.356	2.91	0.343	1.75
Veneer	0.186	1.52	0.223	1.13
Particleboard	0.031	0.25	0.050	0.25
Fiberboard	0.803	6.57	1.262	6.42
Plywood	2.942	24.06	3.765	19.17
Total	12.225	100.00	19.646	100.00

^a Data source: UN Commodity Trade Statistics Database (<http://comtrade.un.org>).

international trade market. The proportions of the structural effect and secondary effect were -29.34 and -17.90 percent, respectively. The reduction of the import scale and import structure of the target markets brought about some impediment to China's export of forest products. Chinese forest products exported to the eight markets showed an obvious trend of weak structure and strong competitiveness, indicating that China's competitiveness was increasing and contributed mostly to the increase in trade value. The competitiveness had strengthened China's superiority in export. The secondary effect as a result of the joint action of the structural effect and the competitiveness effect had some negative impact on export. Compared with other factors, the structural effect and the secondary effect had a relatively small contribution, hindering the export of primary Chinese forest products to some extent.

Second-level decomposition results.—The decomposition results of the structural effect showed that the growth effect, market effect, and structural interaction effect were negative and that the commodity effect was positive. Among the subfactors, the growth effect had the highest influence, accounting for -37.88 percent of the total contribution, indicating that the reduced market scale (first period, US\$127 billion; second period, US\$116.4 billion) of the eight markets hindered the development of China's export of primary forest products. The commodity effect accounted for 26.58 percent of the total contribution, indicating that the commodity structure of primary forest products exported by China had a relatively high positive effect on promoting the export value. The major forest products exported by China were paper/paperboard, which increased from 49.47 percent during 2005 to 2008 to 55.68 percent during 2009 to 2012 (Table 4). Therefore, the growth of paper/paperboard export played a positive role in the growth of China's primary forest products export. The market structure effect was -2.77 percent and played a negative role in promoting the export of forest products. The percentage of primary forest products exported to the United States by China dropped from 41.43 percent (first period) to 29.01 percent (second period) (Table 1). Similarly, the percentage value of export to Hong Kong dropped from 18.43 percent (first period) to 12.27 percent (second period). The other six markets showed an increase in the import of forest products from

Table 5.—Export value of primary forest products exports in the United States to eight major markets.^a

Country	First period (2005–2008)			Second period (2009–2012)		
	Imports from the USA (US\$, billions)	Total imports (US\$, billions)	US share (%)	Imports from the USA (US\$, billions)	Total imports (US\$, billions)	US share (%)
Canada	6.732	10.977	61.33	6.416	10.729	59.80
China	6.152	32.306	19.04	3.536	20.501	17.25
Germany	0.896	24.681	3.63	0.909	26.984	3.37
Italy	0.945	13.217	7.15	0.870	12.130	7.17
Japan	2.095	11.728	17.87	2.110	12.132	17.39
Mexico	5.104	7.324	69.68	5.310	7.431	71.46
ROK	0.938	5.312	17.65	0.987	5.712	17.28
UK	1.421	18.502	7.68	1.377	15.867	8.68

^a Data source: UN Commodity Trade Statistics Database (<http://comtrade.un.org>).

Table 6.—Export value of primary forest products exports in China to eight major markets.^a

Country	First period (2005–2008)			Second period (2009–2012)		
	Imports from China (US\$, billions)	Total imports (US\$, billions)	China's share (%)	Imports from China (US\$, billions)	Total imports (US\$, billions)	China's share (%)
USA	5.065	42.349	11.96	5.700	31.461	18.12
Hong Kong	2.253	3.919	57.48	2.411	3.781	63.76
Japan	1.277	11.728	10.89	2.038	12.132	16.80
UK	0.908	18.502	4.91	1.188	15.867	7.49
ROK	0.548	5.312	10.32	0.723	5.712	12.65
Canada	0.532	10.977	4.85	0.755	10.729	7.04
Germany	0.461	24.681	1.87	0.644	26.984	2.39
The Netherlands	0.212	9.576	2.21	0.286	9.744	2.93

^a Data source: UN Commodity Trade Statistics Database (<http://comtrade.un.org>).

China; however, their market share was relatively small. Therefore, an overall negative market structural effect was still present. The structural interaction effect took a portion of that value, indicating that the interaction between some specific commodities and market effects had a certain impact on the export increase of primary forest products.

According to the decomposition results of the competitiveness effect, the comprehensive competitiveness effect was positive and accounted for the highest proportion among all the effects (150.48%). The comprehensive competitiveness enabled China to maintain certain superi-

ority in export. The specific competitiveness effect was negative with a small value, indicating that the share of some specific commodities was reduced in the specific market and had some influence on the reduced export value. However, its impact was very limited. In general, the competitiveness of Chinese primary forest products was steadily rising.

The decomposition of the secondary effect showed that the pure secondary structure accounted for a relatively high proportion of the influence. The change of the secondary effect was attributed mainly to the change of the dynamic

Table 7.—Constant market share model decomposition for the primary forest products exported by the United States to the eight markets.

Effect	Contribution value (US\$, billions)	Contribution rate (%)
First-level decomposition		
Total variation effect	-2.767	-100.00
Structural effect	-2.444	-88.33
Competitiveness effect	-0.063	-2.28
Second-order effect	-0.260	-9.39
Second-level decomposition		
Growth effect	-2.459	-88.86
Market effect	-0.120	-4.35
Commodity effect	-0.065	-2.36
Structure interaction effect	0.200	7.24
General competitiveness effect	-0.343	-12.40
Specific competitiveness effect	0.280	10.12
Pure second-order effect	0.006	0.23
Dynamic structural effect	-0.266	-9.62

Table 8.—Constant market share model decomposition for the primary forest products exported by China to the eight markets.

Effects	Contribution value (US\$, billions)	Contribution rate (%)
First-level decomposition		
Total variation effect	2.487	100.00
Structural effect	-0.730	-29.34
Competitiveness effect	3.662	147.24
Second-order effect	-0.445	-17.90
Second-level decomposition		
Growth effect	-0.942	-37.88
Market effect	-0.069	-2.77
Commodity effect	0.661	26.58
Structure interaction effect	-0.380	-15.27
General competitiveness effect	3.742	150.48
Specific competitiveness effect	-0.080	-3.24
Pure second-order effect	-0.306	-12.32
Dynamic structural effect	-0.139	-5.58

structural effect, indicating that the interaction between the change of the Chinese export structure and the change of the world's import scale had a significant influence. The proportion of the dynamic structural effect was very small, indicating that the export value of primary forest products to the eight markets was influenced by the interaction of the change of the Chinese export structure and the change of the world's import structure, but the degree of influence was limited.

Conclusions and Limitations

The export changes of primary forest products in the United States and China from 2005 to 2012 were investigated, and the impact factors on the export changes in the two countries were analyzed using the CMS model. Starting with a first-level analysis, the relative importance of market structure, competitiveness, and second-order effects were obtained. A second-level analysis indicated the relative importance of growth, commodity, and market effects. The following conclusions can be drawn from this study.

1. The reduced import scale and change of import structure of the target markets hindered the export of primary forest products for both countries. During the period 2009 to 2012, the decreased demand of the target markets had unfavorably influenced the development of forest product trade for both China and the United States.
2. The countries or regions to which forest products were exported by the United States and China varied geographically. The major forest products in the United States were exported mainly to Canada, China, Mexico, Japan, and the European countries. After 2009, China has become the largest country to import logs, sawn wood, and pulp from the United States. The major Chinese forest products were exported mainly to the United States, Hong Kong, Japan, the United Kingdom, the Republic of Korea, and Vietnam. The United States is a leading country importing fiberboard, plywood, paper/paperboard, and paper products from China.
3. The export structures of the forest products for the two countries were somewhat different. The major forest products exported by the United States included paper/paperboard, pulp, paper products, logs, and sawn wood, among which paper/paperboard accounted for nearly half the total export value of the forest products. The major forest products exported by China were paper/cardboard, paper products, plywood, and fiberboard. Paper and paperboard were the common varieties of the major forest products exported by the United States and China. The global financial crisis in 2008 impacted the export of forest products in the two countries. The export of paper/paperboard, pulp, and paper products in 2009 compared with 2008 dropped significantly and then experienced a slow increase. For China, the export value of paper/paperboard has been continuously increasing at an annual rate of 27.11 percent since 2009.
4. The changes of export value of primary forest products from the two countries during the two periods (2005 to 2008 and 2009 to 2012) were significantly different. Compared with the first period, more primary forest products were exported by the United States in the second period, but the increase was very limited. In addition, the export value to the target markets studied in this paper was somewhat reduced; in other words, the

export value to the major countries had somewhat declined. On the other hand, the major forest products exported by China increased significantly in the second period, and the export value to the major export market also increased dramatically.

5. The changes of the competitiveness of forest products in the international trade market for the two countries were obviously different. The competitiveness effect for the United States changed only slightly, indicating that the US position in the international forest product trade remained stable, and it maintained its leading position in the forest product trade. China's competitiveness in forest products production was enhanced significantly, indicating that China has gradually become a large competitor in forest products export, and Chinese forest products export is continuously finding a high position in the world market. The improved export competitiveness of Chinese forest products was the major factor that promoted the growth of forest products export in China.

The CMS model can divide the past export growth into different components; however, further explanation is needed to help understand the reasons for the increase in exports and how it worked (Banerji 1974, Ahmadi-Esfahani 2006). Jepma's (1986) applied CMS model has no stochastic basis and therefore cannot be used for the purpose of econometric projection of the probable future changes in the market share. The conclusions here, drawn from the analysis, are based on a constant market share norm and are valid only for the particular time period chosen, the level of commodity aggregation adopted, and the particular breakdown of markets. Therefore, future research may be conducted by addressing the model sensitivity (e.g., change the data domain and change the length of time series) and coupling the CMS analysis with those generated by other methods, such as regression analysis, to provide a more rigorous understanding of the forest products exports of the two countries.

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