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Export Growth and Quality Determination of Wood Forest Products: Evidence from China

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Abstract: The rapid-developed scale of China's trade in wood forest products has undergone a considerable uptick. Concomitant with the evolution of high-quality development paradigms, product quality within trade frameworks has gained escalating scrutiny. Based on the statistical analysis of the export characteristics of China's wood forest products, this study leverages BACI data spanning from 1998 to 2017. Utilizing regression-based inverse methods, the study quantifies the quality attributes of these export products, dissects fluctuations in quality, and places particular emphasis on the markets within "Belt and Road Initiative" economies to elucidate dynamic trends and spatial distribution characteristics of export quality in this geoeconomic domain. Based on this, the fixed effect model, random effect model, and system GMM are used to empirically examine the influencing factors of China's wood forest product export quality. This study found that wood-based panel products have the highest quality, followed by paper products and wood furniture among the three major categories of wood forest products. Besides, the overall quality levels of the three products exported to countries participating in the Belt and Road initiative haven't significantly changed, while notable changes are evident across divergent export destination markets. In addition, an empirical study on the influencing factors of the export product quality of wood forest products is conducted, which indicates that total factor productivity, R&D investment, capital intensity, labor costs, and foreign direct investment are influencing factors. Finally, based on the research conclusions, suggestions are provided on how to improve the export quality of wood forest products.

Keywords: wood forest products; export growth; export product quality; determination

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1. Introduction

China is the world's top exporter of wood forest products [1]. From its development history, the export growth of wood forest products used to be mainly driven by price advantage, while with the rise of labor costs in China, this competitive advantage was gradually weakened. At the same time, China's exports of wood forest products have been frequently hindered by anti-dumping and countervailing investigations and other types of trade barriers in other countries [2], which have increased production costs, reduced the international competitiveness of wood forest products, and impeded the further development of wood forest product trade. Consequently, the forest products manufacturing industry in China needs to shift from high-speed development to high-quality development. The Ministry of Commerce's 14th Five-Year Plan for High-quality Development of Foreign Trade proposed to speed up the cultivation of "new competitive advantages" [3]. Improving the quality of export products and promoting the movement of industrial division of labor to the middle and high end of the global value chain is an important way to obtain new competitive advantages. Product quality has become one of the key concerns in China.

Studies on China's trade in wood forest products are relatively abundant, focusing on three aspects: the structure and growth pattern of China's trade in wood forest products [4,5], the competitiveness and trade potential of wood forest products [6–8], and export barriers and trade facilitators for wood forest products [9,10]. It has been found that China's export of wood forest products has problems such as unreasonable export product structure, weak competitiveness, and is hindered by a variety of trade barriers [11]. From the research on product quality, the intricate and multidimensional nature of product quality makes it challenging to establish accurate indicators for its economic measurement. Scholars continue to explore it, and the current measurement methods used in the research process of export product quality mainly include the following four: technical complexity [12], the unit value of products [13], the export quality index [14], and regression estimation [15]. Among them, the regression estimation method is derived from the endogenous determination model of quality, which is a cutting-edge method of measuring the quality of export products in the field of economics. The exogenous influencing factors of changes in export product quality mainly involve the following aspects: trade liberalization [16], a strategic export policy [17], foreign direct investment [18], an agglomeration economy [19], intermediate goods [20], income level [21], and financing constraints [22].

The contributions of this paper are as follows: First, with the changing circumstances in the world, economic, environmental, and resource problems have emerged, and the importance of forest products has gradually become prominent, while previous studies on product quality have mainly focused on broad categories of manufacturing, food processing, textile industry, and other fields. The study of forest products alone involves less and needs to be further supplemented. We take wood forest products as the research object for quality quantification and determination, which expands the field and enriches the content of the existing literature. Secondly, in the previous literature, unit value and other classical methods were mostly used to measure the quality of export products, and this paper adopts the regression estimation method comprehensively considering the advantages and disadvantages of various product quality measurement methods as well as the deepening of research direction. It uses regression estimation to measure the quality of 60 segmented products under the three major categories of wood forest products: wood-based panels, paper products, and wood furniture, which more accurately measures the export quality of wood forest products. Thirdly, improving product quality is an important aspect of micro-product upgrading. The quality improvement of export products can enhance international competitiveness, improve the welfare level of trading countries, alleviate the friction of foreign trade, and expand the profit of enterprises. This study will bring insights into the production and trade decisions of enterprises in wood forest products.

The rest of the study is arranged as follows: Section 2 clarifies the export growth characteristics of China's wood forest products. Section 3 describes the methodology for measuring and determining the export quality of wood forest products. Section 4 analyzes the quality changes, especially the performance in the regional markets joining the Belt and Road Initiative. Section 5 empirically studies the quality determinants of China's export wood forest products. Section 6 puts forward conclusions and discussions.

2. Characteristic Facts

2.1. Slower Growth in Export Trade

Since 2015, the growth rate of China's export of wood forest products has slowed down, and the trade value has been relatively stable, as shown in Figure 1. China's share of the world's total wood forest products export trade is declining, but it is still the world's largest exporter of wood forest products. Specifically, China's export of wood forest products rose from USD 2329.3 million in 1998 to USD 50,021.4 million in 2018, with an average annual growth rate of 17.52%. China's export of wood forest products grew rapidly from 1998 to 2007, especially after China's accession to the World Trade Organization in 2001, with an average annual growth rate of 32.03%. From 2007 to 2009, affected by the financial crisis, the growth rate of exports was greatly reduced, and there was a brief negative growth in

2009. After 2010, with the gradual recovery of the world economy, the export of wood forest products also gradually recovered, and the export value continued to grow from 2010 to 2015. Trade value showed a slight decline in 2016 and continued to show an upward trend from 2016 to 2018. From the perspective of China's share of wood forest products to the world's total wood forest products export, from 1998 to 2015, the share continued to rise, from 1.29% in 1998 to 14.47% in 2015. From 2015 to 2018, it declined in successive years, accounting for 12.64% in 2018, but the share of export trade is still ahead of the rest of the countries in the world.

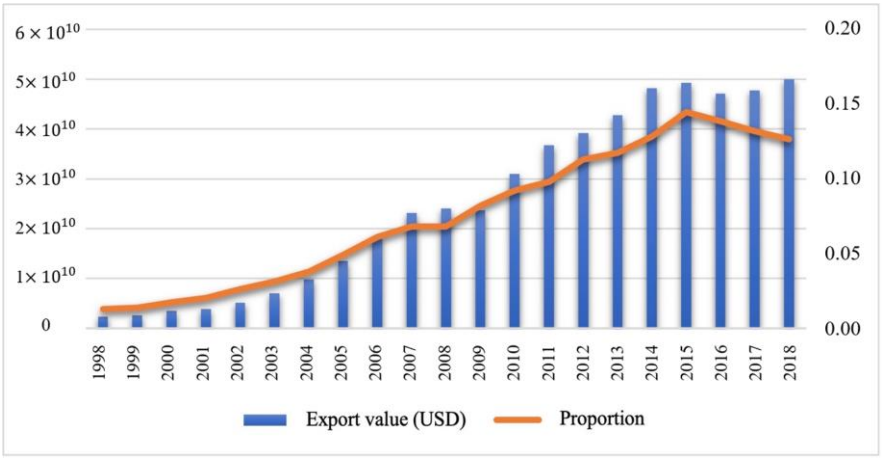

Figure 1. Changes in China's export value of wood forest products and its proportion in the world's total wood forest products trade. Source: calculated according to the data of the United Nations COMTRADE database.

2.2. Export Products Are Dominated by Wood Furniture, Paper Products, and Wood-Based Panels

China's exports of wood forest products are dominated by wood furniture, paper products, and wood-based panels, with roundwood, sawnwood, and wood pulp accounting for a smaller proportion. Specifically (see Appendix A Table A1), the export value of wood furniture accounted for the highest proportion of the total export of wood forest products from 1998 to 2018. Its proportion was maintained between 45% and 55% and showed a trend of first rising and then declining, with the highest proportion of 54.30% in 2003. The export value rose from USD 1084.7 million in 1998 to USD 22,964.4 million in 2018, which decreased slightly in 2016 and then continued to rise slowly. The export value of paper products accounted for the second largest proportion of China's export of wood forest products, the proportion of which remained between 25% and 45% and displayed a first downward and then upward trend. The highest proportion was in 1998, 42.535%, while the lowest was in 2004, accounting for 28.96%, with an average annual proportion of 34.87%. The export value of paper products kept an upward trend, rising from USD 990.8 million in 1998 to USD 19,460.6 million in 2018. In terms of wood-based panels export, it accounted for the third largest share of the total wood forest products export, the proportion of which remained between 5% and 25% and indicated a first rising and then declining trend. The highest proportion was 21.13% in 2007, and the average annual proportion was 14.18%. The export value of wood-based panels showed an upward trend, rising from USD 117.2 million in 1998 to USD 7262.9 million in 2018, with the highest export value reaching USD 7860.0 million in 2014. In addition, the export of sawnwood, wood pulp, and roundwood is relatively small and accounts for a relatively low share. The proportion of sawnwood export in the total export of wood forest products ranked fourth and revealed a downward trend year by year, which decreased from 4.91% in 1998 to 0.36% in 2018, with an average annual proportion of 2.11%. Although the export value of wood pulp and roundwood indicated a rising trend, their export value was small, accounting for a very low proportion of the total export value of wood forest products, accounting for less than 1% in each year, with an average annual proportion of 0.31% and 0.08%, respectively.

2.3. Export Market Concentration Declined and Major Target Markets Stabilized

The market concentration of China's wood forest products export has gradually decreased, although the major export markets are relatively stable, and the export value to emerging economies has increased. We use the Herfindahl–Hirschman Index (H Index) to measure the export market concentration of China's wood forest products (see Figure 2). Overall, China's export market concentration revealed a clear downward trend, with the H index falling from 43.851 in 1998 to 32.351 in 2018. From 1998 to 2004, export market concentration was more stable, and with higher concentration, market concentration was the highest in 1999 with the H index of 44.882; from 2004 to 2014, export market concentration declined significantly and fell to the lowest point in 2014 with an H index of 27.461, the concentration increased slightly between 2014 and 2018. Among them, the United States, Japan, Hong Kong, China, the United Kingdom, and Australia are China's important trading partners in the export of wood forest products. As indicated in Figure 3, based on the share of major target markets in China's wood forest products export, the United States is China's largest export destination of wood forest products, with an annual average share of 29.81% (highest in 2004, 37.94%), but its share is on a downward trend. Hong Kong, China, is China's second-largest export destination of wood forest products; its proportion in China's total export of wood forest products dropped significantly from 31.32% in 1998 to 4.73% in 2018. Japan is China's third largest trading partner for wood forest products, and the proportion also showed a downward trend, falling from 14.66% in 1998 to 5.83% in 2018. In recent years, the share of China's exports to emerging economies such as Malaysia, India, Thailand, and the Philippines has been rising, and the share of Malaysia in China's total export of wood forest products increased from 0.96% in 1998 to 2.32% in 2018. The share of wood forest products exported to India rose from 0.54% in 1998 to 1.75% in 2018. The share of wood forest products exported to Thailand increased from 0.61% in 1998 to 1.30% in 2018. The share exported to the Philippines climbed from 0.47% in 1998 to 1.88% in 2018. Asia's emerging economies gradually became important trading partners in China's wood forest products export.

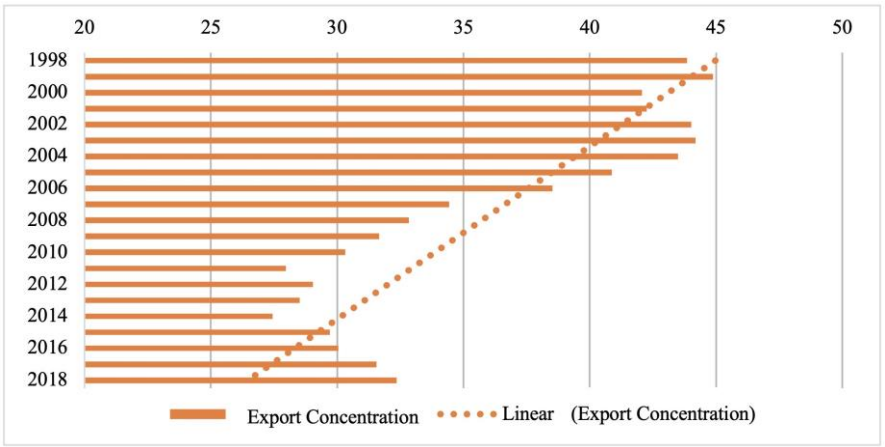

Figure 2. Export concentration of China's wood forest products. Source: calculated according to the data of the United Nations COMTRADE database.

2.4. The Importance of the Belt and Road Initiative Markets Has Been Highlighted

In 2013, the initiative was proposed to build the Belt and Road, which aims to develop economic cooperation with countries along the Belt and Road (referred to as BRI afterward). We chose 65 countries as samples, including Mongolia and ten ASEAN countries, eighteen West Asian countries such as Iran and Iraq, eight South Asian countries such as India and Pakistan, five Central Asian countries such as Kazakhstan, seven countries of the Commonwealth of Independent States such as Russia and Ukraine, and sixteen countries of Central and Eastern Europe such as Poland and Lithuania. The trade value of wood

forest products exported from China to the countries along the BRI and its proportion to the total export of China's wood forest products are shown in Figure 4.

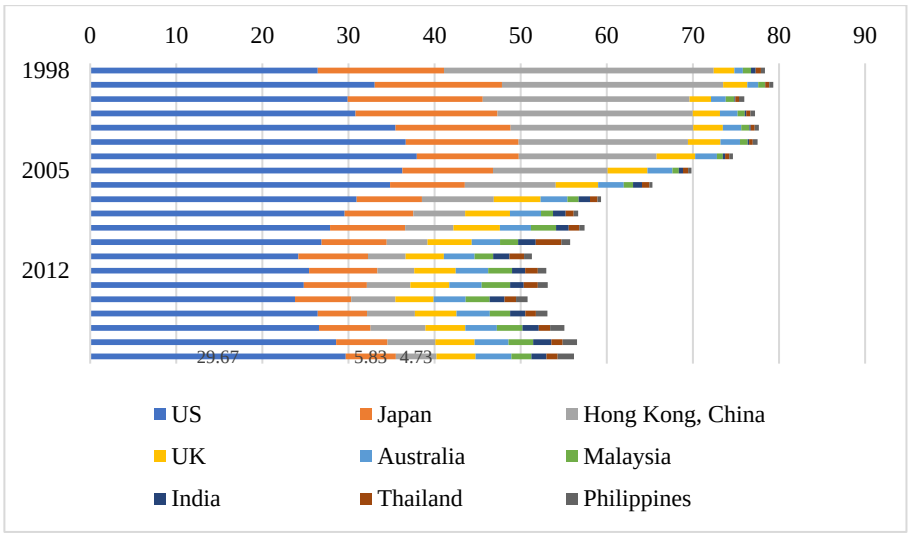

Figure 3. Share of wood forest products exported to major destinations in China's wood forest products exports (unit: %). Note: According to the World Trade Organization agreement, a region can become a member in its own right, i.e., a separate customs territory, as declared and confirmed by its sovereign state. In 1997, the Chinese government issued a statement pledging to retain Hong Kong, China, as a separate customs territory after the return of sovereignty. Source: calculated according to the data of the United Nations COMTRADE database.

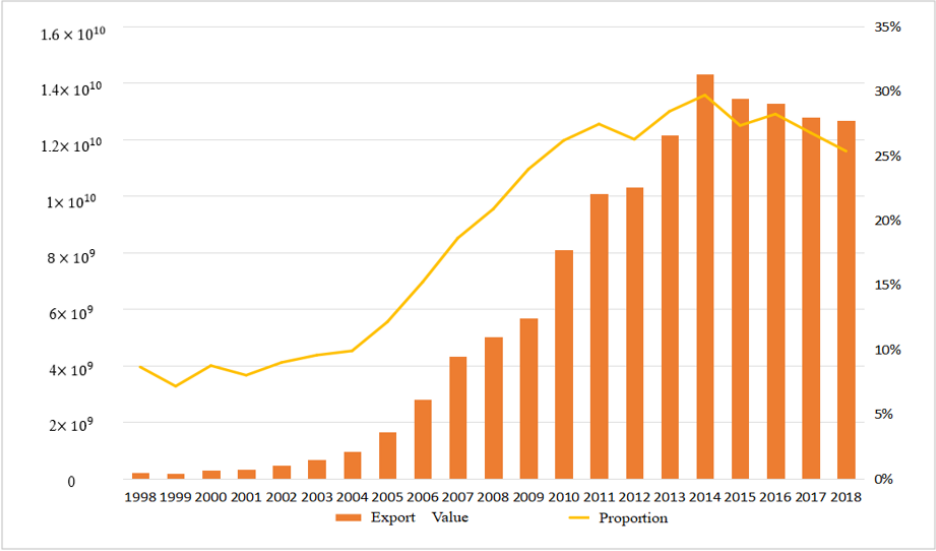

Figure 4. China's export of wood forest products to the Belt and Road initiative economies. Source: calculated according to the data of the United Nations COMTRADE database.

In recent years, the trade value of wood forest products exported to the BRI countries and their share in China's total export of wood forest products have both declined slightly, but the BRI countries are still China's important trade partners. Generally speaking, in terms of export value, China's trade of wood forest products exported to countries along the BRI showed an increased tendency, rising from USD 201.1 million in 1998 to USD 12,679.8 million in 2018, with an average annual growth rate of 27.18%. The export trade rose year by year from 1998 to 2014, and the export value in 2014 was the highest, reaching USD 14,303.3 million, while the export value decreased slightly from 2014 to

2018. The proportion of China's total export of wood forest products exported to the BRI countries was on a rising trend, from 8.63% in 1998 to 25.35% in 2017. The proportion accounted for from 1998 to 2014 rose sharply, with the highest at 29.68% in 2014, and later, there was a slight decrease in share from 2014 to 2018.

Among the countries along the BRI, China's export destinations of wood forest products were relatively concentrated. Singapore, Malaysia, the United Arab Emirates (UAE), India, Vietnam, Thailand, the Philippines, Iran, the Russian Federation, and Indonesia were the main export destinations, accounting for more than 65% of China's total export trade in wood forest products (see Appendix A Table A2). Among them, wood forest products exported to Singapore accounted for the highest proportion and showed a clear downward trend. From 1998 to 2018, its proportion decreased from 34.52% to 8.23%, with an average annual proportion of 13.00%. Conversely, the export value rose from USD 69.4 million in 1998 to USD 1043.4 million in 2018. The share of wood forest products exported to Malaysia was the next highest, with a more stable share, accounting for 9.36% on an annual average, and the export value rose from USD 22.3 million in 1998 to USD 1160.2 million in 2018. The proportion of wood forest products exported to the UAE was also higher, with an overall upward trend. From 1998 to 2018, its proportion rose from 4.01% to 7.08%, with an annual average proportion of 8.21%, and the export value rose from USD 8.1 million in 1998 to USD 897.2 million in 2018. Wood forest products exported to Thailand accounted for 5.54% on an annual basis, and their export value rose from USD 14.2 million in 1998 to USD 652.1 million in 2018. The annual average share exported to India was 5.12%, and the value of export trade increased from USD 125.5 million in 1998 to USD 875.0 million in 2018. The share of wood forest products exported to the rest of the countries was low, with an average annual share of less than 5%.

3. Methodology

3.1. Measurement and Determination of Export Product Quality

Economists have gradually deepened their focus on the quality of trade products in the past 20 years, with most scholars placing product quality heterogeneity as important as firm productivity heterogeneity [23–25]. Baldwin and Harrigan [23] proposed a trade model based on the heterogeneity of the two dimensions of enterprise production efficiency and quality, formally incorporating product quality into the theoretical framework of international trade. Manova and Zhang [26] brought product quality into the trade model of multi-product enterprises and found a positive correlation between the unit value of export products and export value. Hallk and Sivadassan [15] constructed a trade model of productivity and quality heterogeneity to analyze the product quality determination of export enterprises systematically. From the economic perspective, consumers take both product price and quality into account, and the consumption results include the expression of actual experience with product quality. That is to say, quality refers to the performance of the product's competitive advantage beyond the price.

Although the research on product quality is a cutting-edge issue in the field of economics, due to the development of data statistics and measurement methods, the research on the quality of China's export products is not abundant, and the progress is relatively slow. From a statistical perspective, the quantification of product quality requires data such as trade value and trade quantity. Early studies such as Schott [27] and Hummels and Klenow [28] use unit value as a measurement of product quality. With the deepening of methodology exploration, scholars have generally recognized the problem of unit value substitution. As unit value contains both quality and cost information, the reflection of product quality in developing economies is often pulled down by cost. As a result, the assumption that "unit value is equivalent to product quality" has begun to be broken in the studies [29]. The idea of a regression-based inverse method to estimate the demand function using the quantity and price of consumption based on the endogenous quality determination model has been introduced into research. It is used to deduce the quality of the product.

From the theoretical foundations of quality measurement [30,31],

$$\ln q_{ct} = \varepsilon_{ct} - \sigma \ln p_{ct} + \chi_{ct} \tag{1}$$

The quality is contained in the residual term ε_{ct}, q_{ct}, and p_{ct} are the quantity and quality of exported products, respectively, and χ_{ct} is the importing country-year dummy variable; from this, we define the quality as:

$$\text{quality}_{ct} = \widehat{\ln \lambda}_{\text{ct}} = \frac{\hat{\varepsilon}_{ct}}{(\sigma - 1)} = \frac{\ln q_{ct} - \widehat{\ln q}_{ct}}{(\sigma - 1)} \tag{2}$$

Equation (2) can measure the quality of a HS-coded product exported from China to country/region c in year t. In order to enable the quality measurement results to be comparative, we standardized the quality indicators of Equation (2).

$$\text{r-quality}_{\text{ct}} = \frac{quality_{ct} - \min quality_{ct}}{\max quality_{ct} - \min quality_{ct}} \tag{3}$$

$minquality_{ct}$ and $maxquality_{ct}$ denote the minimum and maximum export values of a given HS-coded product from the perspective of all export destinations for all years, respectively. The standardized quality indicators in the above equation do not have units of measurement and can be summed and compared at the product level and export destination level according to the share of export value:

$$\text{TQ} = \frac{v_{mt}}{\sum_{mt \in \Omega} v_{mt}} \times r - quality_{mt} \tag{4}$$

In Equation (4), Ω is the set of samples at a given level, TQ is the overall quality, and V_{mt} is the trade value. The indicator of TQ is between 0 and 1, and a larger value indicates better quality.

The specific calculation process is as follows: the CEPII BACI database is used to extract each coded product's annual export value and export quantity data, and the export price is equal to the ratio of the export value to the export quantity. Then, the price and quantity data of each coded product are brought into Equation (1) for regression, respectively, and the significance test idea of Shi and Shao [32] is taken to ensure the reliability of the quantification. The product quality value of each product is calculated according to Equation (2), and finally, the quality value of different times and product levels is calculated according to Equations (3) and (4).

On the basis of the productivity heterogeneity model [33], quality factors are further introduced, forming a framework for the heterogeneity model of enterprise product quality. Referring to the theoretical framework of Hallak and Sivadasan [15], while considering consumer demand and producer production choices, the decision-making mechanism of enterprise export product quality is clarified; then, a theoretical model for export product quality decision-making is obtained.

From a consumer perspective, in a monopolistic competitive market, the utility function of consumers with constant substitution elasticity is

$$U = [\sum_{j} (\lambda_j q_j)^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}} \tag{5}$$

Under the condition of maximizing consumer utility, the consumer demand function is

$$q_j = p_j^{-\sigma} \lambda_j^{\sigma-1} \frac{E}{P} \tag{6}$$

where j represents the product category, q represents the quantity, p represents the price, λ is the quality, σ is replace elasticity, and $\sigma > 1$. E and P are exogenous variables: market expenditure level and constant substitution elasticity price index, respectively.

From the perspective of producers, the production costs of enterprises include marginal cost C and fixed cost F, and the cost functions are

$$C(\lambda, \varphi) = \frac{k}{\varphi}\lambda^{\beta} \tag{7}$$

$$\mathrm{F}(\lambda, \xi) = \mathrm{F}_0 + \frac{f}{\xi}\lambda^{\alpha} \tag{8}$$

where k and f are constants, α, β is the quality elasticity of fixed cost and marginal cost, respectively, $\alpha > 0$, $0 < \beta < 1$. φ is the ability of enterprises to produce fixed outputs at low cost, i.e., production efficiency. ξ is the ability of an enterprise to produce high-quality products under specific investments, which is known as fixed investment efficiency. Enterprises with high ξ may establish R&D departments internally, which can continuously innovate and meet consumer needs. Both can have an impact on the production cost of the enterprise.

The expression for enterprise profit is

$$\pi(p_j, \lambda_j) = (\frac{p_j}{\lambda_j})^{1-\sigma}\frac{E}{P} - \mathrm{F}_0 - \frac{f}{\xi}\lambda^{\alpha} - \frac{k}{\varphi}\frac{E}{P}p_j^{-\sigma}\lambda^{\beta+\sigma-1} \tag{9}$$

Under the constraint of maximizing profits, enterprises choose the quality level of their products and obtain the quality expression as follows:

$$\lambda(\phi,\ \xi) = [\frac{1-\beta}{\alpha}(\frac{\sigma-1}{\sigma})^{\sigma}(\frac{\phi}{c})^{\sigma-1}\frac{\xi}{f}\frac{E}{P}]^{\frac{1}{\alpha'}} \tag{10}$$

The first-order derivative of Equation (10) yields:

$$\frac{\partial\lambda(\phi,\xi)}{\partial\phi} = \frac{\sigma-1}{c}\frac{1-\alpha}{\beta}(\frac{\sigma-1}{\sigma})^{\sigma}(\frac{\varphi}{c})^{\sigma-2}\frac{\xi}{f}\frac{E}{P} > 0 \tag{11}$$

It can be inferred that production efficiency (ϕ) and fixed investment efficiency (ξ) have positive impacts on product quality and are decisive factors for product quality.

3.2. Data Source for Export Product Quality Measurement

The improvement in product quality is a complex and dynamic process, such as the quality ladders in North–South trade [34]. The identification of quality differences in sub-category products can help sectors in transition economies facing growth bottlenecks, better identify quality problems in subdivided vertical categories, and gain insight into the focus of cultivating advantages. The study of quality heterogeneity within products is an important field under the development of the new–new trade theory.

This study uses the HS96 six-digit code of wood forest products as the classification for product quality measurement. The export value of roundwood, sawnwood, and wood pulp accounts for less than 1% of the total value of wood forest products export, so it selects three major categories of products as the object of study: wood-based panels (including veneer, particle board, fiberboard, and plywood), paper products and wood furniture. According to the export value ranking in the recent five years, we selected 60 products of the three objects. 60 sub-categories with their HS six-digit codes are wood-based panels (HS440890, HS441019, HS441119, HS441129, HS441213, HS441214, HS441219, HS441299), paper products (HS480100, HS480252, HS480260, HS480300, HS480439, HS480529, HS480560, HS480570, HS480580, HS480810, HS480920, HS481011, HS481029, HS481032, HS481091, HS481121, HS481131, HS481139, HS481190, HS481390, HS481420, HS481620, HS481690, HS481710, HS481810, HS481820, HS481830, HS481840, HS481890, HS481910, HS481920, HS481940, HS481950, HS481960, HS482010, HS482020, HS482030, HS482050, HS482090, HS482110, HS482190, HS482311, HS482320, HS482360, HS482370, HS482390), wood furniture (HS940161, HS940169, HS940330, HS940340, HS940350, and HS940360). The selected

products accounted for 98.02% of the total export of wood-based panels, paper products, and wood furniture, so the measurement of the sample could represent the overall quality of the three objects. The selected products are shown with their HS six-digit codes in the Appendix A.

The data on the export value and corresponding export quantity of HS 6-digit products to each destination from 1998 to 2017, which are needed to estimate the product quality of China's wood forest products export, are obtained from the CEPII BACI database. The BACI database is developed and dimensionally expanded based on the United Nations Comtrade data and uses measures such as weighted analysis of variance to ensure its reliability. It is a widely adopted and recognized public data source by scholars in bilateral trade and influencing factors research [35,36]. The sample data of this study include three dimensions, i.e., time, export destination, and product. We chose all the trading partners for which China's major wood forest products export occurred, and the GDP data of each trading partner were from the World Bank database (World Development Indicators).

The study on quality determinants was based on panel data, which covered both cross-section and time dimensions. The two advantages of panel data are that they help to solve unobservable omitted variables and provide more information about the dynamic behavior of individuals. For the problem of unobservable omitted variables, econometric methods such as pooled regression, fixed effect, and random effect are used in empirical research. The estimation strategy of pooled regression is to treat the panel as cross-sectional data (i.e., assuming that the regression equations are the same among individuals), ignoring unobservable or omitted heterogeneity between individuals. The fixed effect model considers the individual characteristics of unobservable variables, while the random effect model reflects that unobservable random variables are not correlated with explanatory variables. Statistical tests can be adopted for the three commonly used panel regression methods to determine which econometric model to choose (i.e., Hausman test and LM test; see empirical analysis in Section 5.3 for details). In a panel model, if the explanatory variables include the lags of the dependent variable, it constitutes a dynamic panel. The lagged variable is used as an instrumental variable in the system GMM regression, which is commonly taken to overcome endogeneity problems and perform robustness tests (see Section 5.3.2 for details).

4. Measurement Results

4.1. Measurement Result of Product Quality in the Export of Major Wood Forest Products

The quality level of wood-based panels in export is the highest, followed by the quality level of paper products, and the quality level of wood furniture is the lowest (see Figure 5). Regarding various products, the quality level of exported wood-based panels presented a discernible upward trend; the quality value rose from 0.450 in 1998 to 0.545 in 2017, increasing by 21.11%. From 1998 to 2006, the quality level of wood-based panels in export increased rapidly, and the quality level was the highest in 2006, with a quality value of 0.617. From 2006 to 2008, affected by the financial crisis, the quality level of exported wood-based panels fluctuated drastically. However, from 2008 to 2017, the quality level of exported wood-based panels remained stable. In contrast, the quality level of paper products in export fluctuated slightly, and the quality increased slightly, rising from 0.366 in 1998 to 0.389 in 2017 with an increase of 6.28%, and the average quality level was always between 0.35 and 0.40 throughout the years. There was no significant change in the quality level of exported wood furniture; the quality value was between 0.2 and 0.25, with a slight decrease from 1998 to 2001, as well as remaining stable after a small increase from 2001 to 2005, but the quality was always at a level. Figure 6 indicates the standard deviation of the quality of three main exported wood forest products, all exhibiting a U-shaped trend of initial decline followed by an increase. This indicated that the difference in product quality within the industry first narrowed and then widened. When new products entered the market, enterprises within the industry were forced to follow suit, resulting in a gradual reduction in product quality gaps and a decrease in available profits. Subsequently, in order

to maintain their competitive advantage, high-productivity enterprises further researched and innovated, eventually producing high-quality new products to gradually expand product quality differences within the industry. This trend aligned with the product life cycle, as the products undergo a new round of innovation and the establishment of new competitive advantages.

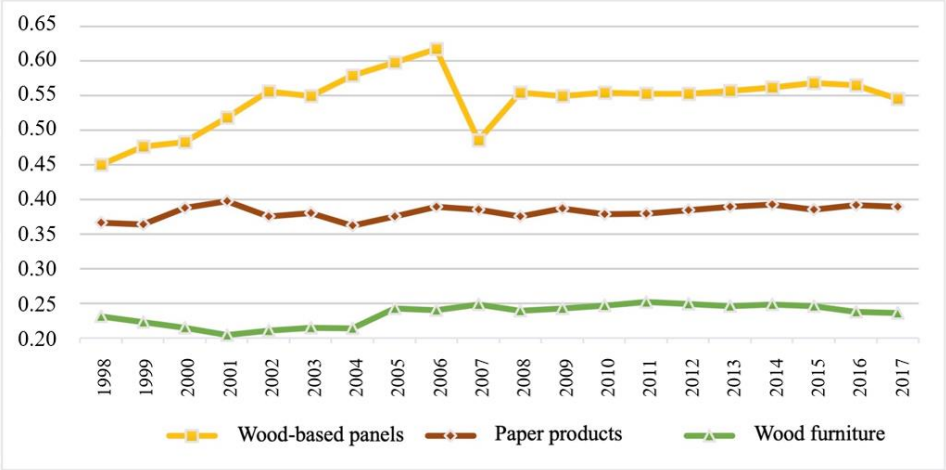

Figure 5. Changes in the quality of China's major exported wood forest products.

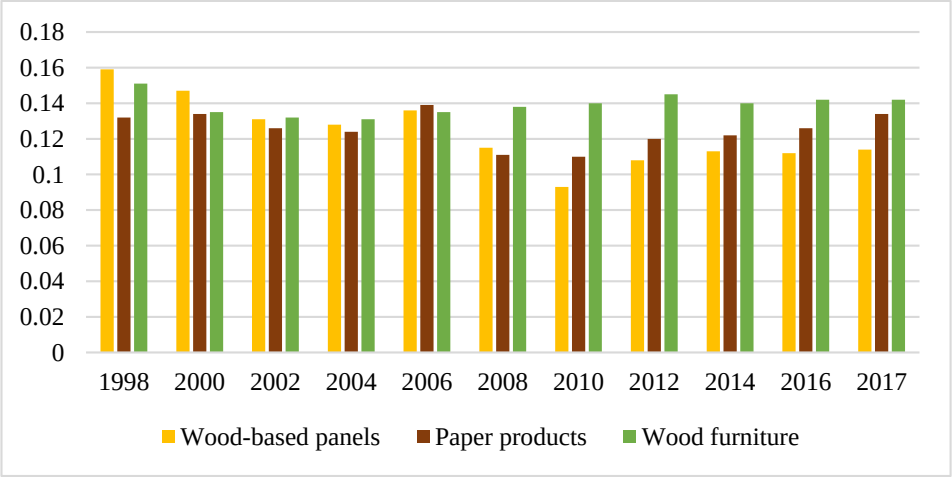

Figure 6. Quality standard deviation of China's major exported forest products.

The product quality of each HS code is specifically analyzed as follows (see Appendix A Table A3). From 1998 to 2017, in terms of the quality level of each 6-digit sub-category of wood-based panels, the product quality level and export value under code 441214 in plywood accounted for the highest share, with an average export value proportion of 26.86% per year, and the quality level in recent years declined slightly, with an average quality value of 0.788. Furthermore, the product quality level and export value under codes 441213, 441119, and 441219 were in the middle, with an average stable quality value between 0.5 and 0.6. The product quality level under codes 440890, 441019, 441129, and 441299 was low, with an average value of 0.3 to 0.5, but the quality level was on the rise. Among them, the product quality level under code 441299 was the lowest, with an average quality value of 0.319, while it had a relatively high export share of 13.84%.

From the perspective of the quality level of each sub-category of paper products (see Appendix A Table A4), newsprint with code of 480100 showed the highest quality, with an average quality value of 0.718, while its share accounted for a lower rate of 0.77%. The quality level of paper and paperboard with codes 482050, 480529, and 481960 was higher,

with an average value of 0.6 to 0.7. The average quality value of the products with codes 481139, 481121, 482090, 481032, 480300, 480580, 481011, 481420, 481810, 481029, 481820, and 48113 was between 0.5 and 0.6, that value with codes 481091, 481710, 482020, 481690, 480560, 480252, 480920, 482110, 481620, 480439, 482311, 482360, and 482190 was between 0.4 and 0.5. Meanwhile, the average quality value of the products with codes 482320, 481840, 480810, 481830, and 480260 was between 0.35 and 0.4, that value with the codes 481390, 481190, 481920, 482010, 480570, 482030, 482370, 481910, 481890, 481940, 482390, and 481950 was lower than 0.35, which was lower than the overall export quality level of paper and paperboard, but they counted for 52.17% of export value. Among them, the product quality level with the code 481950 was the lowest, with an average quality value of 0.180 and an export value of 1.84% of the total export of paper products. The export trade share with codes 482010 and 481940 was relatively high, 13.58% and 11.18%, respectively, while their quality level was not high, with average quality values of 0.302 and 0.245, respectively.

From the view of the quality level of each sub-category of wood furniture (see Appendix A Table A5), the export share with the code of 940360, namely non-kitchen, office, and bedroom wood furniture, was the highest, reaching 44.34%; however, the quality level was the lowest, with an average quality value of 0.184. The quality level of the product with the code 940330, i.e., office furniture (wooden), was the highest, with an average quality value of 0.702; however, its export value proportion was lower, accounting for only 4.26% of the total export value. The quality level of the rest of the wood furniture was not high, with a value between 0.2 and 0.3.

4.2. Changes in the Quality of Wood Forest Products Exported from China to the BRI Countries

4.2.1. Changes in the Quality of Wood-Based Panels Exported from China to the BRI Countries

The overall change in the quality level of wood-based panels exported to the BRI countries was not significant, rising from 0.530 in 1998 to 0.533 in 2017, with an increase of 0.57%, and there were quality level differences between markets (see Figure 7). The export quality level of wood-based panels first rose and then declined from 1998 to 2007, with the highest quality value of 0.602 in 2004. There was no big change in the export quality level of wood-based panels from 2007 to 2017. Among China's major export markets, the quality level of wood-based panels exported to the UAE, India, Thailand, and the Philippines showed a clear rising trend. Among them, the quality level of wood-based panels exported to the UAE was relatively high, which was higher than the overall quality level of all BRI export destinations from 2004 to 2017. The quality of wood-based panels exported to Thailand and the Philippines in recent years was close to the overall quality level of all BRI export destinations. The quality of wood-based panels exported to India was low, and the quality each year was lower than the overall quality level of all BRI export destinations, and there was much room for improvement. The quality of wood-based panels exported to Malaysia and Singapore was higher but showed a clear downward trend. Among them, the quality of wood-based panels exported to Malaysia was higher than the overall quality level of all BRI destinations in all years, and the quality value declined from 0.621 in 1998 to 0.547 in 2017. The quality of wood-based panels exported to Singapore rose sharply from 0.543 in 1998 to 0.680 in 2006, and the quality continued to decline from 2006 to 2017. After 2014, the quality level began to be lower than the overall quality level of the BRI destinations. The trend of quality changes in wood-based panels exported to Vietnam, Russia, Iran, Indonesia, and Israel was not significant. Among them, the quality of wood-based panels exported to Vietnam and Israel was relatively high, and the quality of wood-based panels exported to Russia, Iran, and Indonesia was relatively low, which has room for further quality increase.

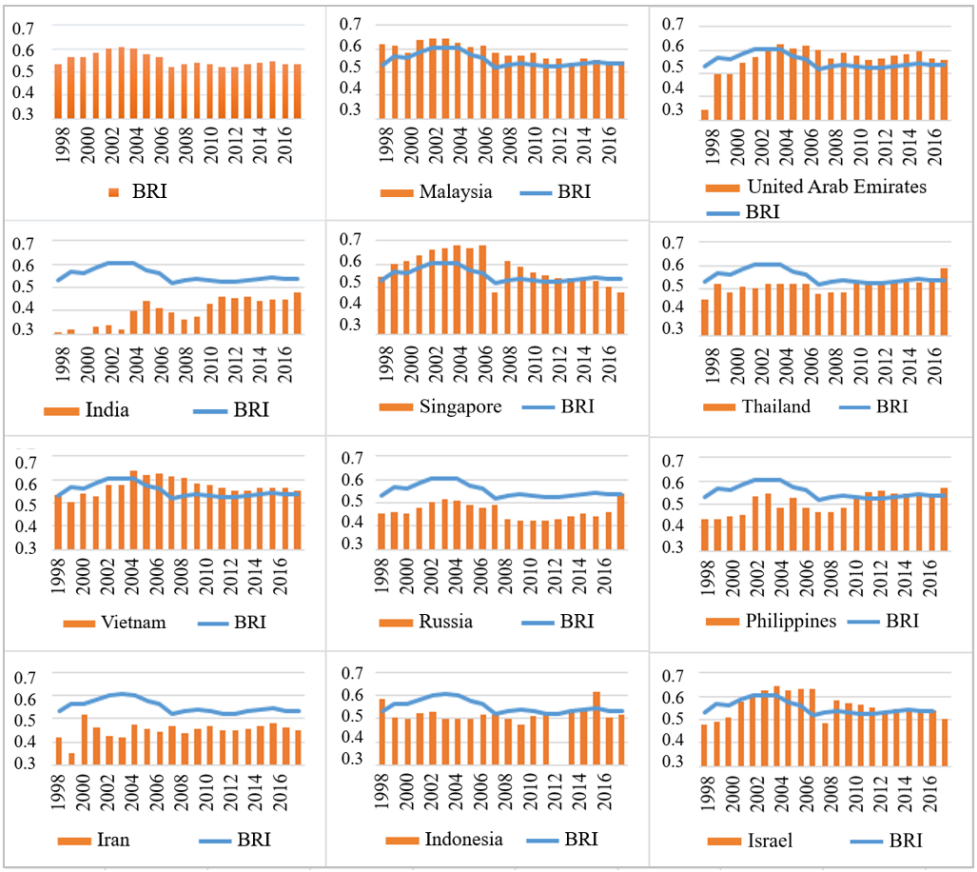

Figure 7. Quality of wood-based panels exported from China to major BRI markets.

4.2.2. Changes in the Quality of Paper Products Exported from China to the BRI Countries

The quality level of paper products exported to the BRI countries fluctuated constantly with no clear upward or downward trend, and there were differences in the quality level between various destinations (see Figure 8). From the perspective of the overall quality level of exports to the BRI countries, the quality level in 2001 was the highest, with a value of 0.512, and the quality level in 2012 was the lowest, with a value of 0.448. From the perspective of export destinations, the quality of paper products exported to India, Iran, and Israel was on the rise. Among them, the quality of products exported to India fluctuated greatly, with the lowest quality value of 0.333 in 2003 and the highest quality value of 0.668 in 2008. The quality value rose from 0.420 in 1998 to 0.469 in 2017, with an increase of 11.67%. The quality of paper products exported to Iran was higher, with the quality value rising from 0.417 in 1998 to 0.510 in 2017, an increase of 22.30%. From 2000 to 2017, its quality level was higher than the overall quality level of paper products exported to the BRI countries. The quality of paper products exported to Israel had a more significant increase from 0.340 in 1998 to 0.482 in 2017, with an increase of 41.77%. The quality of paper products exported to Russia declined slightly, and the quality first increased and then declined from 1998 to 2004, with the highest quality value of 0.581 in 2001. Then, the quality from 2004 to 2017 was more stable and consistently lower than that of the BRI countries as a whole, and the quality needed to be further improved. The quality of paper products exported to Malaysia, the United Arab Emirates, Singapore, Thailand, Vietnam, the Philippines, and Indonesia was relatively stable. Among them, the quality of paper products exported to Malaysia, the United Arab Emirates, Singapore, Vietnam, and the Philippines was relatively higher, while the quality of those exported to Thailand was slightly lower than the overall quality level of the BRI destinations. In addition, the quality of paper products exported to Indonesia was much lower than the overall quality level of the BRI destinations, and the quality level has much room for improvement.

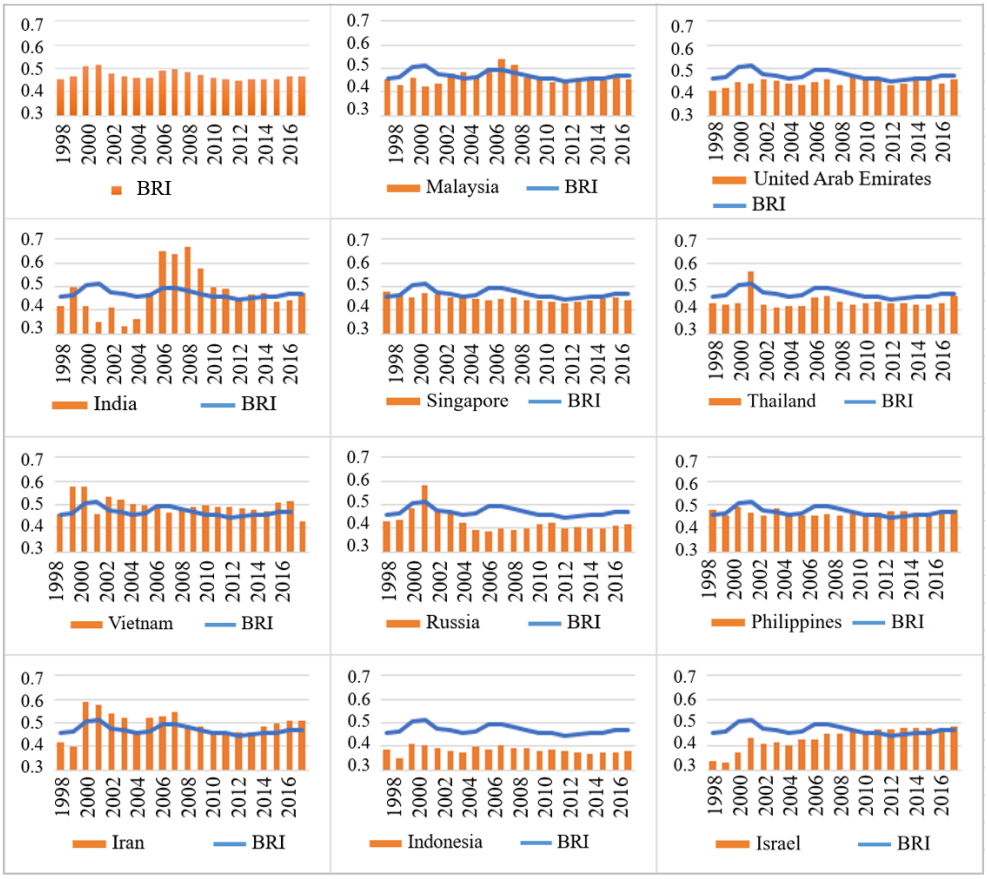

Figure 8. Quality of paper products exported from China to major BRI markets.

4.2.3. Changes in the Quality of Wood Furniture Exported from China to the BRI Countries

The quality of wood furniture exported to countries along BRI was relatively stable, with a slight decrease from 2012 to 2017. The highest quality level was recorded in 2002 with a value of 0.407, while the lowest quality was recorded in 2013 with a value of 0.369 (see Figure 9). In terms of different destinations, the quality of wood furniture exported to Malaysia, Thailand, Indonesia, and Israel showed an upward trend. Among them, the quality of wood furniture exported to Malaysia and Israel was higher. The quality value of that exported to Malaysia rose from 0.344 in 1998 to 0.390 in 2017, an increase of 13.37%. The quality value of that exported to Israel increased by 32.59% from 0.270 in 1998 to 0.358 in 2017. The quality exported to Thailand and Indonesia was relatively low, which was lower than the overall quality level of the BRI destinations in all years. Specifically, the quality of wood furniture exported to Thailand increased from 0.255 in 1998 to 0.341 in 2017, an increase of 33.73%. The quality of exports to Indonesia increased by 23.14% from 0.242 in 1998 to 0.298 in 2017. The quality of wood furniture exported to Singapore and Russia showed a downward trend. Among them, the quality level of wood furniture exported to Singapore was roughly the same as the overall quality level of the BRI destinations, with a slight decline from 0.426 in 1998 to 0.369 in 2017. The quality of wood furniture exported to Russia declined sharply from 0.341 in 1998 to 0.201 in 2017, which was lower than the overall quality level of the BRI destinations in all years. Additionally, there was no obvious change in wood furniture quality exported to the UAE, India, Vietnam, the Philippines, or Iran. The quality of wood furniture exported to the UAE, Vietnam, and the Philippines showed fluctuations around the overall quality level of the BRI destinations. Nevertheless, their quality level was relatively high, while the quality of that exported to India and Iran continued to fluctuate with a comparatively low-quality level.

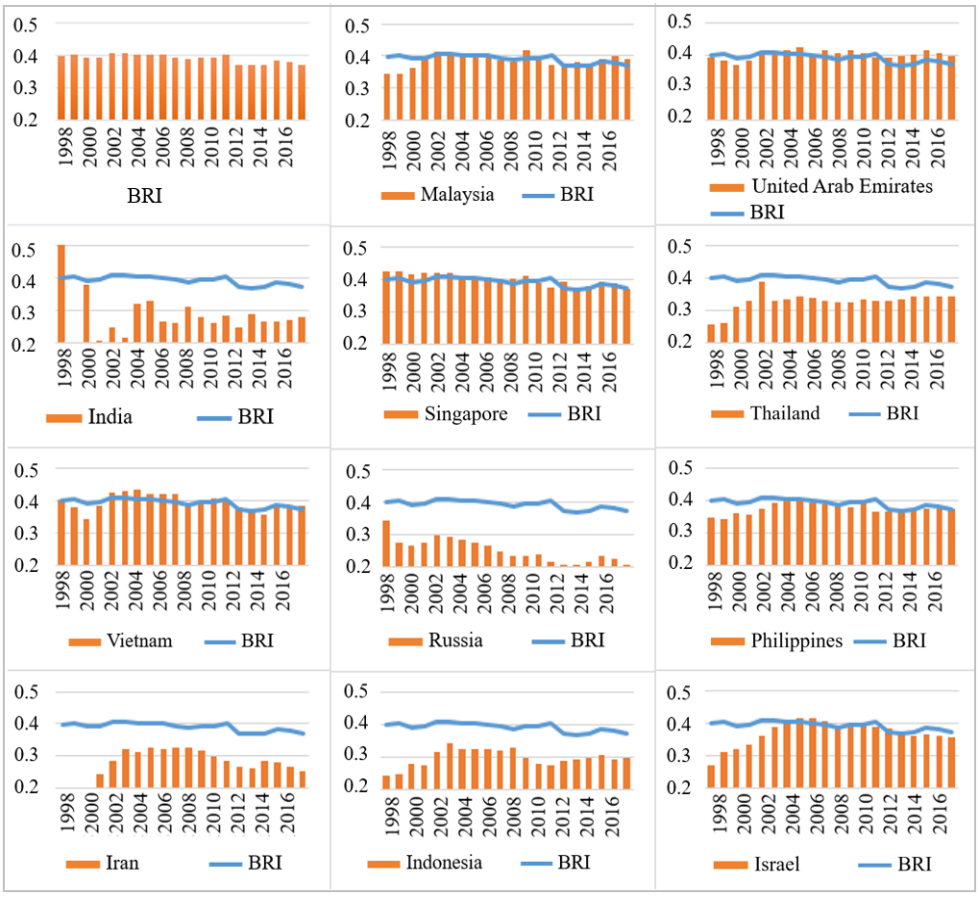

Figure 9. Quality of wood furniture exported from China to major BRI markets.

5. Determinants Analysis

5.1. Empirical Model

According to the theoretical analysis of export product quality determination in Section 3, it can be concluded that production efficiency and the ability to produce high-quality products are the major determinants of export products [15]. The study uses the export quality of wood forest products as the explained variable and takes factors that directly or indirectly affect a company's production efficiency and ability to produce high-quality products as the explanatory variables (see Table 1), and the descriptive statistical results are listed in Table 2. Specifically, the explanatory variables include total factor productivity (*tfp*), R&D investment (*thc*), labor cost (*labor*), foreign direct investment (*invest*), industry scale (*scale*), capital density (z), whether or not a free trade agreement is signed (*Q*), and financing constraints (*finance*). A semi-logarithmic model is established as follows:

$$q_{itd} = \alpha_0 + \alpha_1 tfp_{it} + \alpha_2 lnthc_{it} + \alpha_3 lnlabor_{it} + \alpha_4 invest_{it} + \alpha_5 lnscale_{it} + \alpha_6 lnz + \alpha_7 finance_{it} + \alpha_8 Q_{it} + \varepsilon_{it} \quad (12)$$

Among them, i represents products, t represents time, d represents export trade partners, q represents the quality of exported products, and ε represents residuals.

5.2. Data and Variables

5.2.1. Total Factor Productivity

In this study, total factor productivity is used as a measure of production efficiency. The measurement of total factor productivity refers to the extended method of Solow's residual method [37], which is approximately estimated as follows: total factor productivity = ln(Industrial Value-added/Labor force) − capital contribution coefficient × ln(Fixed assets/Labor force), where the capital contribution coefficient is assumed as 1/3. As shown

in the quality expression derived from the model of product quality heterogeneity, total factor productivity positively impacts product quality.

Table 1. Variable description and data sources.

Variable	Explanation	Anticipated Effect	Data Source
tfp	Total Factor Productivity	+	The industrial added value and fixed asset data come from the China Industry Statistical Yearbook, while the labor force data come from the China Labor Statistics Yearbook.
thc	R&D Investment	+	The number of industrial enterprises above a certain scale and internal expenditure on research and development comes from the China Science and Technology Statistics Yearbook.
labor	Labor Cost	+/−	The total wage and the number of employees on-site at the end of the year come from the China Labor Statistics Yearbook.
invest	Foreign Direct Investment	+	The amount of foreign investment, investment from Hong Kong, Macao, and Taiwan regions of China, and the actual capital come from the China Industry Statistical Yearbook.
scale	Industry Scale	+	The number of employees on-site at the end of the year comes from the China Labor Statistics Yearbook.
z	Capital Intensity	+	The fixed asset data come from the China Industry Statistical Yearbook, while the number of employees comes from the China Labor Statistics Yearbook.
finance	Financing Constraints	−	The interest expense and total assets data come from the China Industry Statistical Yearbook.
Q	Whether Signing a Free Trade Agreement	+/−	The data on whether or not a free trade agreement is signed comes from the China Free Trade Area Service Website.

Table 2. Variable descriptive statistics.

Variable	Observations	Mean	Std. Deviation	Minimum	Maximum
quality	10,039	0.5005187	0.1363858	0	1
tfp	8644	12.41399	4.501433	8.17706	19.90974
lnthc	9668	9.33594	3.521916	3.612103	14.75769
lnlabor	9856	10.87705	1.663369	8.459352	14.24928
invest	8644	0.3735321	0.1812412	0.0817856	0.9021394
lnscale	10,039	12.97402	0.448866	11.98916	13.93909
lnz	8644	12.5466	0.7351631	10.96491	13.64527
finance	8286	0.0139098	0.0027566	0.009	0.0191179
Q	10,039	0.0354617	0.1849529	0	1

5.2.2. R&D Investment

The measure of R&D investment is the ratio of internal expenditure on R&D by industrial enterprises above a certain scale to the number of industrial enterprises above a certain scale. R&D investment has a direct impact on the improvement of enterprise product quality. Firms with high R&D investment typically have strong technological and product innovation capabilities, which are beneficial for improving product quality.

5.2.3. Labor Cost

Labor cost is represented by the ratio of total wages to the number of employees on the payroll at the end of the year. On the one hand, an increase in labor costs may lead to an increase in operating costs for enterprises, which may result in a reduction in investment in other departments, such as R&D, especially for companies that use low prices to participate in market competition. This is detrimental to improving the quality of exported products. On the other hand, an increase in labor costs can enhance employees' enthusiasm for work

and attract more highly skilled employees, thereby improving production efficiency and fixed input efficiency, which is beneficial for improving the quality of exported products. Therefore, the impact of changes in labor costs on product quality is uncertain.

5.2.4. Foreign Direct Investment

Foreign direct investment is represented by the ratio of investment from foreign and Hong Kong, Macao, and Taiwan regions of China shareholders to the total capital of the enterprise. The entry of foreign capital can bring in senior management talents and efficient management models, thereby improving production efficiency. Additionally, foreign capital entry can bring advanced technology and skilled talents, enhancing fixed input efficiency and improving product quality.

5.2.5. Industry Scale

Industry scale is represented by the number of employees on the payroll at the end of the year. A larger industry scale usually means having more sufficient funds, more human resources, and better industrial structures, which are beneficial for improving the quality of exported products.

5.2.6. Capital Intensity

Capital intensity measures the density of capital input and is represented by the ratio of net fixed assets to employees. All types of production inputs have an impact on the quality of exported products, and increased capital input generally leads to improved product quality.

5.2.7. Financing Constraints

Financing constraints are represented by the ratio of interest expense to total assets. A higher value indicates a lower degree of financing constraints. Financing constraints mainly manifest as insufficient funds and limited external funds, resulting in insufficient enterprise R&D momentum and being unfavorable for improving the quality of exported products.

5.2.8. Whether Signing a Free Trade Agreement

Whether signing a free trade agreement acts as a dummy variable: if there is a free trade agreement, it is assigned a value of 1; if there is no free trade agreement, it is assigned a value of 0. Signing a free trade agreement leads to a decrease in tariff levels and trade costs. On the one hand, more enterprises will participate in international trade, particularly those with lower production efficiency, leading to a decline in the quality of exported products. On the other hand, more enterprises participating in international trade increase market competition and are beneficial for improving the quality of exported products. Therefore, the impact of signing a free trade agreement on the quality of exported products is uncertain.

5.3. Empirical Results

The data used in this paper are long-panel data, and the number of time t is much smaller than that of country i, so the influence of non-stationary time series on regression results can be ignored. The panel data regression model included fixed-effect, random-effect, and pooled models. The Hausman test and F test are used to examine the suitability of the model. The test results (p-values) are shown in Table 3.

Table 3. Model suitability test.

	Wood-Based Panels	Paper Products	Wood Furniture
Hausman test (fixed effect/random effect)	0.7075	0.0376	0.0001
F test (fixed effect/pooled model)	-	0.0000	0.0000
LM test (random effect/pooled model)	0.0000	-	-
Model choice	Random-effect model	Fixed-effect model	Fixed-effect model

Note: If the p-value of the Hausman test is less than 0.1, the fixed effect model is accepted rather than the random effect. If the p-value of the F-test is less than 0.1, the fixed effect model is accepted rather than the pooled model. If the p-value of the LM test is less than 0.1, the random effect model is accepted.

5.3.1. Regression Results for Different Products

The regression results for the influencing factors of export product quality for different products show that the impact of various factors on the quality of exported products varies (see Table 4). Specifically:

(1) Total factor productivity has a significant positive impact on the quality of all three exported products, which is consistent with expectations. Among them, the impact on paper product quality is the greatest, while the impact on wood furniture quality is the least;
(2) R&D investment has a significant positive impact on the quality of three types of products, and the impact on the quality of wood-based panels is higher than that of the other two types of products, indicating that wood-based panel companies have high efficiency in the use of R&D investment funds;
(3) Labor costs have a significant negative impact on the quality of wood-based panels and wood furniture while having a significant positive impact on the quality of paper products. The rise in labor costs significantly increases the operating costs of labor-intensive industries such as wood-based panels and wood furniture. In order to maintain the original market competitiveness of products, companies reduce their investment in other areas, which has a negative impact on the quality of export products. For capital-intensive industries such as paper products, the impact of rising labor costs is relatively small. In this case, companies will choose to hire highly skilled employees, which has a positive impact on product quality;
(4) Foreign direct investment has no significant impact on the quality of three types of export products;
(5) The impact coefficient of industrial scale on wood furniture is positive and significant at the 10% level, indicating that the expansion of the wood furniture industry scale has brought the required capital, human resources, and other production factors for the development of the industry, while the impact on the quality of wood-based panels and paper products is not significant;
(6) Capital intensity has a significant positive impact on the quality of paper products but no significant impact on the quality of wood-based panels and wood furniture, indicating that increasing the abundance of capital factors in the paper products industry can improve product quality;
(7) The financing factor has a significant constraining impact on wood-based panels at the 10% level. Wood-based panel companies face strong financing constraints, which have an adverse impact on the quality improvement of export products. This may be an important reason why the quality of wood-based panels, although at a high level, has remained stable after the financial crisis, making it difficult to achieve a rapid increase in quality, like in the early 20th century. However, financing constraints do not significantly affect the quality of other products;
(8) The signing of free trade agreements significantly negatively impacts paper product quality. Trade costs decrease, and some low-efficiency enterprises participate in international trade, decreasing the quality of exported products. However, signing free trade agreements does not significantly affect the quality of wood-based panels and furniture.

5.3.2. Endogeneity and Robustness Tests

(1) Endogeneity Test

In the previous regression, the issue of endogeneity was not considered. Due to the mutual influence between explanatory and explained variables, the basic regression may suffer from bias due to endogeneity issues. Therefore, we conducted further discussion on the issue of endogeneity. The increase in foreign direct investment will affect the quality of exported products, and on the other hand, the improvement of export product quality and product competitiveness will attract foreign investment. The enhancement of financing constraints will also affect the quality of exported products, and at the same

time, the improvement in export product quality and enterprise profitability will also affect financing constraints. Therefore, this study considers the impact of endogeneity and adopts the first-lagged values of foreign direct investment and financing constraints as instrumental variables, using the system GMM method for regression, and the regression results are shown in Table 5.

Table 4. Regression results of wood forest products by three major categories.

	Wood-Based Panels	Paper Products	Wood Furniture
tfp	0.0887 ***	0.106 ***	0.0558 ***
	(0.0296)	(0.0386)	(0.0193)
lnthc	0.0204 ***	0.00600 ***	0.00413 **
	(0.00506)	(0.00174)	(0.00180)
lnlabor	−0.0854 ***	0.0276 *	−0.0554 ***
	(0.0277)	(0.0166)	(0.0197)
invest	0.0910	−0.0346	−0.0197
	(0.294)	(0.0543)	(0.0146)
lnscale	0.0351	−0.0175	0.0293 *
	(0.0318)	(0.0153)	(0.0172)
lnz	−0.0218	0.0944 *	0.00627
	(0.0152)	(0.0523)	(0.0294)
finance	1.528 *	0.188	0.731
	(0.880)	(1.585)	(1.032)
Q	0.00798	−0.0412 ***	−0.000938
	(0.0131)	(0.0135)	(0.0101)
_cons	−0.787	0.207	−0.0225
	(0.646)	(0.349)	(0.230)

Note: standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table 5. GMM regression results.

	Wood-Based Panels	Paper Products	Wood Furniture
tfp	0.0550 ***	0.154 **	0.168 ***
	(0.0163)	(0.0654)	(0.0517)
lnthc	0.609 ***	0.00605 *	0.133 *
	(0.151)	(0.00325)	(0.0737)
lnlabor	−0.753 ***	0.0412 *	−0.0588 ***
	(0.162)	(0.0240)	(0.0199)
invest	−3.223 ***	0.0798	−0.153 **
	(0.658)	(0.181)	(0.0643)
lnscale	0.0242 *	−0.0146	0.0479 *
	(0.0128)	(0.0189)	(0.0273)
lnz	0.211 ***	0.140 **	0.000288
	(0.0481)	(0.0644)	(0.00515)
finance	8.410	−1.659	0.105
	(5.140)	(1.308)	(1.804)
Q	−0.00514	−0.0349 ***	−0.0917 ***
	(0.00675)	(0.00822)	(0.0117)
_cons	−2.777 **	−0.121	0.490
	(1.163)	(0.437)	(0.330)

Note: standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

The results of system GMM regression show that: (1) for wood-based panels, the impact of total factor productivity, R&D investment, labor costs, and capital intensity on the quality of exported products is still significant, and the direction of influence remains the same as the basic regression results. After overcoming endogeneity, the influence coefficients of R&D investment, labor productivity, and capital intensity have significantly increased, and the significance of industrial size on the quality of wood-based panel exports has also improved significantly in a positive direction. It is worth noting that foreign direct investment caused a significant negative impact due to strong competition

effects from foreign direct investment. When foreign investment increases, competition in the domestic market becomes more intense. To maintain market share and competitive advantages, companies will reduce their profit space, which is not conducive to improving the quality of wood-based panel exports. In addition, the impact of financing constraints is no longer significant. (2) For paper and paperboard products, total factor productivity, R&D investment, labor costs, capital intensity, and whether to sign a free trade agreement have a significant impact on the quality of paper product exports, and the direction of influence has not changed. The influence of foreign direct investment, industrial size, and financing constraints has always been insignificant. (3) For wood furniture products, total factor productivity, R&D investment, labor costs, and industrial size still have a significant impact on the quality of wood furniture exports, but the direction of influence has not changed. After excluding endogeneity, the influence coefficients of total factor productivity and R&D investment have significantly increased, while the impact of capital intensity and financing constraints on wood furniture exports remains insignificant. It is worth noting that after significant improvements in significance, both foreign direct investment and free trade agreements turned to significant negative impacts.

(2) Robustness Test

To improve the reliability and robustness of the regression results, this article adopts two methods—grouped regression and variable substitution—to test the robustness of the regression results. In the grouped regression robustness test, we divide the sample into developed economies and developing economies to perform regression separately, and the regression results are shown in Table 6. In the variable substitution robustness test, we use different methods to measure foreign direct investment and financing constraints, and the regression results are shown in Table 7. Here, foreign direct investment is measured by the ratio of the industrial output value of foreign-invested enterprises and Hong Kong, Macao, and Taiwan regions of China enterprises to that of scale above industrial enterprises, and the higher the ratio, the higher the level of foreign direct investment and product quality. Financing constraints are measured by the ratio of accounts receivable to total assets, and the higher the ratio, the greater the financing constraints and the lower the product quality. Industrial output value, accounts receivable, and total assets data are from the China Industrial Statistical Yearbook.

Table 6. Regression results by classified sample.

	Wood-Based Panels		**Paper Products**		**Wood Furniture**	
	Developed Economy	**Developing Economy**	**Developed Economy**	**Developing Economy**	**Developed Economy**	**Developing Economy**
tfp	0.168 ***	0.212 ***	0.0630 **	0.104 ***	0.0275 *	0.0621 ***
	(0.0575)	(0.0402)	(0.0234)	(0.0331)	(0.0133)	(0.0209)
lnthc	0.0208 ***	0.00283 *	0.00739 *	0.00584 ***	0.00459 ***	0.00459 **
	(0.00426)	(0.00159)	(0.00416)	(0.00162)	(0.00109)	(0.00206)
lnlabor	−0.186 ***	−0.239 ***	0.0171 *	0.0335 **	−0.0778 ***	−0.0547 ***
	(0.0370)	(0.0445)	(0.00880)	(0.0129)	(0.0132)	(0.0185)
invest	−0.958 **	−0.242 ***	−0.218	0.0302	−0.0338 ***	−0.0186
	(0.389)	(0.0475)	(0.131)	(0.0597)	(0.00836)	(0.0171)
lnscale	0.0221 *	−0.0738 ***	0.0736 **	−0.0252	0.0509 ***	0.0256 *
	(0.0113)	(0.0156)	(0.0309)	(0.0392)	(0.0102)	(0.0141)
lnz	0.193 ***	0.0595 **	0.0541 *	0.0862 ***	0.0485 ***	0.0404
	(0.0435)	(0.0282)	(0.0262)	(0.0301)	(0.0111)	(0.347)
finance	−1.048 ***	3.065 ***	0.0118	−1.066	−0.129	0.933
	(0.268)	(0.644)	(0.00818)	(0.838)	(0.504)	(1.153)
Q	−0.0499	0.0256 *	−1.357 **	−0.0436 ***	−0.0201	0.00244
	(0.0372)	(0.0149)	(0.564)	(0.0123)	(0.0126)	(0.0113)
_cons	−2.166 *	−0.995 **	−0.841	0.302	−0.458 ***	−0.0790
	(1.154)	(0.497)	(0.586)	(0.497)	(0.101)	(0.951)

Note: standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Table 7. Variable replacement regression results.

	Replacement of Foreign Direct Investment			Replacement of Financing Constraints		
	Wood-Based Panels	**Paper Products**	**Wood Furniture**	**Wood-Based Panels**	**Paper Products**	**Wood Furniture**
invest				−0.252 *	−0.00323	−0.0237
				(0.131)	(0.0246)	(0.0167)
invest2	−0.390 ***	0.302 **	0.0496			
	(0.145)	(0.144)	(0.0370)			
finance	2.806 *	2.141 **	1.214			
	(1.623)	(0.951)	(1.036)			
finance2				−0.0842 ***	−0.0812	−0.0130
				(0.0253)	(0.134)	(0.0579)
tfp	0.0703 ***	0.116 ***	0.0416 ***	0.127 ***	0.0872 ***	0.0588 **
	(0.0202)	(0.0283)	(0.0125)	(0.0327)	(0.0293)	(0.0242)
lnthc	0.00650 *	0.00219 *	0.00183 *	0.0116 ***	0.00483 ***	0.00413 **
	(0.00389)	(0.00129)	(0.00110)	(0.00358)	(0.00147)	(0.00185)
lnlabor	−0.0727 *	0.0882 ***	−0.0258 **	−0.0605 **	0.0483 ***	−0.0505 ***
	(0.0402)	(0.0211)	(0.0110)	(0.0271)	(0.0147)	(0.0155)
lnscale	0.00248	−0.0289 *	0.0194 *	0.0243	−0.0406	0.0266 **
	(0.00690)	(0.0150)	(0.0104)	(0.0283)	(0.0252)	(0.0134)
lnz	0.0703 **	0.0261 **	0.00222	0.735 ***	0.0351 *	0.000667
	(0.0327)	(0.0130)	(0.0196)	(0.146)	(0.0188)	(0.0289)
Q	0.0195	−0.0404 ***	−0.00108	0.0144	−0.0423 ***	−0.00263
	(0.0136)	(0.0135)	(0.0109)	(0.0142)	(0.0115)	(0.00604)
_cons	−1.087 *	0.699 ***	−0.00413	−0.784	0.916 ***	0.0161
	(0.563)	(0.206)	(0.144)	(0.587)	(0.317)	(0.192)
N	2503	2711	2660	2669	3031	2944
R^2	0.054	0.022	0.027	0.061	0.017	0.048

Note: standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

From the regression results of the developed economies group: (1) For wood-based panels, the direction and significance of the impact of total factor productivity, R&D investment, labor costs, foreign direct investment, industrial size, and capital intensity on product quality have not changed, and the results are stable. For wood-based panels exported to developed economies, the impact of total factor productivity has slightly increased, while that of R&D investment, labor costs, and foreign direct investment has slightly decreased. (2) For paper products, the direction and significance of the impact of total factor productivity, R&D investment, labor costs, capital intensity, and whether to sign a free trade agreement on paper product export quality have not changed, and the significance of industrial size has been significantly improved. For paper products exported to developed economies, the impact of total factor productivity, labor costs, and capital intensity has slightly decreased, while that of whether to sign a free trade agreement has slightly increased. (3) For wood furniture products, the direction and significance of the impact of total factor productivity, R&D investment, labor costs, foreign direct investment, and industrial size on wood furniture export quality have not changed, and the significance of capital intensity has been significantly improved. The significance of whether to sign a free trade agreement has disappeared. For wood furniture exported to developed economies, the impact of total factor productivity, R&D investment, and foreign direct investment has slightly decreased.

From the regression results of the developing economies group: (1) For wood-based panels, the direction and significance of the impact of total factor productivity, R&D investment, labor costs, foreign direct investment, and capital intensity on product quality have not changed, and the results are stable. The direction of industrial size impact has changed, and the significance of financing constraints and whether to sign a free trade agreement has been improved. For wood-based panels exported to developing economies, the impact of total factor productivity has slightly increased, while that of R&D investment, labor costs, foreign direct investment, and capital intensity has slightly decreased. (2) For paper products, the direction and significance of the impact of total factor productivity, R&D investment, labor costs, capital intensity, and whether to sign a free trade agreement on paper product export quality have not changed, and none of these factors have undergone

significant changes in their impact. (3) For wood furniture products, the direction and significance of the impact of total factor productivity, R&D investment, labor costs, and industrial size on wood furniture export quality have not changed. The significance of foreign direct investment and whether to sign a free trade agreement has disappeared. For wood furniture exported to developing economies, the impact of total factor productivity and R&D investment has slightly decreased.

From the regression results after replacing the variable of foreign direct investment, it can be seen that (1) the significance and direction of the impact of total factor productivity, R&D investment, labor costs, and capital intensity on the export quality of the three products show significant robustness. (2) The impact of industrial scale on the quality of wood-based panels is no longer significant; there is a significant negative impact on the quality of paper products exported, which is because in the process of industrial-scale expansion, new enterprises are constantly joining, and some of them have lower product quality, leading to a decrease in the overall quality level; there is a significant positive impact on the quality of wood furniture, and the result is robust. (3) The signing of free trade agreements still has a significant negative impact on paper products, and the result is robust; the impact on wood furniture is no longer significant. (4) Foreign direct investment still has a significant negative impact on wood-based panels, and the result is robust; the significance of its impact on paper products has been improved, showing a significant positive impact; its impact on wood furniture is no longer significant. (5) The significance of financing constraints has been improved, and financing constraints significantly positively impact the quality of wood-based panels and paper products.

From the regression results after replacing the variable of financing constraints, it can be seen that (1) the significance and direction of the impact of total factor productivity, R&D investment, labor costs, and capital intensity on the export quality of the three products show significant robustness. (2) Industrial scale still has a significant positive impact on wood furniture, and the result is robust; its impact on the quality of wood-based panels is no longer significant. (3) The signing of free trade agreements still has a significant negative impact on paper products, and the regression result is robust; its impact on wood furniture quality is no longer significant. (4) Foreign direct investment still has a significant positive impact on the quality of wood-based panels, and the result is robust; its impact on paper products and wood furniture is no longer significant. (5) The significance of financing constraints has been improved.

Based on the model of heterogeneity in enterprise product quality, this section selects factors that affect the quality of exported products to establish a double logarithmic model for empirical research. Using panel data from 1998 to 2017, fixed effect models and random effect models are used for basic regression, and system GMM regression is used to test endogeneity. Group regression and variable substitution methods are used for robustness testing. The results of influencing factors are as follows: (1) Total factor productivity, R&D investment, and capital intensity positively impact the quality of wood-based panels exports; labor costs and foreign direct investment negatively impact the quality of wood-based panels exports. The results remain valid after excluding endogeneity and conducting robustness testing. (2) Total factor productivity, R&D investment, labor costs, and capital intensity positively impact the quality of paper product exports; whether or not to sign a free trade agreement negatively impacts the quality of paper product exports. The results remain valid after excluding endogeneity and conducting robustness testing. (3) Total factor productivity, R&D investment, and industrial scale promote the quality of wood furniture exports; labor costs have a restraining effect on the quality of wood furniture exports. The results remain valid after excluding endogeneity and conducting robustness testing.

6. Conclusions and Discussions

This article first analyzes the current situation of China's export trade in wood forest products, then uses regression-based inverse methods to measure the export product quality of major wood forest products and conducts a detailed analysis of it. Finally, it

conducts empirical research on the influencing factors of the export product quality of wood forest products. The research conclusions are as follows:

From the results of China's export status of wood forest products, it is found that although China is the world's largest exporter of wood forest products, the growth rate of trade volume has slowed down in recent years, and its proportion in the world's total trade volume has been declining year after year. From the supply-side perspective, the crisis of insufficient supply and rising prices of raw materials due to the global pandemic and politically motivated trade wars has affected the production of enterprises [38,39]. From the demand-side perspective, the demand in foreign markets is sluggish, and the existence of a series of trade barriers, such as high tariffs, also hinders the export of some Chinese enterprise products [40,41]. The structure of exported products mainly consists of wood-based panel products, paper products, and wood furniture, with the remainder accounting for a relatively small proportion. In terms of the structure of export destinations, the concentration of China's wood forest product export trade has gradually decreased. The United States, Japan, Hong Kong, China are still important trading partners, but the proportion of total exports has decreased. The proportion of exports to other countries, especially emerging economies, has increased. In terms of product competitiveness, wood furniture and wood-based panel products have strong competitiveness, but in recent years, their competitiveness has shown a downward trend, and the competitiveness of other products needs to be improved. The proportion exported to the rest of the world, especially the emerging economies, has risen. This suggests that China's wood forest products have excellent growth potential in emerging markets, particularly in Asia [2]. The importance of forest products trading partners in the Belt and Road Initiative markets is growing. China's 14th five-year plan clearly states that "Green" is the main concept of the Belt and Road Initiative. Trade in forest products and "Belt and Road" are bound to be mutually beneficial [42].

From the results of the changes in the product quality of China's wood forest exports, it was found that there are differences in the quality levels of subdivisions of wood forest products. China has targeted more promising markets and is continuously increasing the value added of its export products [43]. The export product quality of wood-based panels is relatively high, while there is considerable room for improvement in the product quality of paper products and wood furniture. The quality level of wood-based panel exports is the highest, showing a significant upward trend on the whole, with little difference in the quality levels exported to developed and developing economies, which are relatively high. The quality level of paper product exports is second, with a slight increase and relative stability, but the quality level exported to developed economies is significantly lower than that exported to developing economies. The quality level of wood furniture exports is the lowest, with little change in quality levels, and the quality level exported to developed economies is lower than that exported to developing economies. The quality levels of wood-based panel products, paper products, and wood furniture exported to the Belt and Road countries have not changed much. The quality of paper products and wood furniture needs further improvement.

From the results on the influencing factors of product quality of China's wood forest exports, it was found that for wood-based panels, total factor productivity, R&D investment, labor costs, foreign direct investment, and capital intensity significantly impact the quality of wood-based panels exports. The industrial scale, financing constraints, and whether or not to sign a free trade agreement have little impact on the quality of wood-based panel exports. Among them, total factor productivity, R&D investment, and capital intensity positively impact the quality of wood-based panel exports; labor costs and foreign direct investment negatively impact the quality of wood-based panel exports. For paper products, total factor productivity, R&D investment, labor costs, capital intensity, and whether or not to sign a free trade agreement significantly impact the quality of paper product exports. Foreign direct investment, industrial scale, and financing constraints have little impact on the quality of paper product exports. Among them, total factor productivity, R&D

investment, labor costs, and capital intensity positively impact the quality of paper product exports; whether or not to sign a free trade agreement negatively impacts the quality of paper product exports. For wood furniture, total factor productivity, R&D investment, labor costs, and industrial scale significantly impact the quality of wood furniture exports. Foreign direct investment, capital intensity, financing constraints, and whether or not to sign a free trade agreement have little impact on the quality of wooden furniture exports. Among them, total factor productivity, R&D investment, and industrial scale have a promoting effect on improving the quality of wood furniture exports; labor costs have a restraining effect on improving the quality of wood furniture exports. This study focuses on companies' internal production and operation and supplements the positive impact of production volume on export volume obtained by Saraswati et al. [44] by measuring total factor productivity, R&D investment, and labor costs.

The following suggestions and recommendations are provided. On the one hand, the trade of wood forest products should be developed from factor-driven to innovation-driven practices [45]. According to the endogenous determination model of quality, the enhancement of R&D investment can significantly improve the quality level of exported wood forest products in various categories. Therefore, it should create a favorable innovation environment, increase the investment in R&D, improve the efficiency of R&D, and promote the technology level. For example, by reforming the fiscal system, strengthening the fiscal power of the province-level government, providing more precise policies and financial assistance to enterprises, adapting to local conditions, and stimulating the vitality and competitiveness of export trade [46]. Small and medium-sized enterprises occupy a large proportion of China's forest production enterprises. However, they usually attach less importance to R&D and have a weak sense of independent innovation. Thus, improving the R&D investment and innovation capacity should be the main direction of their transformation to establish competitive advantage and expand the market [47]. Firstly, enterprises should establish specialized R&D departments or enrich the R&D function, such as actively cooperating with universities, research institutions, etc. Secondly, enterprises should improve R&D efficiency and achievement application to effectively transform scientific research into actual products, apply R&D achievements to practice, and achieve quality marginal drive [48].

On the other hand, human capital support should be strengthened. Practice shows that human capital can play a more important role than material capital in the process of enterprise development, and it has been found that human capital has a significant impact on improving the quality of wood forest products in export. From the perspective of enterprises, on the one hand, the production and operation activities of each link in the enterprise need to be supported by corresponding levels of human resources. Therefore, enterprises should pay attention to introducing different levels of human resources. They should not only introduce technical talents capable of production and processing but also pay attention to introducing management talents engaged in organizational management work and professional technical talents engaged in technical research and development work to improve product production efficiency and reduce the export of labor-intensive, low-value-added products, achieve the transformation and upgrading of export product quality, and enhance the competitiveness of export products [49]. In addition, in the current environment of artificial intelligence emergence and labor cost increase, especially in labor-intensive industries like wood-based panels and wood furniture, enterprises should consider partial substitution of labor production factors, which aims to alleviate the operating pressure brought about by the rise in labor costs as well as the negative impact on the quality. Secondly, enterprises should also pay attention to the employees' training. Employees should be trained in technical and professional skills before and during work so that their proficiency will be promoted to improve labor productivity. Regular training is one important way to improve staff quality, especially in the transformation and upgrading of the industry. Enterprises can also make full use of the network to establish internal learning platforms to encourage employees to carry out independent learning.

There are differences in the impact of foreign direct investment on the quality of exported products in different types of industries. This study shows that foreign direct investment significantly negatively impacts the quality of exported wood-based panels after controlling endogeneity and testing robustness while having no definite impact on the quality of exported paper products and wood furniture. Therefore, we should approach foreign direct investment rationally, improve the efficiency of foreign investment utilization, and fully leverage the advantages of foreign investment, such as the foreign market information flow and advanced technology brought about by foreign capital [50]. From the government's perspective, it is not possible to generalize to all industries and implement policies that vigorously attract foreign investment in all industries. It is necessary to comprehensively consider factors such as industry characteristics, development level, and development stage, formulate reasonable foreign investment introduction policies, continuously improve laws and regulations on foreign investment introduction, and create a good market competition environment. In addition, enterprises should treat foreign investment rationally. The efficient management mode brought by foreign investment may not be consistent with the development stage of the enterprise. In the process of learning from foreign investment, enterprises should also fully consider their development situation and pay attention to the localization, integration, and application of technology and management modes.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. China's export value of various wood forest products (Unit: USD 100 million).

Year	Roundwood	Sawnwood	Wood-Based Panels	Wood Pulp	Paper Products	Wood Furniture	Share of Top Three Products (%)
1998	0.125	1.143	1.172	0.099	9.908	10.847	0.941
1999	0.080	1.375	1.823	0.034	9.249	13.095	0.942
2000	0.079	1.780	2.637	0.106	14.058	16.685	0.944
2001	0.056	1.949	3.274	0.083	14.831	18.521	0.946
2002	0.032	1.900	5.588	0.156	17.079	27.063	0.960
2003	0.029	2.340	6.469	0.213	23.062	38.155	0.963
2004	0.020	2.176	15.172	0.163	28.457	52.293	0.976
2005	0.020	2.786	24.220	0.357	39.288	68.432	0.977
2006	0.014	3.527	37.425	0.587	53.971	87.837	0.977
2007	0.012	3.899	48.992	0.920	71.198	106.848	0.979
2008	0.010	4.014	47.855	0.984	77.450	110.187	0.979
2009	0.046	3.451	36.123	0.910	75.671	120.352	0.981
2010	0.105	3.404	47.687	1.401	95.612	161.565	0.984
2011	0.068	3.590	61.053	2.310	129.055	171.151	0.984
2012	0.017	3.295	67.123	1.278	137.218	183.309	0.988
2013	0.067	3.240	68.882	1.063	159.877	194.392	0.990
2014	0.081	2.953	78.600	1.177	178.185	220.915	0.991
2015	0.041	2.052	73.078	1.131	187.524	228.485	0.993
2016	0.298	1.932	69.067	1.097	176.101	222.068	0.993

Table A1. *Cont.*

Year	Roundwood	Sawnwood	Wood-Based Panels	Wood Pulp	Paper Products	Wood Furniture	Share of Top Three Products (%)
2017	0.302	2.021	67.224	1.350	179.886	226.871	0.992
2018	0.236	1.785	72.629	1.313	194.606	229.644	0.993
Trend year by year							

Note: This table reflects the export value of China's wood forest products and the total share of the top three categories in wood forest products export. The blue curves reflect the value trend, while the green curve reflects the share trend. Based on the theory of intra-industry trade, products under the categories may also be imported simultaneously. According to our calculation, China's top categories of imported wood forest products are wood pulp, paper products, sawnwood, and roundwood (the first two categories each account for more than 25%; the latter two each approach 20%). Source: calculated according to the data of the United Nations COMTRADE database, https://comtradeplus.un.org/TradeFlow (accessed on 1 June 2023).

Table A2. China's major export trading partners of wood forest products in the Belt and Road economies (unit: %).

Year	Singapore	Malaysia	UAE	Thailand	India	Vietnam	Philippines	Indonesia	Russia	Iran
1998	34.519	11.088	4.012	7.068	6.213	5.595	5.403	3.306	3.313	0.302
1999	33.547	10.823	3.456	6.385	0.739	3.361	6.911	6.181	1.615	0.224
2000	23.369	11.375	3.876	4.818	1.400	3.967	6.933	5.459	1.883	8.834
2001	16.682	10.427	7.009	6.169	2.025	3.080	6.693	4.631	2.764	4.968
2002	16.093	10.542	7.568	5.193	1.665	3.541	5.339	5.316	3.713	1.740
2003	12.612	9.285	8.851	4.387	1.920	3.238	5.913	6.927	4.499	2.160
2004	9.738	7.048	10.792	4.925	2.560	4.307	4.261	5.628	4.378	1.873
2005	7.273	6.128	9.570	4.843	3.965	4.570	3.239	4.337	5.677	3.558
2006	5.502	7.151	9.422	5.590	6.827	3.813	2.418	3.628	5.357	4.757
2007	5.939	7.003	10.017	4.655	7.074	4.194	2.216	3.782	5.948	5.091
2008	5.017	6.729	11.552	4.491	7.018	3.751	2.463	3.334	7.698	3.721
2009	15.286	12.255	9.675	5.146	6.110	3.254	2.534	3.636	3.722	3.567
2010	9.773	8.024	6.899	11.412	7.801	3.775	3.889	7.131	4.127	3.828
2011	9.876	7.906	8.040	6.187	6.862	4.359	3.361	4.940	5.131	4.232
2012	7.080	10.542	9.334	5.604	5.813	4.474	3.710	4.296	5.814	3.596
2013	7.909	11.657	10.248	5.800	5.554	4.683	3.995	4.938	5.639	4.069
2014	9.123	9.375	10.152	4.510	5.834	5.252	4.476	4.648	5.996	5.871
2015	13.064	8.639	9.765	4.461	6.507	6.729	4.898	3.102	2.918	3.990
2016	12.896	10.588	7.908	4.683	6.694	7.515	5.893	3.156	2.662	3.767
2017	9.375	10.721	7.182	4.848	7.944	8.714	6.219	3.600	2.914	3.247
2018	8.229	9.150	7.076	5.143	6.901	9.839	7.428	4.062	3.421	2.409
Average	12.995	9.355	8.210	5.539	5.115	4.858	4.676	4.573	4.247	3.610
Trend year by year										

Source: calculated according to the data of the United Nations COMTRADE database.

Table A3. The quality of China's exported wood-based panels.

Product	HS Code	Average Quality	Average Annual Export Value Proportion	Quality Change Trend
Wood-based panels	441214	0.788	26.857%	
	441213	0.560	16.972%	
	441119	0.514	6.012%	
	441219	0.510	13.752%	
	440890	0.468	11.101%	
	441019	0.464	1.570%	
	441129	0.336	9.899%	
	441299	0.319	13.837%	

Source: calculated from the quality measurement results, and the following tables are from the same source.

Table A4. The quality of China's exported paper products.

Product	HS Code	Average Quality	Average Annual Export Value Proportion	Quality Change Trend
Paper products	480100	0.718	0.768%	
	482050	0.663	3.479%	
	480529	0.634	0.176%	
	481960	0.617	1.208%	
	481139	0.597	1.027%	
	481121	0.592	0.867%	
	482090	0.572	0.809%	
	481032	0.572	1.279%	
	480300	0.563	1.524%	
	480580	0.559	0.272%	
	481011	0.551	6.416%	
	481420	0.550	0.762%	
	481810	0.548	2.403%	
	481029	0.528	1.663%	
	481820	0.515	2.092%	
	481131	0.513	0.510%	
	481091	0.493	2.010%	
	481710	0.486	0.698%	
	482020	0.486	0.866%	
	481690	0.480	0.148%	
	480560	0.480	0.454%	
	480252	0.475	4.401%	
	480920	0.455	0.606%	
	482110	0.447	3.681%	
	481620	0.445	0.135%	
	480439	0.432	0.253%	
	482311	0.431	0.809%	
	482360	0.431	2.266%	
	482190	0.410	0.767%	
	482320	0.398	0.357%	
	481840	0.392	3.724%	
	480810	0.386	0.281%	
	481830	0.379	0.655%	
	480260	0.376	0.459%	
	481390	0.324	0.228%	
	481190	0.306	2.927%	
	481920	0.304	7.355%	
	482010	0.302	13.576%	
	480570	0.298	0.223%	
	482030	0.284	2.053%	
	482370	0.273	0.578%	
	481910	0.272	4.408%	

Table A4. *Cont.*

Product	HS Code	Average Quality	Average Annual Export Value Proportion	Quality Change Trend
Paper products	481890	0.249	1.239%	
	481940	0.245	11.179%	
	482390	0.222	6.564%	
	481950	0.180	1.844%	

Table A5. The quality of China's exported wood furniture.

Product	HS Code	Average Quality	Average Annual Export Value Proportion	Quality Change Trend
Wood furniture	940161	0.245	26.515%	
	940169	0.267	6.345%	
	940330	0.702	4.257%	
	940340	0.244	4.136%	
	940350	0.219	14.407%	
	940360	0.184	44.339%	

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