forests

MDPI

Article

Does the Regional Comprehensive Economic Partnership Promote Forest Product Exports? Evidence on Bilateral Export Performance from China

Xi Zhang [1], Shufan Han [2,*], Xiuxiu Zheng [2] and Yong Chen [1]

[1] Research Institute of Forestry Policy and Information, Chinese Academy of Forestry, Beijing 100091, China; zhangxi@caf.ac.cn (X.Z.); chenyong2000@vip.sina.com (Y.C.)
[2] Research Institute for Global Value Chains, University of International Business and Economics, Beijing 100029, China; zhengxiuxiu@uibe.edu.cn
* Correspondence: shufan_han@163.com

Abstract: This study examines the quarterly export data of forest products at the Harmonized System 6-digit level from China's 31 provinces to destination economies from 2017 to 2023 to examine the impact of the Regional Comprehensive Economic Partnership agreement on bilateral forest product trade. A time-varying Difference-in-Differences model is constructed using the effective dates of the agreement for each member, combined with the Propensity Score Matching method, comparing export flows between China with member and non-member economies in the pre- and post-agreement periods. The main findings indicate that the effective commitments of the Regional Comprehensive Economic Partnership in destination economies have significantly enhanced the bilateral exports of forest products from China's provinces. Compared with non-member destination economies, China's exports of timber forest products to member countries increased by over 22% after the agreement came into effect, with notable increases in eastern coastal provinces and in processed forest products including wooden furniture and paper products. To maximize the promotion of forest product exports under this framework, it is suggested that China enhance transportation links between its central and western inland provinces to reduce transportation costs. Additionally, closer trade cooperation among member countries is recommended to facilitate the development of trade in intermediate products. Furthermore, the strengthened collaboration between upstream and downstream industries could facilitate the integrated development of the regional timber processing industry supply chain.

Keywords: forest products; Regional Comprehensive Economic Partnership; export; time-varying Difference-in-Differences model

Academic Editor: Luis Diaz-Balteiro

Received: 31 October 2024
Revised: 4 December 2024
Accepted: 23 December 2024
Published: 2 January 2025

Citation: Zhang, X.; Han, S.; Zheng, X.; Chen, Y. Does the Regional Comprehensive Economic Partnership Promote Forest Product Exports? Evidence on Bilateral Export Performance from China. *Forests* **2025**, *16*, 64. https://doi.org/10.3390/f16010064

1. Introduction

The Regional Comprehensive Economic Partnership (RCEP) agreement, involving the ten members of the Association of Southeast Asian Nations (Association of Southeast Asian Nations, abbreviated as ASEANs, stands for the Association of Southeast Asian Nations and includes Indonesia, Malaysia, the Philippines, Singapore, Thailand, Brunei, Vietnam, Laos, Myanmar, and Cambodia), along with China, Japan, South Korea, Australia, and New Zealand, was formally signed on 15 November 2020. The agreement aims to establish a unified market in the Asia–Pacific region by reducing tariffs and lowering trade and investment barriers as a response to the rising challenges of de-globalization and trade

protectionism. The anticipated effects of the RCEP free trade area include the enhancement of policy stability, the promotion of regional production integration, and a reduction in supply chain costs, with one significant manifestation being the facilitation of trade flow. In light of the increasing focus on concepts such as trade facilitation policies and global fragmentation, what is the impact of the RCEP, as a pivotal trade integration agreement, on the trade of forest products, especially concerning various production stages? This represents a critical inquiry.

RCEP member countries play a crucial role in forest resources and the global trade of forest products. Firstly, the RCEP region accounts for nearly one-third of the world's population and GDP, and boasts significant forest resources, positioning it as a key area for global forestry development. According to the data from the World Bank and UN Comtrade, the RCEP's forest area represented about one-seventh of the global total in 2023, while its trade value in forest products constituted approximately one-fifth of the world total. RCEP member countries include major timber producers (New Zealand, Australia, Thailand), processors (China, Vietnam, Indonesia), and consumers (Singapore, Japan, South Korea). Secondly, timber forest products accounted for 2.49% of the RCEP's export trade, which is higher than their share in global export trade (2.40%). On the import side, timber forest products represented 1.44% of the RCEP's import trade, which is lower than their share in global import trade (2.36%). This indicates that the RCEP is an important producer of timber forest products for export. Specifically, based on calculations using trade data from the UN Comtrade database, the authors found that, from 2017 to 2023, exports of timber forest products of RCEP member countries accounted for approximately one-quarter of the global total timber forest product exports. The export value was USD 109.14 billion in 2017, followed by fluctuating growth, peaking at USD 160.23 billion in 2022 before a slight decline in 2023. Their global market share reached 27.13% in 2022 but fell to 22.74% in 2023 (see Figure A1). Notably, the region's global import share of timber forest products has been declining since 2018. Thirdly, as a major forestry country and the "world's factory", China ranks first globally in the production, processing, and trade of forest products, with other RCEP member countries as important trading partners. According to China's customs data, in 2023, the trade volume of forest products reached USD 180 billion, with total exports around USD 90 billion, primarily consisting of timber forest products, which accounted for over 80%. Of this, exports to other RCEP member countries amounted to USD 29.48 billion, representing approximately 33% of the total, underscoring the strong trade relationship between China and other RCEP member countries in the forest product market. However, it is noteworthy that, in recent years, the timber processing industry and trade in the Asia–Pacific region have been impacted by trade friction and the COVID-19 pandemic. For example, in 2023, China experienced a decline in the trade volume of timber forest products with other RCEP member countries. Given the increasing uncertainties, it is crucial to evaluate whether the RCEP has effectively facilitated bilateral trade in forest products. Addressing this question necessitates a rigorous and scientifically grounded empirical economic analysis. Therefore, this study employs quarterly export data of forest products (at the HS 6-digit level, which is the most highly disaggregated product classification widely used by international customs) from China's 31 provinces to destination economies from 2017 to 2023, using the effective dates of the RCEP agreement for each trading partner to construct a time-varying Difference-in-Differences (DID) model to analyze the impact of the RCEP's implementation on bilateral forest product exports. The main findings indicate that the effectiveness of RCEP commitments in destination economies has significantly promoted bilateral exports of forest products from provinces in China, particularly for processed products such as wooden furniture and paper products.

The innovative aspects and contributions of this paper are threefold. First, the RCEP region is an important global market for forest products, with China as a major exporter. Analyzing the trade flow effects of this regional economic cooperation policy is crucial for understanding trade dynamics in the context of integration. Second, this study utilizes a high-dimension bilateral trade dataset that includes the provincial jurisdictions of the exporting economy (China), destination economies, product classifications (HS 6-digit level), and quarterly timeframes. By controlling for high-dimension fixed effects, it comprehensively assesses whether the RCEP enhances bilateral trade in forest products, identifying both general patterns and specific nuances. Third, this research enriches the literature on forest product trade within economic integration frameworks and explores the differences between intermediate inputs and final goods in global production. The findings offer valuable insights for nations aiming to develop scientifically informed trade policies, enhancing the effectiveness of their strategies in a globalized economy.

The remainder of the study is organized as follows: Section 2 summarizes the relevant literature; Section 3 outlines the methodology, data sources, and parallel trend tests; Section 4 presents the baseline results, placebo tests, and robustness checks; Section 5 discusses the findings, with a particular focus on the heterogeneity of forest products; and Section 6 concludes with implications for future policymaking.

2. Literature Review

Amid rising de-globalization, multilateral negotiations within the World Trade Organization (WTO) have stagnated, and its traditional trade rules are insufficient for deep value chain cooperation in the Asia–Pacific region, prompting a shift toward regional trade cooperation. Despite the increasing number of Regional Trade Agreements (RTAs) and the evolving trade structure in the region, a comprehensive Free Trade Agreement (FTA) remains absent [1]. In this regard, the Regional Comprehensive Economic Partnership (RCEP), proposed by the ASEANs in 2012, is a significant RTA that integrates and optimizes existing agreements among members, effectively addressing the Spaghetti Bowl Phenomenon caused by the proliferation of regional trade agreements [2,3]. As a result, the RCEP has attracted significant academic interest.

While the positive effects of the RCEP have not been widely quantified due to its recent occurrence, the implementation of trade agreements is likely to impact trade and economic welfare among member countries, as supported by the existing literature. First, a number of studies support that trade agreements facilitate the expansion of trade among member economies and enhance welfare, with existing research indicating that participating economies benefit, while non-participating economies may incur losses. Magee (2008) highlighted that regional trade agreements (RTAs) promote bilateral trade between member countries while suppressing trade between members and non-members [4]. Caliendo and Parro (2012) discovered that the North American Free Trade Agreement (NAFTA) significantly boosted intra-bloc trade, but had adverse effects on trade with non-member economies [5]. Ahmed et al. (2020) noted that the RCEP positively impacts all member economies, with more substantial economic gains observed in countries like China and India compared to ASEAN members [6]. Li and Cheol (2018) indicated that the RCEP could increase China's trade by 1.5% and income by 2.5%, slightly surpassing the benefits for South Korea [7]. Park et al. (2021) used a general equilibrium model to assess the impacts of RCEP, CPTPP, and the U.S.–China trade war, finding that the RCEP would deepen East Asia's production networks, enhance productivity, and boost wages and employment. The RCEP is projected to deliver almost twice the benefits of the CPTPP, and their combined effects would largely offset the U.S.–China trade war's negative impact on the global economy [8]. Other studies suggest that trade agreements also benefit non-member countries.

Sun and Reed (2010) showed that agreements like the ASEAN–China free trade agreement (FTA) and EU-15 significantly increased agricultural trade flows among members without harming non-members [9]. Similarly, Sánchez-Albornoz and Timini (2021) found that Latin American trade agreements positively affected both member and non-member trade [10]. Mattoo et al. (2022) further noted that deep trade agreements boost trade between signatories by 44% on average without reducing trade with non-members [11]. In the long term, the gains and trade flows induced by free trade agreements typically increase over time, suggesting that multilateral cooperation and free trade agreements possess long-term returns [12,13]. With the rise of heterogeneous trade theory, scholars have focused on the micro-structure of trade performance, particularly the intensive and extensive margin. Bernard et al. (2009) found that preferential trade agreements (PTAs) mainly boost trade at the intensive margin [14], while Foster et al. (2010) showed that regional trade agreements (RTAs) promote exports through the extensive margin, especially for large countries [15]. For forest products, Barbier (1999) highlighted that tariff reductions under the Uruguay Round boosted trade [16], while Yin et al. (2020) found that regional integration, such as in the EU and NAFTA, significantly enhanced forest product trade, with stronger effects in the EU [17]. However, trade agreements can also have negative effects. NAFTA caused U.S. manufacturing job losses [18], and Shlapak et al. (2023) noted that RTAs often benefit developed economies more, increasing pressures on developing economies [19]. Zhang et al. (2023) warned that China's natural forest logging ban under the RCEP could destabilize its trade network [20], while Fan et al. (2024) found that intensified competition under PTAs negatively impacts China's exports [21].

Second, from the perspective of production sharing, trade agreements facilitate the flow of intermediate goods among member economies. The rules of origin (RoO) in RTAs or FTAs may incentivize economies to increase their use of intermediate goods from other member states [22], thereby enriching producers' sources of inputs [23], fostering cooperation along the production network [24], and enhancing the quality of export products [25,26].

Moreover, regional trade agreements play a crucial role in mitigating trade policy uncertainties and stabilizing regional supply chains. It has been shown that FTAs can boost trade growth by reducing or eliminating uncertainty and lowering non-tariff trade costs while keeping actual tariff levels constant. Limão and Maggi (2015) analyzed the gains from trade and found that trade agreements provide additional potential gains by reducing trade policy uncertainty, in addition to the traditional gains from lowering the average level of trade barriers [27]. Handley and Limão (2017) focused on the changes in trade policy uncertainty (TPU) before and after China's accession to the WTO, revealing that the U.S. granting China Permanent Normal Trade Relations (PNTR) status following its accession reduced TPU, leading to a 22% to 30% increase in China's exports to the U.S [28,29]. Carballo et al. (2022) similarly underscored this viewpoint, illustrating that preferential trade agreements notably alleviated the contraction in the extensive margin of U.S. trade in the aftermath of the 2008 financial crisis [30]. Currently, there is a rising trend of restrictive bilateral trade policies worldwide, with U.S.–China trade frictions negatively impacting both countries' GDP, per capita income, and employment [31,32]. Meanwhile, due to the Russia–Ukraine conflict and specific economic sanctions, Russia's forest product exports have been hindered, forcing its forestry companies to seek alternative markets including Japan and South Korea [33]. Under these circumstances, a stable regional trade agreement can serve as a safe haven for member economies facing external trade barriers, providing a buffer against economic disruptions and enhancing resilience in regional trade dynamics. RCEP member countries possess significant market potential and geographic

proximity advantages, facilitating market entry and reducing transportation costs [34,35], while also enhancing the resilience of regional supply chains [36].

Detailed descriptions of the literature related closely to this paper are listed in Table A1. Compared to the existing literature, this paper presents several innovative aspects. First, it employs high-dimension data by utilizing quarterly export transactions from China's 31 provinces to destination economies from 2017 to 2023, providing new evidence on the impact of RCEP implementation on forest product trade flows. Second, it offers a detailed examination through HS 6-digit level product trading data, allowing for an in-depth analysis of the export situation for forest products with varying degrees of processing, such as wooden furniture and paper products. Finally, this research adopts a scientific methodology by combining Propensity Score Matching with Difference-in-Differences models, which effectively controls for potential confounding factors, thereby enhancing the reliability of the estimated results.

3. Materials and Methods

3.1. Estimation Strategy

The Difference-in-Differences (DID) method, as a measure often used in academia to assess the effects of policies, can estimate the net effects of policy shocks by comparing the differences in changes before and after the policy shocks between the treatment group (individuals directly affected by the policy changes) and the control group (individuals not directly affected by the policy changes). The RCEP agreement, as an exogenous policy, eliminates concerns of reverse causality. Furthermore, the use of fixed effects estimation with panel data helps mitigate omitted variable bias, effectively addressing endogeneity issues to a significant extent. However, the varying characteristics of individual economies may lead to heterogeneous impacts of the RCEP agreement's implementation on China's forest product export flows, potentially influencing the overall conclusions. Therefore, referring to the method proposed by Beck et al. (2010) [37], this paper utilizes a time-varying Difference-in-Differences (DID) identification strategy, applied to panel data following Propensity Score Matching (PSM), covering the period from 2017 to 2023. The analysis spans export locations (China's province), products (HS 6-digit), year quarters, and importing economies to assess the impact of the RCEP agreement's effectiveness on China's forest product exports to other RCEP member countries. In the baseline model, the first difference arises from the trade performance between RCEP member countries and non-RCEP destination economies. The second difference pertains to the trade performance before and after the RCEP agreement's implementation. The regression model is specified as follows.

$$LnForest\_Exp_{ipdt} = \beta_0 + \beta_1 RCEP_{dt} + \beta_d + \beta_{pt} + \beta_{it} + \varepsilon_{ipdt} \quad (1)$$

In Equation (1), the dependent variable $LnForest\_Exp_{ipdt}$ represents the logarithm of the export value of timber forest product p (at the HS 6-digit level) from province i to destination economy d in time year–quarter t, with the logarithmic transformation method following Liu and Qiu, 2016 [38]. The logarithmic form of the dependent variable is $lny = ln\left[Y + \left(Y^2 + 1\right)^{1/2}\right]$. This form of transformation solves the problem of the presence of zeros in the dependent variable (especially when dealing with multiple zeros) and is more flexible than the traditional logarithmic form of taking $ln(y+1)$ because the estimated coefficients can be used to account for percentage changes and do not affect the accuracy of the regression results when the dependent variable is close to a zero value. We supplement the appendix with robustness tests using alternative logit forms (Table A3), and the results remain robust. Due to the advance announcement of the effective date and the need for manufacturers to prepare inventory for export, we set the time cutoff in the DID model to be

over six months prior to the effective date. Therefore, the independent variable $RCEP_{dt}$ is a dummy variable that takes the value of 1 if the transaction occurs between China and RCEP member countries on or after six months prior to the member's commitment effective date, which corresponds to the third quarter before the commitments take effect; otherwise, it takes the value of 0. The constant term is denoted as β_0, and β_d, β_{pt}, β_{it} represent the fixed effects for destination, product–time (year–quarter), and export location (China's provinces, except for Hong Kong, Macao, and Taiwan)–time (year–quarter), respectively. The term ε_{ipdt} is the error term, clustered at the destination economy level. Our primary interest lies in the estimated coefficients of $RCEP_{dt}$, β_1, which measure the impact of the effectiveness of the RCEP agreement on the trade of forest products. If the estimated coefficient β_1 is significantly positive, it indicates that the effectiveness of the RCEP agreement has a promotional effect on the trade of forest products between China and other RCEP member countries compared to non-RCEP destination economies.

3.2. Data

Our empirical analysis uses data from three categories of sources: first, export data from the General Administration of Customs (GAC) of the People's Republic of China (http://www.customs.gov.cn/ (accessed on 4 December 2024)); second, effective dates of the RCEP agreement for member countries (https://www.rcepnews.com/ (accessed on 4 December 2024)); and third, the economy–year dimension characteristic variables used as covariates for Propensity Score Matching (PSM) are obtained from the World Bank database (https://databank.worldbank.org/source/world-development-indicators (accessed on 4 December 2024)) and the website of the French Center for International Economics (CEPII) (https://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp (accessed on 4 December 2024)).

3.2.1. China's Export Data of Timber Forest Products at the Province–Year–Quarter Level

The export data utilized in the empirical analysis are sourced from the official website of the General Administration of Customs of China, covering the period from 2017 to 2023. This dataset encompasses 31 provinces (including 4 municipalities directly under the central government) and over 200 exporting destinations, detailing quarterly export values (in USD) of the product (at the HS 6-digit code level). To address infrequent trade occurrences and minimize noise, the data are aggregated to the quarterly province–HS6–destination level, with variables at this level serving as the dependent variable. The economy-level characteristic variables used for Propensity Score Matching are obtained from the World Bank database and the French Center for International Economics (CEPII) website, focusing on data from 2017. This dataset includes information on geographic distances, adjacency, GDP, and per capita disposable income for over 200 economies.

3.2.2. RCEP Effective Date

The data on the effective dates of RCEP member countries used in the empirical study of this paper are sourced from the RCEP NEWS website (https://www.rcepnews.com (accessed on 4 December 2024)), which is listed in Table 1. The content of this table represents the effective dates of the RCEP agreement for each member country. If China's transactions with a member country (where both trading parties are RCEP members) occur after the agreement's implementation date, it is assumed that the trade may be influenced by the RCEP agreement.

Table 1. RCEP effective date.

Country	Effective Date	Effective Quarter
China	1 January 2022	2022Q1
Japan	1 January 2022	2022Q1
Korea	1 February 2022	2022Q1
New Zealand	1 January 2022	2022Q1
Australia	1 January 2022	2022Q1
Brunei	1 January 2022	2022Q1
Cambodia	1 January 2022	2022Q1
Indonesia	2 January 2023	2023Q1
Laos	1 January 2022	2022Q1
Malaysia	18 March 2022	2022Q1
Myanmar	1 May 2022	2022Q2
Philippines	2 June 2023	2023Q2
Singapore	1 January 2022	2022Q1
Thailand	1 January 2022	2022Q1
Vietnam	1 January 2022	2022Q1

Source: Collated from RCEP NEWS website: https://www.rcepnews.com (accessed on 4 December 2024).

3.2.3. Descriptive Statistics

Descriptive statistics for the key variables are presented in Table 2, highlighting the main characteristics, such as the sample size of 923,541, with the dependent variable exhibiting a maximum value of 20.83 and a minimum value of 0.02, yielding a mean of approximately 10.03 and a variance of around 3.08. Since the independent variable is a dummy variable, it has a maximum value of 1 and a minimum value of 0, and the fluctuating variance is around 0.27. This indicates significant variation in the scale of China's timber forest product exports to different economies.

Table 2. Descriptive statistics.

Variable	N	Mean	Min	Max	SD	p50
LnForest_Exp	923,541	10.03	0.02	20.83	3.08	10.36
RCEP	923,541	0.08	0	1	0.27	0

3.3. Parallel Trend Test

The subject of this paper involves the RCEP member countries with varying dates of agreement implementation, thus requiring the use of a time-varying DID model. We follow the method proposed by Beck et al. (2010) to conduct a parallel trend test [37]. Propensity Score Matching (PSM) is employed to match samples, followed by a Difference-in-Differences analysis.

To establish a precise treatment effect, it is necessary to satisfy the parallel trend assumption, which means that, in the absence of the policy intervention, the trend in the dependent variable should be the same for the treatment and control groups. If the parallel trend assumption does not hold, it implies that there were systematic differences between the treatment and control groups before the policy was implemented, and the results of the DID estimates may be confounded by these differences, resulting in biased or invalid estimates. In our study, an essential prerequisite for the validity of the time-varying DID model is that, prior to the RCEP agreement's implementation, the export trends of forest products from the treated group and the control group must remain consistent over time without divergent changes. Therefore, we estimate the following dynamic model.

$$\begin{aligned} LnForest\_Exp_{ipdt} &= \beta_0 + \beta_1 RCEP_{dt}^{-9} + \beta_2 RCEP_{dt}^{-8} + \ldots + \beta_6 RCEP_{dt}^{-4} + \ldots \\ &+ \beta_7 RCEP_{dt}^{-2} + \ldots + \beta_{15} RCEP_{dt}^{6} + \beta_d + \beta_{it} + \beta_{pt} + \varepsilon_{ipdt} \end{aligned} \quad (2)$$

The data dimension used in Equation (2) is at the province (*i*)–product (*p*)–destination (*d*)–quarterly (*t*) level. When the destination economy *d* is an RCEP member and the RCEP commitments of the relevant economy come into effect thereafter, it takes a value of 1; otherwise, it takes a value of 0. Therefore, the estimated coefficient of the $RCEP_{dt}$ captures the impact of RCEP implementation on China's timber forest product exports. To maintain consistency with the empirical baseline model specified in Equation (1), the anchor point for the parallel trend test is also set to six months prior to the effective date, namely, quarter $t = -3$.

Figure 1 presents the dynamic treatment effects under the parallel trend test. When the time of the shock is identified as 1 January 2022, the time point *pre*_5 represents the fourth quarter of 2020. For all time points prior to *pre*_5, the confidence intervals of the coefficients include zero and are statistically insignificant, indicating no significant trend differences in forest product exports between the treated and control groups before the RCEP's implementation, thereby satisfying the parallel trend assumption. One possible explanation for the positive coefficient in *pre*_5 is that the RCEP agreement was officially signed on 15 November 2020. This news may similarly benefit member countries' trade in timber forest products as the subsequent formal implementation. It is worth noting that *post*_3 exhibits a significant upward trend, with the coefficient's confidence interval not containing zero, indicating statistical significance. This suggests that, at the *post*_3 time point, the export values of forest products for the treatment and control groups diverge following the entry into force of the RCEP, with the treatment group experiencing a significant increase in export values.

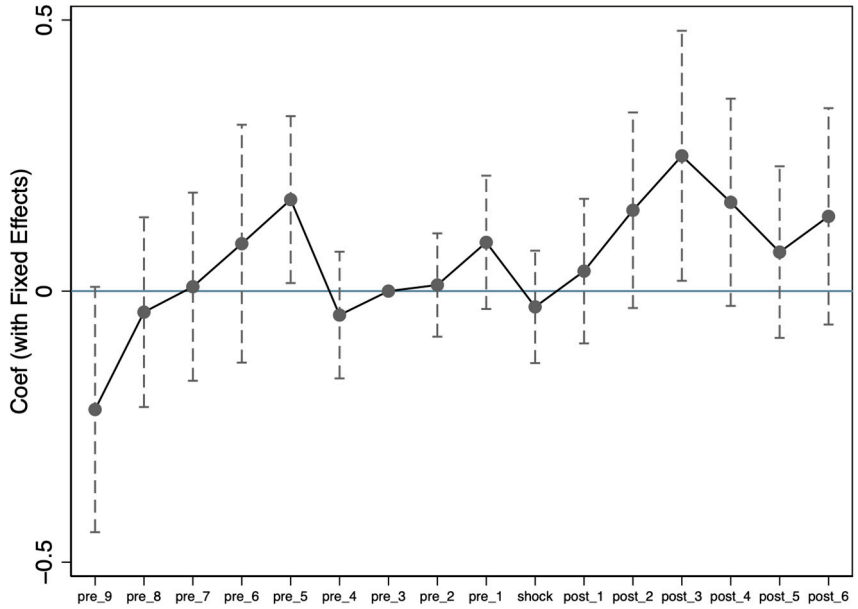

Figure 1. Parallel trend test results.

4. Results

4.1. Baseline Results

Table 3 presents the estimated results of Equation (1), indicating that the effective commitments of RCEP in destination economies have significantly enhanced the bilateral exports of forest products from China's provinces. In column (1), only the economy fixed effects are controlled, with none of the other characteristics included. The estimated

coefficient of $RCEP_{dt}$ turns out to be not statistically significant. We then consider various confounders and include them into the regression sequentially. Column (2) introduces province–year fixed effects to address unobserved supply-side factors specific to individual provinces. The resulting coefficient of $RCEP_{dt}$ becomes 0.128 and is statistically significant at the 10% level. In Columns (3) and (4), referring to the study by Tang and Zheng (2023) [39], we further control for product–year fixed effects (to account for global product cycles) and year–quarter fixed effects (to address seasonal fluctuations). The results show that, all else being equal, China's exports of timber forest products increased by approximately 22.6% compared to non-RCEP destination economies after the agreement came into effect. In Columns (5) to (7), we replace product–year, province–year, and year–quarter fixed effects with product–year–quarter and province–year–quarter fixed effects (to control for higher frequency global and domestic product cycles). We find quantitatively similar effects on the value of exports.

Table 3. Baseline results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	***LnForest_Exp*** **Export Value of Timber Forest Products (USD), in Log**						
RCEP	0.003	0.128 *	0.262 ***	0.226 ***	0.003	0.090	0.228 ***
	(0.060)	(0.068)	(0.069)	(0.068)	(0.060)	(0.066)	(0.068)
Constant	10.033 ***	10.020 ***	10.007 ***	10.010 ***	10.033 ***	10.024 ***	10.010 ***
	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)
Observations	923,541	923,541	923,503	923,503	923,541	923,541	923,265
R-squared	0.074	0.139	0.335	0.336	0.074	0.144	0.344
Economy FE	YES	YES	YES	YES	YES	YES	YES
Province–Year FE	—	YES	YES	YES	—	—	—
HS6–Year FE	—	—	YES	YES	—	—	—
Year–Quarter FE	—	—	—	YES	—	—	—
Province–Year–Quarter FE	—	—	—	—	—	YES	YES
HS6–Year–Quarter FE	—	—	—	—	—	—	YES

Note: Observations are by year–quarter–province–product (HS 6-digit)–destination level. Standard errors clustered by economy are reported in parenthesis. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.2. Placebo Test

The baseline results support that the RCEP agreement has promoted the export of timber forest products from China to other member countries. However, the results may be influenced by other policy changes or random factors. To enhance the credibility of the findings, we examine the robustness of the baseline regressions through a placebo test.

We randomly assign the treated and control groups within the sample to obtain the kernel density of the coefficient estimates of the interaction term DID for the treated group and the time point at which the policy came into effect and the scatterplots of the *p*-values corresponding to them. Given the random assignment, if the interaction term from the placebo test does not significantly affect the dependent variable, there would be no significant omitted variable bias. This would be reflected in the coefficient estimates clustering around zero. Conversely, a deviation from zero would suggest potential model misspecification. To account for potential small-probability events influencing the estimates, 1000 simulation iterations are performed.

Figure 2 displays the placebo test results on the impact of the RCEP agreement on the export of forest products across provinces in China. The horizontal red dashed line represents a *p*-value of 0.1. Scatter points below this line indicate statistical significance

at the 10% level, while those above are insignificant. The vertical dashed line marks the true policy treatment effect from the baseline results (0.228 in column (7), Table 3). As can be seen from the Figure 2, the majority of the coefficients are distributed around 0, the mean values are far away from the true values, the dotted line indicating the value of the benchmark regression coefficients is intersected with the kernel density of the coefficient estimates but deviates from the normal value, and most of the *p*-values are above 0.1, which implies that the impact of the RCEP agreement on China's export trade of timber forest products is not affected by the other unobserved factors, and the placebo test is validated.

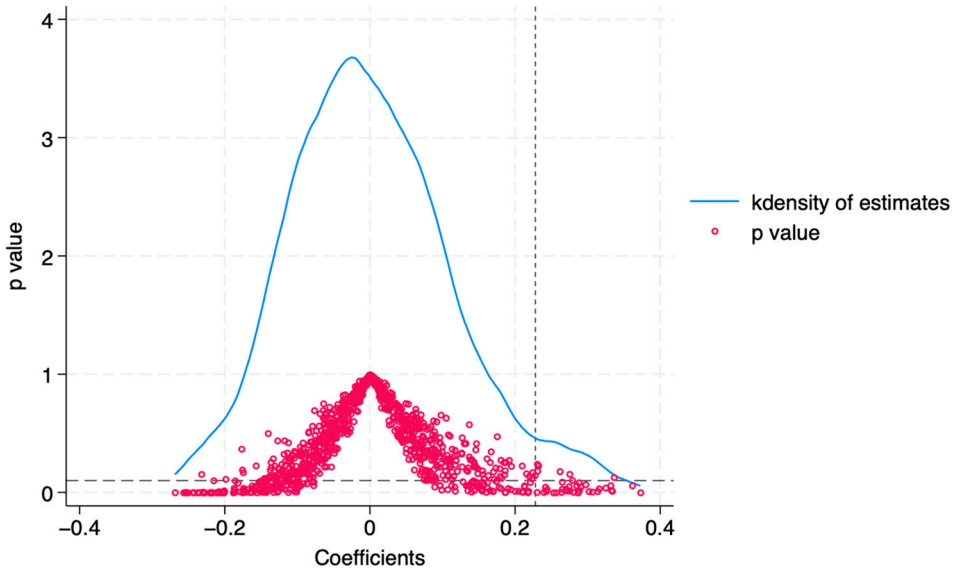

Figure 2. Placebo test results.

4.3. Robustness Check

4.3.1. Balanced Panel Data

This paper uses unbalanced panel data in the estimation of the baseline model, which may involve missing data. To address this issue, we conduct a robustness check using a balanced panel sample. The results shown in Table 4 indicate that the coefficients of the key independent variables remain significantly positive, confirming the robustness of the baseline results.

Table 4. Robustness checks using balanced panel sample.

	(1)	(2)
Variables	***LnForest_Exp*** **Export Value of Timber Forest Products (USD), in Log**	
RCEP	0.242 ***	0.249 ***
	(0.049)	(0.050)
Constant	12.599 ***	12.601 ***
	(0.005)	(0.005)
Observations	222,124	221,704
R-squared	0.413	0.420
Province–Year FE	YES	—
HS6–Year FE	YES	—
Year–Quarter FE	YES	—
Economy FE	YES	YES
Province–Year–Quarter FE	—	YES
HS6–Year–Quarter FE	—	YES

Note: Observations are by year–quarter–province–product (HS 6-digit)–destination level. Standard errors clustered by economy are reported in parenthesis. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.3.2. Change the Product Dimension to HS 4-Digit Code

The estimation of the baseline model in this paper is based on the trade relationship in the province–destination–product–time dimension of China's exports, with product trade data classified at the HS 6-digit code level. Alternatively, aggregating to the HS 4-digit code enables the simpler categorization of product types. The results shown in Table 5 are largely consistent with the baseline results. Following the implementation of the RCEP agreement, the export value of timber forest products from China's provinces to RCEP member countries significantly increased compared to non-RCEP destination economies.

Table 5. Robustness checks after changing the product dimension to HS 4-digit code.

	(1)	(2)	(3)	(4)
	Unbalanced Panel		**Balanced Panel**	
Variables	***LnForest_Exp*** **Export Value of Timber Forest Products (USD), in Log**			
RCEP	0.175 **	0.177 **	0.233 ***	0.237 ***
	(0.073)	(0.074)	(0.051)	(0.052)
Constant	10.461 ***	10.461 ***	12.903 ***	12.903 ***
	(0.007)	(0.007)	(0.005)	(0.005)
Observations	505,128	505,071	157,248	157,164
R-squared	0.359	0.366	0.421	0.429
Province–Year FE	YES	—	YES	—
HS4–Year FE	YES	—	YES	—
Year–Quarter FE	YES	—	YES	—
Economy FE	YES	YES	YES	YES
Province–Year–Quarter FE	—	YES	—	YES
HS4–Year–Quarter FE	—	YES	—	YES

Note: Observations are by year–quarter–province–product (HS 4-digit)–destination level. Standard errors clustered by economy are reported in parenthesis. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.3.3. Inclusion of Non-Timber Forest Products

China's forest resources are diverse, comprising both timber and non-timber forest products. However, the baseline model estimation focuses solely on timber forest products. To enhance the robustness of our analysis, here, we have included non-timber forest products in the sample, with the classification standards referring to the Food and Agriculture Organization of the United Nations (FAO). Table 6 shows that the results including non-timber forest products align with the baseline results, with policy treatment effects being significant at the 1% level. Subsequent to the implementation of the RCEP agreement, China's exports of forest products, including non-timber forest products, to RCEP member countries significantly increased compared to those to non-RCEP member economies.

Table 6. Robustness checks—inclusion of non-timber forest products.

	(1)	(2)	(3)	(4)
	Unbalanced Panel		**Balanced Panel**	
Variables	***LnForest_Exp*** **Export Value of Timber Forest Products (USD), in Log**			
RCEP	0.186 ***	0.188 ***	0.211 ***	0.219 ***
	(0.065)	(0.065)	(0.045)	(0.047)
Constant	10.123 ***	10.123 ***	12.645 ***	12.648 ***
	(0.007)	(0.007)	(0.004)	(0.005)
Observations	1,048,690	1,048,131	245,532	244,748
R-squared	0.328	0.336	0.393	0.400
Province–Year FE	YES	—	YES	—
HS6–Year FE	YES	—	YES	—

Table 6. *Cont.*

	(1)	(2)	(3)	(4)
	Unbalanced Panel		Balanced Panel	
Variables	*LnForest_Exp* Export Value of Timber Forest Products (USD), in Log			
Year–Quarter FE	YES	—	YES	—
Economy FE	YES	YES	YES	YES
Province–Year–Quarter FE	—	YES	—	YES
HS6–Year–Quarter FE	—	YES	—	YES

Note: Observations are by year–quarter–province–product (HS 6-digit)–destination level. Standard errors clustered by economy are reported in parenthesis. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.3.4. Adding Control Variables

In order to further exclude the potential impact on the estimation results of the model due to the absence of control variables in the model, our paper adds two control variables that are closely related to trade, i.e., GDP and terms of trade, and incorporates these two variables into the baseline model. The results in Table 7 show that the results are still significant after adding the control variables to the baseline model, which indicates that the signing and implementation of the RCEP agreement has greatly promoted China's timber forest product exports to other member countries. Specifically, under the assumption that all other factors remain constant, the implementation of the RCEP agreement increases China's exports of timber forest products to RCEP member countries by about 20 percent.

Table 7. Robustness checks—adding control variables.

	(1)	(2)
Variables	*LnForest_Exp* Export Value of Timber Forest Products (USD), in Log	
RCEP	0.172 **	0.179 **
	(0.082)	(0.082)
lnGDP	0.534 ***	0.529 ***
	(0.189)	(0.188)
Terms_trade	0.000	0.000
	(0.001)	(0.001)
Constant	−4.576	−4.455
	(5.157)	(5.125)
Observations	656,527	656,285
R-squared	0.338	0.347
Province–Year FE	YES	—
HS6–Year FE	YES	—
Year–Quarter FE	YES	—
Economy FE	YES	YES
Province–Year–Quarter FE	—	YES
HS6–Year–Quarter FE	—	YES

Note: Observations are by year–quarter–province–product (HS 6-digit)–destination level. Standard errors clustered by economy are reported in parenthesis. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

4.3.5. Bacon Decomposition Test

The results reported in Table 8 once again demonstrate that the signing and implementation of the RCEP agreement significantly boosted China's exports of timber forest products to other member countries. Specifically, under the assumption that other factors remain constant, the implementation of the RCEP agreement increased the export value of timber forest products between China and its RCEP member countries by approximately 24%. Given that there may be an estimation bias in the time-varying DID model due to

the potential issue of "early treatment groups later becoming control groups", a Bacon decomposition test was conducted. The results show that reasonable control group settings account for more than 99% of the sample size, and the estimated coefficients are larger in such cases. This suggests that the bias caused by unreasonable control group settings is not severe, and the actual trade impact of the RCEP agreement on China's exports of timber forest products to other member countries is likely to be greater than 24%.

Table 8. Robustness checks—Bacon decomposition test.

		(1)		(2)	
Variables		***LnForest_Exp*** **Export Value of Timber Forest Products (USD), in Log**			
RCEP		0.242 ***		0.249 ***	
		(0.049)		(0.050)	
Constant		12.599 ***		12.601 ***	
		(0.005)		(0.005)	
Observations		222,124		221,704	
R-squared		0.413		0.420	
Province–Year FE		YES		—	
HS6–Year FE		YES		—	
Year–Quarter FE		YES		—	
Economy FE		YES		YES	
Province–Year–Quarter FE		—		YES	
HS6–Year–Quarter FE		—		YES	
Results of Bacon decomposition		Estimated coefficient	Weight	Estimated coefficient	Weight
Treated vs. Never Treated (reasonable)		0.258	0.979	0.201	0.978
Cohorts	Earlier Treated vs. Later Control (reasonable)	−0.063	0.018	−0.037	0.016
	Later Treated vs. Earlier Control (unreasonable)	0.114	0.004	−0.045	0.006

Note: Observations are by year–quarter–province–product (HS 6-digit)–destination level. Standard errors clustered by economy are reported in parenthesis. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

5. Discussion

The baseline results advocate that the effective commitments of the RCEP in destination economies have significantly enhanced bilateral exports of forest products from China's provinces. The reasons behind these results can be analyzed as follows: First, the RCEP agreement provides tariff reductions, relaxed market access, the establishment of negative lists for investments, and trade facilitation measures, reducing the costs of entering member countries and creating trade expansion effects. Second, as the world's largest free trade area by population and economic size, the RCEP opens new market opportunities and potential consumer demand for China. Third, the rules of origin accumulation foster the integration of supply chains, value chains, and industrial networks across the region, enabling Chinese forest products to better integrate into regional supply chains and enhance their export competitiveness. Fourth, the RCEP agreement encourages trade and investment cooperation, diversifying risks and addressing international trade challenges. In particular, under strained global trade relations, the RCEP helps China reduce its reliance on individual markets, promoting the diversification of trade partners and strengthening exports to member countries.

However, the positive effects of RCEP implementation on the exports of forest products from China's provinces to member countries do not apply universally to all products and regional characteristics. The specifics are illustrated in the following heterogeneity tests.

5.1. BEC Categories

Based on the BEC (Classification by Broad Economic Categories) method from the United Nations Comtrade database, which distinguishes different production stages, products can be classified into intermediate inputs, consumption goods, and capital goods. The export performance of forest products under the favorable conditions brought about by the RCEP agreement may vary depending on the characteristics of the products. Accordingly, in Table 9, based on the BEC product classification, we conduct heterogeneity tests using corresponding sub-samples.

Table 9. Heterogeneity tests—BEC categories.

	(1)	(2)	(3)
Sub-Samples	**Intermediate Inputs**	**Consumption Goods**	**Capital Goods**
Variables	***LnForest_Exp*** **Export Value of Timber Forest Products (USD), in Log**		
RCEP	0.161 **	0.382 ***	0.147
	(0.070)	(0.086)	(0.143)
Constant	10.025 ***	9.951 ***	11.206 ***
	(0.007)	(0.008)	(0.016)
Observations	574,126	339,821	9196
R-squared	0.316	0.438	0.496
Economy FE	YES	YES	YES
Province–Year–Quarter FE	YES	YES	YES
HS6–Year–Quarter FE	YES	YES	YES

Note: Observations are by year–quarter–province–product (HS 6-digit)–destination level. Standard errors clustered by economy are reported in parenthesis. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

The results demonstrate that the RCEP agreement significantly enhances the exports of forest products categorized as intermediate inputs and consumption goods (columns (1) and (2)), while showing no substantial effect on the export of capital goods (column (3)). Specifically, holding all other conditions constant, exports of intermediate forest products from China's provinces to RCEP member countries increased by approximately 16%, and exports of forest consumption goods rose by 38% compared to non-RCEP destination economies. This outcome may be attributed to the low substitutability of capital goods, which makes them more susceptible to non-tariff barriers. Additionally, most capital goods in the sample data fall under "Furniture; wooden, for office use" (HS6: 940330). Given the long replacement cycles for office furniture, the market's response to tariff reductions may be slower.

5.2. Specific Commodity Categories

China is endowed with abundant forest resources and has developed a complete industrial chain of forestry characterized by a complex and diverse range of forest products that encompass almost everything from traditional timber products to modern forest chemical products. Based on these characteristics, we categorize timber forest products into four common categories: wood-based panels, paper products, wooden furniture, and miscellaneous products (e.g., industrial roundwood, other wood raw materials, and sawn wood), conducting heterogeneity tests on the corresponding sub-samples. The results presented in Table 10 indicate that the RCEP agreement significantly enhanced China's export value of wood-based panels, paper products, and wooden furniture (columns (1) to

(3)), while showing no significant effect on the export of miscellaneous products (column (4)). Specifically, controlling for other factors, after the implementation of the RCEP, the exports of wood-based panels from China's provinces to other RCEP member countries increased by 13.3%, paper products by 27.6%, and wooden furniture by 24% compared to non-RCEP destination economies.

Table 10. Heterogeneity tests—commodity categories.

	(1)	(2)	(3)	(4)
Sub-Samples	**Wood-Based Panels**	**Paper Products**	**Wooden Furniture**	**Others**
Variables	***LnForest_Exp*** **Export Value of Timber Forest Products (USD), in Log**			
RCEP	0.133 *	0.276 ***	0.240 **	−0.037
	(0.077)	(0.074)	(0.103)	(0.103)
Constant	11.466 ***	9.556 ***	10.727 ***	10.568 ***
	(0.009)	(0.008)	(0.008)	(0.009)
Observations	58,751	581,058	133,770	149,595
R-squared	0.277	0.315	0.580	0.283
Economy FE	YES	YES	YES	YES
Province–Year–Quarter FE	YES	YES	YES	YES
HS6–Year–Quarter FE	YES	YES	YES	YES

Note: Observations are by year–quarter–province–product (HS 6-digit)–destination level. Standard errors clustered by economy are reported in parenthesis. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

5.3. Heterogeneity Across Regions

The baseline results reflect average effects across China's provincial-level forest product exports. Given the significant differences in resource endowments, economic development levels, and industrial structures between eastern, central, and western China, the impact of the RCEP agreement on forest product exports may vary by region. Therefore, we conduct heterogeneity tests based on these regional classifications. Table 11 shows that the implementation of the RCEP agreement significantly boosted forest product exports from eastern provinces (column (1)), but had no notable impact on central or western regions (columns (2) and (3)). Specifically, holding other factors constant, forest product exports from eastern provinces to RCEP member countries increased by nearly 35%. In China, the manufacturing of forest products is primarily concentrated in central and eastern regions, especially along the eastern coast, whereas exports from the western region are minimal. Therefore, eastern regions are more likely to benefit from external regional trade agreements.

To summarize, the baseline results align with most of the existing literature, confirming that trade agreements enhance trade flows among member countries. However, this study specifically examines forest products within the context of the RCEP agreement, further exploring heterogeneity through the analyses of production stages (intermediate or final goods) and regional locations. The findings indicate that the RCEP has a stronger export promotion effect on China's deep-processed products, such as wooden furniture and paper products, compared to primary processed products like wood-based panels. Additionally, there are notable regional imbalances in the development of China's forest manufacturing and export industries. These results complement the existing research.

Table 11. Heterogeneity tests—regional variation.

	(1)	(2)	(3)
Sub-Samples	**Eastern**	**Central**	**Western**
Variables	***LnForest_Exp*** **Export Value of Timber Forest Products (USD), in Log**		
RCEP	0.346 ***	0.094	−0.021
	(0.062)	(0.116)	(0.093)
Constant	10.086 ***	9.990 ***	9.578 ***
	(0.006)	(0.014)	(0.013)
Observations	638,337	182,138	101,578
R-squared	0.379	0.359	0.353
Economy FE	YES	YES	YES
Province–Year–Quarter FE	YES	YES	YES
HS6–Year–Quarter FE	YES	YES	YES

Note: Observations are by year–quarter–province–product (HS 6-digit)–destination level. Standard errors clustered by economy are reported in parenthesis. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

As a critical strategic resource, it is essential to leverage the comparative advantages of each country to achieve efficient resource utilization and management [40,41]. Currently, trade in timber forest products among RCEP member countries is highly interconnected, with increasingly complex trade relationships. The RCEP agreement, thus, presents significant new opportunities for China's forest product exports.

However, the RCEP has been in effect for a relatively short period. While we have conducted empirical estimation using quarterly data, which offers greater precision than annual data, we acknowledge that additional data will become available over time. This will allow us to extend the sample period of the current quarterly data and potentially observe longer-term effects. In future research, we can further explore the impacts on product quantity, price, quality, etc., and include tariff and non-tariff data (which will require substantial data cleaning efforts) to investigate the economic and trade effects of tariff reductions and the reduction in trade and investment barriers resulting from the RCEP agreement.

6. Conclusions

This study examines the quarterly export data of forest products at the HS 6-digit level, covering China's 31 provinces and their exports to destination economies from 2017 to 2023, to examine the impact of the Regional Comprehensive Economic Partnership agreement on bilateral forest product trade. A time-varying Difference-in-Differences model, augmented by Propensity Score Matching method, is employed using the effective dates of the RCEP agreement for each trading partner to evaluate the impact of its implementation on bilateral forest product exports. The results of the empirical study show that the RCEP has significantly boosted Chinese provinces' exports of timber forest products to other RCEP member countries. After the agreement came into effect, China's exports of timber forest products to RCEP members increased by around 22% to 26% compared to non-members. This positive effect varies in terms of products and regional characteristics.

Specifically, (1) the export promotion effect of the RCEP on highly processed products such as wooden furniture and paper products between China and other member countries is greater than that of primary processed products such as wood-based panels. A possible explanation is that the RCEP includes both trade promotion and investment facilitation measures. After the agreement's implementation, some Chinese forestry enterprises, particularly export-oriented ones, relocated primary processing activities, such as wood-based panels, to other member states to benefit from lower raw material and production costs. In contrast, value-added products like wooden furniture and paper products face higher

barriers to relocation due to larger investment needs and higher technical skill requirements, resulting in a stronger export promotion effect. Moreover, while the RCEP reduces tariff barriers, non-tariff factors still constrain trade flows. For instance, stricter legality requirements for imported timber forest products in some member states (e.g., Japan, South Korea, Australia, and Indonesia) to combat illegal logging increase environmental certification costs, partially offsetting tariff reductions. This impact is more pronounced for lower-profit-margin products like wood-based panels. (2) The RCEP significantly promotes the export of timber forest products from China's eastern region, while its impact on the central and western regions remains insignificant, highlighting the uneven regional development of China's forestry manufacturing and export industries. The eastern region benefits from lower transportation costs due to abundant port resources. However, rising land and production factor costs in this region may accelerate the shift of forestry manufacturing to central and western regions. Unlocking the growth potential of these regions in forest product exports will be crucial for enhancing timber trade between China and RCEP member countries in the future.

To maximize the ongoing promotion of forest product exports under the Regional Comprehensive Economic Partnership (RCEP), China and other member countries need to deepen cooperation in trade facilitation and industrial chain integration. This includes the following: (1) Leveraging the comparative advantages of RCEP member countries in forest resources, production factor costs, technology, and capital, optimizing product sharing within the industrial supply chain to stimulate intra-regional trade in timber forest products. For instance, China could shift primary processing activities, such as wood-based panels, to ASEAN countries, New Zealand, and other members, while focusing on the development of wooden furniture and paper products with greater export potential. (2) Streamlining logistics channels, particularly by enhancing transportation routes between China's inland provinces in the central and western regions and other RCEP member countries, and giving full play to the growth potential of inland provinces in the forestry manufacturing and export industries. (3) By further reducing non-tariff barriers, strengthening the mutual recognition of quality and environmental standards for forest products will facilitate trade. (4) Establishing an RCEP trade information platform to deliver targeted commercial information services to forest product producers and traders would create new trade opportunities.

Author Contributions: Conceptualization, X.Z. (Xi Zhang), X.Z. (Xiuxiu Zheng) and Y.C.; Data curation, X.Z. (Xi Zhang); Formal analysis, S.H.; Methodology, X.Z. (Xiuxiu Zheng); Visualization, S.H.; Writing—original draft, S.H., X.Z. (Xiuxiu Zheng) and X.Z. (Xi Zhang); Writing—review and editing, X.Z. (Xi Zhang), X.Z. (Xiuxiu Zheng), S.H. and Y.C. All authors have read and agreed to the published version of the manuscript.

Funding: Xi Zhang acknowledges the support of the project "Research and Development Fund Project" from the Research Institute of Forestry Policy and Information, Chinese Academy of Forestry (500103-6032). Xiuxiu Zheng acknowledges the support of the project "Firms' Export Market Adjustment and Innovation Performance Under the Influence of Technical Barriers to Trade: Theoretical Mechanism and Evidence from China" from the National Natural Science Foundation of China (72403039), the project "The Impact of Trade Barrier Risks on Trade, Mechanisms, and Response Strategies (Subproject 2)" from the National Natural Science Foundation of China (72341010), the "111 Project" from the Ministry of Education of the People's Republic of China (B18014), the "Philosophy and Social Sciences Laboratories" program from the Ministry of Education of the People's Republic of China, and the " Fundamental Research Funds for Central Universities" from the UIBE (22QD28).

Data Availability Statement: The export data used in this paper are collected from the General Administration of Customs (GAC) of the People's Republic of China (http://www.customs.gov.cn/ (accessed on 4 December 2024)), and its aggregated version is available upon request. The

effective dates of the RCEP agreement for member countries are sourced from RCEP NEWS website (http://www.rcepnews.com (accessed on 4 December 2024)). The economy–year-level characteristic variables used as covariates for Propensity Score Matching are obtained from the World Bank database (https://databank.worldbank.org/source/world-development-indicators (accessed on 4 December 2024)) and the website of the French Center for International Economics (https://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele.asp (accessed on 4 December 2024)).

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

Appendix A

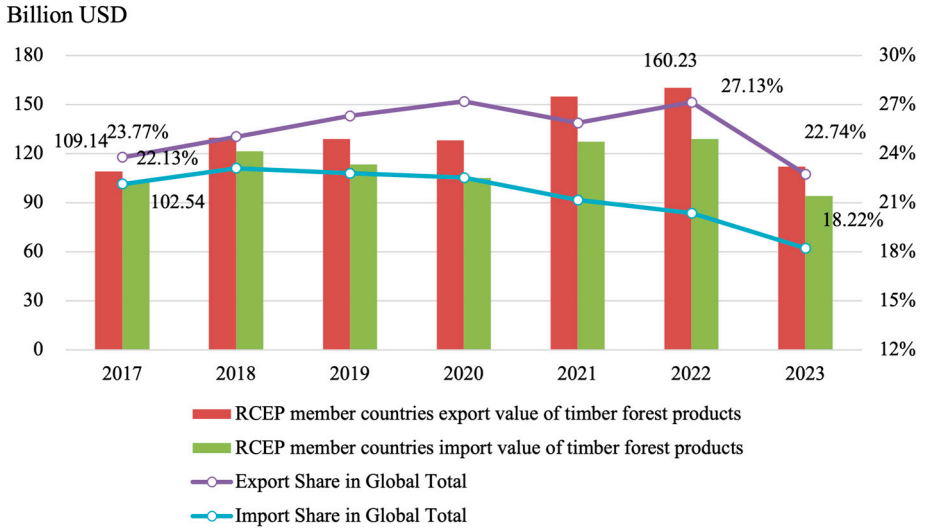

Figure A1. Import and export value of timber forest products by RCEP member countries and their global share (2017–2023). Source: Calculated by the authors using data from the UN Comtrade database (https://wits.worldbank.org/ (accessed on 4 December 2024)).

Appendix B

Table A1. Detailed description of the selected literature.

Literature	Authors	Method	Variable Used	Conclusions Related to the Topic of Our Paper
New measures of trade creation and trade diversion	Christopher S.P. Magee (2008) [4]	Gravity Model	Size of economy; dummy variables for RTAs; population, income level, and other variables related to country characteristics; distance, sharing a border, being landlocked or an island, having a common language, and any other unobserved historical or cultural ties.	There are clear anticipatory effects of regional trade agreements, with trade estimated to increase by 26% on average in the four years leading up to the start of a trade deal, trade continues to rise significantly over the first 11 years a regional agreement is in place, and the long-run impact of the average regional agreement is estimated to be an 89% increase in trade flows.

Table A1. *Cont.*

Literature	Authors	Method	Variable Used	Conclusions Related to the Topic of Our Paper
Estimates of the Trade and Welfare Effects of NAFTA	Caliendo, L.; Parro, F. (2012) [5]	General Equilibrium Model	Bilateral trade flows, tariff levels, productivity, intermediate goods prices, etc.	This paper used the general equilibrium model and the estimated elasticities to identify the impact of NAFTA's tariff reductions. This paper find that Mexico's welfare increases by 1.31%, U.S.'s welfare increases by 0.08%, and Canada's welfare declines by 0.06%. We find that intra-bloc trade increases by 118% for Mexico, 11% for Canada, and 41% for the U.S.
Impacts of Free Trade Agreements on Agricultural Trade Creation and Trade Diversion	Lin Sun; Michael R. Reed (2010) [9]	Poisson Pseudo-Maximum-Likelihood (PPML); Gravity Model	GDP; dummy variables for RTAs; population, income level, and other variables related to country characteristics; distance, sharing a border, having a common language, etc.	The ASEAN–China preferential trade agreement, EU-15, EU-25, and Southern African Development Community agreements have generated large increases in agricultural trade among their members.
Trade Creation and Trade Diversion in Deep Agreements	Mattoo, A.; Mulabdic, A.; Ruta, M. (2017) [11]	Gravity Model	PTA dummy; tariffs; relative tariffs; trade value; depth variables; etc.	Some provisions of deep agreements have a public goods aspect that not only facilitates trade among member economies, but also increases trade between member economies and non-member economies.
Spatial Spillover Effects of Global Forest Product Trade	Yin, Z.H.; Wang, F.; Gan, J.B. (2020) [17]	Spatial autoregressive (SAR) interaction model	Trade flows; economic factors; resource endowment; tariff; geographical factors; cultural factors; regional economic integration; timber legality assurance trade policies; etc.	Regional economic integration has a positive contribution to forest product trade, and the EU has a greater promoting effect on forest product trade. There is a significant spatial spillover effect in the global forest product trade, and the total effect (TE) in 2014 is significantly higher than that in 2004, which is attributed to the significant increase in the origin effect (OE), destination effect (DE), and network effect (NE). Especially in 2014, the network effect (NE) accounted for about 45% of the total effect.

Table A1. *Cont.*

Literature	Authors	Method	Variable Used	Conclusions Related to the Topic of Our Paper
The impact of high-standard free trade areas on the diversification of China's export products: Expanding market or intensifying competition?	Fan, Z.B.; Bian, R.M.; Li, H. (2024) [21]	Trade model with multiproduct firms; Gravity Model; PSM	Depth index, including the number of WTO+ clauses, the number of WTO-X clauses, etc.; Herfindahl–Hirschman Index (HHI); economic factors: GDP, population, openness to trade (TRADE); and other control variables: geographic distance (Dis), whether it is a landlocked country (Bod), whether it shares an official language (Lan), whether it is a member of the European Union (EU), whether it is a member of the North American Free Trade Area (NAFTA), and so on.	The deepening of trade agreements affected China's export diversification negatively. This negative correlation was predominantly due to the similarity in comparative advantages between China and its trade partners, leading to the "competition intensification effect" overshadowing the "market expansion effect".
Economic and Policy Uncertainty: Aggregate Export Dynamics and the Value of Agreements	Carballo, J.; Handley, K.; Limão, N. [30]	Examine the interaction of economic and policy uncertainty in a dynamic heterogeneous firms model.	GDP; GDP growth rate; FTA dummy variable; other control variables such as population, geographic distance, official language, whether landlocked or not, etc.	Uncertainty about foreign income, trade protection, and their interaction dampens export investment. This can be mitigated by trade agreements, which are particularly valuable in periods of increased demand volatility. The extensive and intensive margins played an important role in the adjustment of U.S. exports, with the extensive margin adjusting 1/3 of the contraction in U.S. exports.
Impact of Trade Restrictions on the Russian Forest Industry: Evidence from Siberian Timber Producers	Gordeev, R.V.; Pyzhev, A.I. (2023) [33]	Trade Network Analysis; multi-stage double-difference method; PSM; parallel trend test	Trade value of timber products; FTA dummy variable; GDP; population; distance; borders; language; forest area; etc.	This study finds that the trade network of Chinese wood forest products is becoming increasingly complex, and the central position of China and the Association of Southeast Asian Nations (ASEANs) in the network is increasing year by year. The signing of FTAs has had a significant positive impact on the trade of wood forest products in China and a significant trade creation effect.

Appendix C

Table A2. Classification of timber forest products (version HS 2017).

Product Category	*HS Code*
Industrial roundwood	4403
Other wood raw materials	4401, 4402, 4404, 4405, 4406
Sawn wood	4407
Wood-based panels	
Veneer	4408
Particle board	4410
Fiberboard	4411
Plywood	4412
Wood pulp and recovered (waste and scrap) paper or paperboard	47
Paper products	
Paper and paperboard	48
Printed products	49
Wooden furniture	94013000, 94014010, 94014090, 94016110, 94016190, 94016900, 94019090, 94033000, 94034000, 94035010, 94035091, 94035099, 94036010, 94036091, 94036099, 94039000
Other timber forest products	4409, 4413-4421, 45, 96091010, 96091020

Appendix D

The covariates used for Propensity Score Matching (PSM) include the logarithmic form of Gross Domestic Product (lnGDP), contig (a binary variable equal to 1 if the two economies share a border, otherwise it is 0), Gross National Income (GNI) per capita, import dependence (the ratio of a economy's total imports to its GDP for a given year), and geographical distance (the geographical distance between the capitals of the two economies). These variables effectively capture economy-specific characteristics. Figure A2 reports the balance diagnostic results of PSM, detailing the standardized percentage bias for each covariate before and after matching. The results indicate that, except for GNI per capita, the % bias for the remaining covariates is relatively small and significantly lower than the pre-matching % bias, suggesting that the selection of covariates is appropriate.

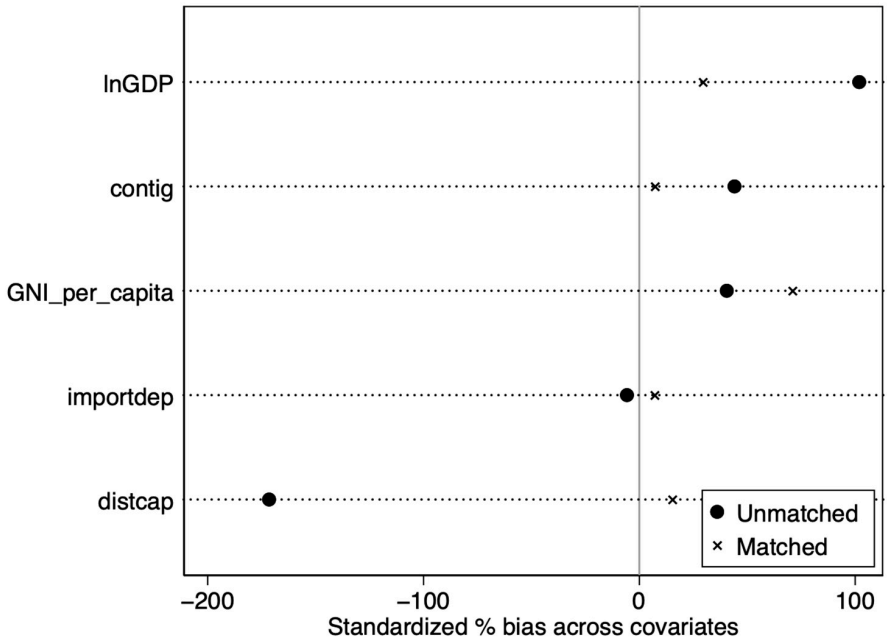

Figure A2. Balanced diagnostic results of PSM.

Figure A3 presents the common support graph for Propensity Score Matching. The result shows that most samples from both the treated and control groups fall within the common value range, while those outside this range exhibit more extreme propensity scores. This further confirms the appropriateness of the matched samples obtained through PSM.

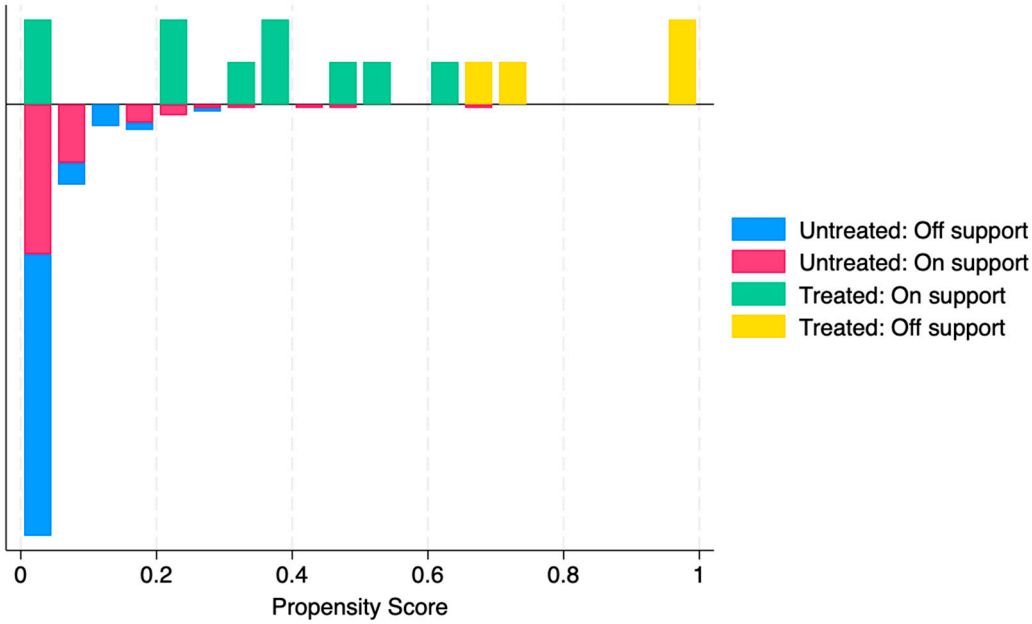

Figure A3. Common support graph for PSM.

To ensure the quality of sample matching, we further employ kernel density plots to visually illustrate the differences in propensity scores between the treatment and control groups before and after matching. As shown in Figure A4, the two kernel density curves exhibit significant deviation prior to matching. However, the curves align more closely after matching, indicating that the matching results are satisfactory.

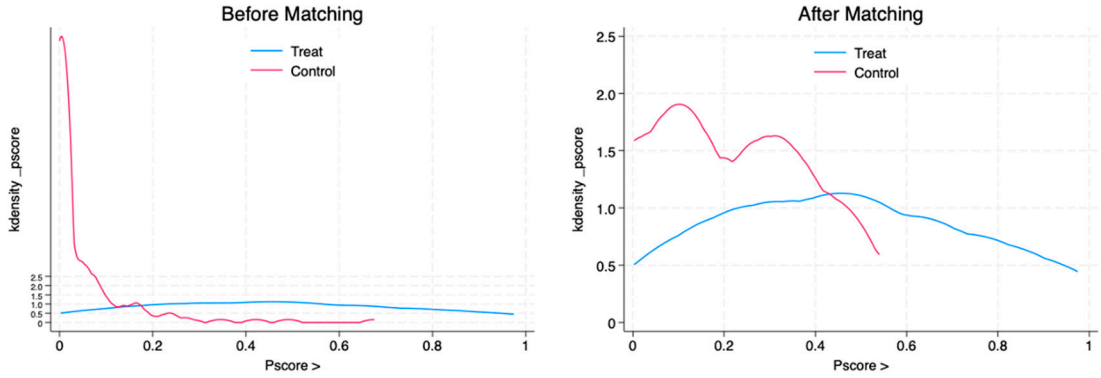

Figure A4. Kernel density graph of PSM.

Appendix E

In order to verify that the transformation method of taking logarithms of the dependent variable used in this paper is reasonable and effective, our paper adopts the other two methods of taking logarithms to conduct the robustness test, and the results are shown in Table A3. The results show that neither the form of *lny* nor the form of $ln(y+1)$ affects the significance level of the coefficients, and they are still significant at 1%, which implies that the core conclusion of this paper still holds, that is, the entry into force of the RCEP

agreement significantly promotes China's exports of timber forest products to the member countries compared to the non-RCEP destination economies.

Table A3. Robustness checks—replacing the logarithmic method with the dependent variable.

	(1)	(2)	(3)	(4)
	Lny		***Ln(y+1)***	
Variables	***LnForest_Exp*** **Export Value of Timber Forest Products (USD), in Log**			
RCEP	0.199 ***	0.201 ***	0.222 ***	0.224 ***
	(0.068)	(0.067)	(0.068)	(0.068)
Constant	9.370 ***	9.370 ***	9.327 ***	9.327 ***
	(0.007)	(0.007)	(0.007)	(0.007)
Observations	918,380	918,140	923,503	923,265
R-squared	0.334	0.342	0.337	0.345
Province–Year FE	YES	—	YES	—
HS6–Year FE	YES	—	YES	—
Year–Quarter FE	YES	—	YES	—
Economy FE	YES	YES	YES	YES
Province–Year–Quarter FE	—	YES	—	YES
HS6–Year–Quarter FE	—	YES	—	YES

Note: Observations are by year–quarter–province–product (HS 6-digit)–destination level. Standard errors clustered by economy are reported in parenthesis. ***, **, * indicate significance at the 1%, 5%, and 10% levels, respectively.

References

1. Li, C.; Whalley, J. How close is Asia already to being a trade bloc? *J. Comp. Econ.* **2017**, *45*, 847–864. [CrossRef]
2. Bhagwati, J.N. *US Trade Policy: The Infatuation with FTAs*; The AEI Press: Washington, DC, USA, 1995.
3. Sopranzetti, S. Overlapping free trade agreements and international trade: A network approach. *World Econ.* **2017**, *41*, 1549–1566. [CrossRef]
4. Magee, C.S.P. New measures of trade creation and trade diversion. *J. Int. Econ.* **2008**, *75*, 349–362. [CrossRef]
5. Caliendo, L.; Parro, F. Estimates of the Trade and Welfare Effects of NAFTA. *NBER Work. Pap.* **2012**, *82*, 1–44.
6. Ahmed, Y.; Delin, H.; Reeberg, B.G. Is the RCEP a Cornerstone or Just Collaboration? Regional General Equilibrium Model Based on GAMS. *J. Korea Trade* **2020**, *24*, 171–207. [CrossRef]
7. Li, Q.; Cheol, M.H. The trade and income effects of RCEP: Implications for China and Korea. *J. Korea Trade* **2018**, *22*, 306–318. [CrossRef]
8. Park, C.Y.; Petri, P.A.; Plummer, M.G. The Economics of Conflict and Cooperation in the Asia-Pacific: RCEP, CPTPP and the US-China Trade War. *East Asian Econ. Rev.* **2021**, *25*, 233–272. [CrossRef]
9. Sun, L.; Reed, M.R. Impacts of Free Trade Agreements on Agricultural Trade Creation and Trade Diversion. *Am. J. Agric. Econ.* **2010**, *92*, 1351–1363. [CrossRef]
10. Sánchez-Albornoz, A.E.D.; Timini, J. Trade Agreements and Latin American Trade (Creation and Diversion) and Welfare. *World Econ.* **2021**, *44*, 2004–2040. [CrossRef]
11. Mattoo, A.; Mulabdic, A.; Ruta, M. *Trade Creation and Trade Diversion in Deep Agreements*; Policy Research Working Paper Series; World Bank: Washington, DC, USA, 2017.
12. Petri, P.A.; Plummer, M.G.; Urata, S.; Zhai, F. *Going It Alone in the Asia-Pacific: Regional Trade Agreements without the United States*; Policy Research Working Paper Series; Peterson Institute for International Economics: Washington, DC, USA, 2017.
13. Besedes, T.; Kohl, T.; Lake, J. Phase out tariffs, phase in trade? *J. Int. Econ.* **2020**, *127*, 103385. [CrossRef]
14. Bernard, A.B.; Jensen, J.B.; Redding, S.J.; Schott, P.K. *The Margins of U.S. Trade (Long Version)*; NBER Working Papers; National Bureau of Economic Research: Cambridge, MA, USA, 2009.
15. Foster-Mcgregor, N.; Pschl, J.; Stehrer, R. *The Impact of Preferential Trade Agreements on the Margins of International Trade*; wiiw Working Papers; The Vienna Institute for International Economic Studies (wiiw): Vienna, Austria, 2010.
16. Barbier, E.B. The Effects of the Urugauy Round Tariff Reductions on the Forest Product Trade: A Partial Equilbrium Analysis. *World Econ.* **1999**, *22*, 87–115. [CrossRef]
17. Yin, Z.H.; Wang, F.; Gan, J.B. Spatial Spillover Effects of Global Forest Product Trade. *For. Policy Econ.* **2020**, *113*, 102–112. [CrossRef]
18. Rodrik, D. What Do Trade Agreements Really Do? *J. Econ. Perspect.* **2018**, *32*, 73–90. [CrossRef]
19. Shlapak, A.; Yatsenko, O.; Tananaiko, T.; Lyskova, L. Institutional Provision of Tariff and Non-Tariff Regulation of Cross-Border Trade. *Econ. Ecol. Soc.* **2023**, *7*, 1–23. [CrossRef]

20. Zhang, Q.; Cheng, B.D.; Diao, G.; Tao, C.L.; Wang, C. Does China's natural forest logging ban affect the stability of the timber import trade network? *For. Policy Econ.* **2023**, *152*, 102974. [CrossRef]
21. Fan, Z.B.; Bian, R.M.; Li, H. The impact of high-standard free trade areas on the diversification of China's export products: Expanding market or intensifying competition? *China World Econ.* **2024**, *32*, 33–67. [CrossRef]
22. Conconi, P.; García-Santana, M.; Puccio, L.; Venturini, R. From Final Goods to Inputs: The Protectionist Effect of Rules of Origin. *Am. Econ. Rev.* **2018**, *108*, 2335–2365. [CrossRef]
23. Bas, M.; Strauss-Kahn, V. Input-trade liberalization, export prices and quality upgrading. *J. Int. Econ.* **2015**, *95*, 250–262. [CrossRef]
24. Sun, K.; Xiao, H.; Jia, Z.; Tang, B. Estimating the effects of regional value chains of the RCEP in a GVC-CGE model. *J. Asian. Econ.* **2023**, *88*, 101647. [CrossRef]
25. Grossman, G.M. The Theory of Domestic Content Protection and Content Preference. *Q. J. Econ.* **1981**, *96*, 583–603. [CrossRef]
26. Falvey, R.; Reed, G. Economic effects of rules of origin. *Weltwirtsch Arch.* **1998**, *134*, 209–229. [CrossRef]
27. Limão, N.; Maggi, G. Uncertainty and Trade Agreements. *Am. Econ. J. Microecon.* **2015**, *7*, 1–42. [CrossRef]
28. Handley, K.; Limão, N. Policy Uncertainty, trade, and welfare: Theory and evidence for China and the United States. *Am. Econ. Rev.* **2017**, *107*, 2731–2783. [CrossRef]
29. Feng, L.; Li, Z.; Swenson, D.L. Trade Policy Uncertainty and Exports: Evidence from China's WTO Accession. *J. Int. Econ.* **2017**, *106*, 20–36. [CrossRef]
30. Carballo, J.; Handley, K.; Limão, N. Economic and Policy Uncertainty:Aggregate Export Dynamics and the Value of Agreements. *J. Int. Econ.* **2022**, *139*, 103661. [CrossRef]
31. Rosyadi, S.A.; Widodo, T. Impact of Donald Trump's tariff increase against Chinese imports on global economy: Global Trade Analysis Project (GTAP) model. *J. Chin. Econ. Bus. Stud.* **2018**, *16*, 125–145. [CrossRef]
32. Chor, D.; Li, B. Illuminating the Effects of the US-China Tariff War on China's Economy. *J. Int. Econ.* **2024**, *150*, 103926. [CrossRef]
33. Gordeev, R.V.; Pyzhev, A.I. Impact of Trade Restrictions on the Russian Forest Industry: Evidence from Siberian Timber Producers. *Forests* **2023**, *14*, 2452. [CrossRef]
34. Moral-Pajares, E.; Martínez-Alcalá, C.; Gallego-Valero, L.; Caviedes-Conde, Á.A. Transparency Index of the Supplying Countries' Institutions and Tree Cover Loss: Determining Factors of EU Timber Imports? *Forests* **2020**, *11*, 1009. [CrossRef]
35. Gao, L.; Pei, T.; Tian, Y. Trade Creation or Diversion?—Evidence from China's Forest Wood Product Trade. *Forests* **2024**, *15*, 1276. [CrossRef]
36. Liu, Q.; Ning, Z. Impact of Global Supply Chain Crisis on Chinese Forest Product Enterprises: Trade Trends and Literature Review. *Forests* **2023**, *14*, 1247. [CrossRef]
37. Beck, T.; Levine, R.; Levkov, A. Big Bad Banks? The Winners and Losers from Bank Deregulation in the United States. *J. Financ.* **2010**, *65*, 1637–1667. [CrossRef]
38. Liu, Q.; Qiu, L.D. Intermediate input imports and innovations: Evidence from Chinese firms' patent filings. *J. Int. Econ.* **2016**, *103*, 166–183. [CrossRef]
39. Tang, H.; Zheng, X. How did China's zero Covid policy affect itsexports? *Rev. Int. Econ.* **2023**, *32*, 545–573. [CrossRef]
40. Valera, F.; Bolonio, L.; La Calle, A.; Moreno, E. Deployment of Solar Energy at the Expense of Conservation Sensitive Areas Precludes Its Classification as an Environmentally Sustainable Activity. *Land* **2022**, *11*, 2330. [CrossRef]
41. Elmahdoubi, F.; Mabroum, S.; Hakkou, R.; Ibnoussina, M. Geopolymer Materials Based on Natural Pozzolans from the Moroccan Middle Atlas. *Minerals* **2021**, *11*, 1344. [CrossRef]