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Determinants of Temporary Trade Barriers in Global Forest Products Industry

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Received: 23 March 2020; Accepted: 1 May 2020; Published: 8 May 2020



Abstract: Imposing temporary trade barriers (TTBs) as remedy actions against imports has become popular among global countries in recent decades. Many countries have employed these trade barriers to protect domestic firms from possible injury by unfair international trade. This study evaluated the main factors that influenced the implementation of TTBs in the forest products industry from 1995 to 2015 for two scenarios: a global and developing countries scenario; and a paper and non-paper products scenario. A two-step sample selection model was employed to assess the determinants of the decision to impose TTBs and the frequency to implement TTBs for the scenario of global and developing countries. From the perspective of forest products, determinants of applying TTBs on paper and non-paper products were examined with the probit regression. For the scenario of global and developing countries, the import, employment in agriculture, forest coverage rate, inflation, and GDP per capita were significant determinants. For the scenario of paper and non-paper products, variables of the forest area, imports, exports, GDP per capita, tariff rate, expenditure on education, and employment in agriculture were significant. The results show that a country with a large per capita GDP is more likely to file more TTBs against others. One implication is that countries should be cautious to impose TTBs, as it may cause the attention to shift from the inefficiencies of domestic forest firms to the unfair trade actions of exporters.

Keywords: antidumping; countervailing; forest sector; two-step sample selection

1. Introduction

Since the end of 2017, trade barriers have been increasingly used among countries to protect domestic industries, such as the US–European, US–Canada, and US–China trade disputes [1–4]. Except for uniform tariffs, the most widely used trade protectionist policies are temporary trade barriers (TTBs), which include antidumping (AD), safeguards, and countervailing (CV) [5–8]. Since the Uruguay round of multilateral trade negotiations elaborating upon the basic principles of TTBs in 1994, the use of TTBs has evolved into a global phenomenon with an increasing number of countries adopting them [5,9]. In particular, developing countries have become some of the most frequent users of TTBs since the 1995 inception of the WTO [10–12]. From 1995 to 2015, there are 7121 AD cases and 923 CV duties according to the temporary trade barriers database (TTBD) [13]. Among those trade barriers within the forest sector, there are 372 AD cases and 20 CV duties on multiple forest products related to 28 petition economies over the same period [13]. Their global distribution is shown in Figure 1.

According to the Food and Agriculture Organization of the United Nations (FAO), global trade has grown faster in recent decades, with an average growth rate of 8.3% for 1994–2004 relative to the average growth rate of 5.9% from 1981 to 1993 [14]. In addition, a recovery is observed from the economic downturn of 2008 during the period from 2011–2015 [14]. In the forest sector, the global trade value was \$230 billion in 2015 [2,15]. The financial performance of the forest products industry has been vulnerable to recent changes in trade policies [16–19]. The share of forest products in international trade has declined even though it has been one of the primary manufacturing sectors [20]. Based on the FAO's classification of forest products, those investigated forest products can be disaggregated into paper and non-paper products [13,14,21–25]. In 2015, the global trade value of wood pulp and paper and paperboard was \$38 and \$94 billion, respectively, while the value of the global trade of sawnwood and wood-based panels was \$36 and \$30 billion, respectively. The market for paper products is different from the non-paper products market in many significant ways [26]. According to TTBD, there were 230 cases involving paper products and 142 cases involving non-paper products from 1995 to 2015 [13]. Thus, it is of great interest to investigate the trade issues in the forest sector due to its unstable trend and increasing use of trade barriers.

Although some studies analyzed trade issues for non-forest products, there have been relatively few on the forest sector, and none have conducted determinant analyses of using TTBs for global trade cases in the forest products industry [27–29]. In addition, no independent variable was selected to express the characteristic of the forest products industry. In the non-forest sector from the perspective of global countries, Krupp [30] estimated the factors that motivated the decision to file an AD petition in the US chemical industry and concluded that the chemical production index, price-cost margin, penetration of import, size of employees, and dumping margins would affect the filing decision. Lee and Swagel [29] found that countries were going to protect weak industries and offering fewer measures to protect strong industries by employing the simultaneous determination of global non-tariff trade barriers and trade flows in 1988. Anders and Caswell [27] analyzed the impact of food safety standards on overall imports from the top trading countries and revealed that the opposite perspectives of standards existed—a positive effect on developed countries and a negative effect on developing countries. Besedes and Prusa [28] evaluated the effects of an AD by applying ten-digit harmonized system (HS) trade data and found that AD measures made the hazard rate grow by over a half, and claimed that the export markets of those affected countries that were investigated by AD actions could not recover even if AD measures were removed later.

For developing countries, a few studies estimated the determinants of AD employment in non-forest sectors. Aggarwal [5] applied a panel data analysis to evaluate how macro factors would influence the employment of AD in developed and developing countries from 1980 to 2000. She claimed that the employment of AD would spread among developing countries due to the greater liberalization pressures and more countries may retaliate to counter the AD use against them. Bown [10] found that developing countries would receive AD protection regarding macroeconomic shocks in order to keep consistent with the endogenous trade policy by applying the six-digit HS product-level data, and emphasized the flexibility of AD as a protectionism measure facing various political-economic shocks. Egger and Nelson [31] applied the gravity model to analyze the effects of an AD on the volume of world trade by dividing the sample into developing and developed countries, claiming that the trade volume and welfare effects caused by AD have been negative. Sudsawasd [32] applied a panel dataset of 56 countries to investigate the effect of tariff liberalization on the AD from 1995 to 2007, and concluded that a lower tariff rate would result in more AD actions, as developed countries were more sensitive to the change of tariff policy compared with developing countries. Bagayev et al. [33] found that there were larger AD trade effects on low-income countries by estimating the impact of AD actions for importers including developing countries. As no research conducted the determinants analysis of TTBs in the forest products industry for both global and developing countries, this study would be the first to examine the main factors that influence the use of TTBs for both global and developing countries, with particular attention given to the groups of paper and non-paper products.

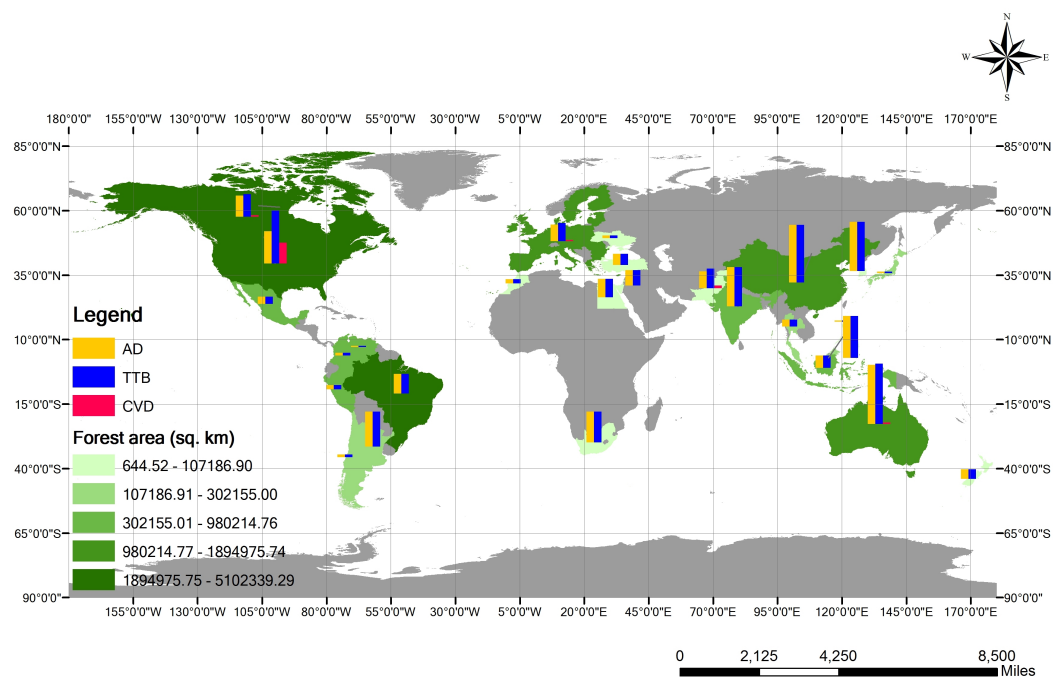


Figure 1. Distribution of temporary trade barriers for global countries from 1995 to 2015. Note: number of TTBs came from the temporary trade barriers database [13]. The forest areas were collected from the world bank indicator [34].

2. Methodology

2.1. Empirical Models

Among all global countries, 28 economies have used TTBs to protect their domestic industries from 1995 to 2015 [13]. Those countries are termed as petition countries, which denote the country who imposes TTBs against others in this study. In particular, Australia has been the largest petition country, imposing 43 TTBs in total, and the US is the second-largest petition country with 38 cases, while Japan, the Philippines, and Venezuela have used only one [13]. Figure 1 shows the relationship between the number of TTBs and the forest area for petition countries. The distribution of the employment of TTBs is not equal or normalized as not every country has adopted TTBs. Thus, the relationship between the number of TTBs and the forest resource of a country will be investigated. Specifically, this type of non-categorical discrete data of global TTBs is termed as count data, which will include many zeros as only a small part of global countries have applied TTBs to protect the forest products industry. As the density of the TTBs sample is not a normal density because the population has been truncated and the sample selection bias can be induced by a departure from random sampling, a two-step sample selection model with count data is developed from the perspective of global countries to analyze determinants of countries' decision to impose TTBs in the first stage and those countries' frequency to use TTBs in the second stage. As the number of TTBs cases by developing countries has increased dramatically in recent decades [10], an estimation specifically addressing developing countries will also be conducted.

Two kinds of simulation were investigated: the scenario of global and developing countries by a two-step sample selection model, and the scenario of paper and non-paper products by a probit model. For the scenario of global and developing countries, the study was conducted based on two stages: the first stage estimated the determinants of decisions to implement TTBs for petition countries; the second stage analyzed factors that influenced those countries' frequency of using TTBs to protect domestic industries. From the perspective of forest products, the factors that influenced the use of TTBs on both paper and non-paper products were analyzed separately. As only 28 economies have

used TTBs in the period of 1995–2015, it is impossible to conduct the two-stage analysis if data are classified into paper and non-paper products for the small independent variables in the frequency stage of the model. Under this circumstance, a probit regression was used to estimate the main factors that influence a country's decision to impose TTBs on different forest products.

A two-step sample selection model involves a behavioral specification of the count model that has many applications in different research fields [35–38]. In this study, we assumed the employment of TTBs in a country was contingent upon if a country decided to impose TTBs. In the scenario of global and developing countries, the major determinants that influenced a country's decision to employ TTBs were initially evaluated by a selection equation, since there existed large differences between the case numbers for each country. The frequencies of those countries were then estimated using an outcome equation. In the first stage of the probit estimation, the explanatory variables were selected, such as the forest coverage rate, forest area, employment in agriculture, import, or export. The dependent variable (w_i) would have a value of 1 when a country initiated TTBs or a value of 0 when no TTBs were conducted. In the second stage, the number of TTBs was specified as a function of the related or the same set of explanatory variables only when the dependent variable had a value of one in the first stage. The dependent variable (the number for the use of TTBs) in this stage would take finite integer values (x_i) and be randomly distributed over time. The corresponding equations are expressed as follows:

Participation/Selection stage:

$$z_i = g(w_i) \quad (1)$$

Intensity/Outcome stage:

$$y_i = f(x_i) \quad (2)$$

where z_i is a binary variable that indicates whether country i decides to impose TTBs against other countries; and y_i denotes the number of TTBs that countries imposed against others. y_i is observed only when $z_i = 1$. Besides, z_i equals 1 only when the country i makes at least one implementation of TTBs against other countries (0 otherwise).

2.2. Estimation Techniques

Since a behavioral specification of the count model generally involves a participation equation and an intensity equation [35], we examined which factors were associated with a country's forest trade volume and forest area, and conditional on them, which factors could affect the model's frequency. According to Figure 1, some countries employed a large number of TTBs against others, while others may impose fewer TTBs or even zero. The participation decision to impose TTBs against others (z_i) and the frequency of employing TTBs (y_i) could be related but affected by different independent variables or by the same set of explanatory variables to a different degree stage [10,37,39–41]. Thus, the set of independent variables in the selection stage (w_i) could be different from the outcome stage (x_i). In general, a probit estimation will be applied in the participation stage of the two-step sample selection model, in which the dependent variable will have a value of one only when a country files at least one case. The corresponding equations are expressed as follows:

$$z_i^* = \gamma' w_i + e_i \quad (3)$$

$$\Pr(z_i = 1) = \Phi(\gamma' w_i) \quad (4)$$

$$\Pr(z_i = 0) = 1 - \Phi(\gamma' w_i) \quad (5)$$

where γ' is the set of parameters to be evaluated. $\Phi(\cdot)$ is the cumulative normal distribution function for the selection equation. In the selection stage, z_i is a realization of an unobserved continuous variable (z_i^*) with a normally distributed error (e_i). $z_i^* = 1$ if $z_i^* > 0$, and 0 otherwise.

In the outcome stage, the dependent variable takes finite integer values and is randomly distributed over time. Since the model would not be identified if both equations are linear because of the nonzero correlation between the error terms, some insignificant variables from preliminary analyses are excluded from the equations to ensure model identification and improve the convergence by applying a two-step sample selection model. The Poisson regression model is the most common form of estimation method adopted to assess the count data models [35]. In particular, the intensity model with Poisson distribution can be expressed as follows:

$$y_i = \beta' x_i + \varepsilon_i \quad (6)$$

$$\Pr(Y = y_i | x_i) = \frac{\exp(-\lambda_i) \lambda_i^{y_i}}{y_i!}, y_i = 0, 1, \dots; \quad (7)$$

where β' , ε_i , and λ_i are the set of parameters to be estimated, error term, and the Poisson distribution parameter in the outcome stage, respectively. y_i is observed only when $z_i = 1$. The two error terms are correlated, which can be expressed as $(\varepsilon_i, \varepsilon_i) = \text{NID}(0, 0, 1, \sigma_e^2, \sigma_\varepsilon^2, \rho)$, where σ_e^2 and σ_ε^2 separately denote variance of the two error terms; ρ represents the correlation coefficient between the two error terms. Without correction of the sample selection bias, the estimates in the outcome equation would not be accurate. Thus, the value of ρ can prove that the two stages of the participation decision and application frequency are positively correlated and supported the employment of the two-stage sample selection model to estimate them simultaneously.

For the Poisson regression, there exists the equidispersion, where its conditional mean would equal to its conditional variance ($E(y_i | x_i) = \text{Var}(y_i | x_i)$). However, there also exists over-dispersion, in which the conditional variance could be greater than the conditional mean in many cases ($E(y_i | x_i) > \text{Var}(y_i | x_i)$). Under this circumstance, the Poisson distribution would not be efficient anymore. To deal with that, the negative binomial regression model would be created. The variance of the dependent variable will then be different from its mean by using $\tilde{\lambda}_i$ to replace the previous λ_i [37,38]. The corresponding equations are expressed as follows:

$$\log \lambda_i = \beta' x_i \quad (8)$$

$$E(y_i | x_i) = \text{Var}(y_i | x_i) = \lambda_i \quad (9)$$

$$\frac{\partial E(y_i | x_i)}{\partial x_i} = \lambda_i \beta \quad (10)$$

$$\tilde{\lambda}_i = \exp(\beta' x_i + \mu_i) = \lambda_i \delta_i \quad (11)$$

$$\delta_i = \exp(\mu_i) \quad (12)$$

$$\Pr(y_i | x_i) = \frac{\Gamma(\theta + y_i)}{\Gamma(1 + y_i) \Gamma(\theta)} \gamma_i^{y_i} (1 - \gamma_i)^\theta \quad (13)$$

$$\gamma_i = \frac{\mu_i}{\mu_i + \theta} \quad (14)$$

$$\text{Var}(y_i | x_i) = \lambda_i [1 + (\frac{1}{\theta}) \lambda_i] = \lambda_i + \alpha \lambda_i^2, \text{ where } \alpha = \frac{1}{\theta} \quad (15)$$

where δ_i has a gamma distribution $\Gamma(\theta)$. The negative binomial regression model can regenerate the probability of the dependent variable $\Pr(y_i | x_i)$ through combining the Poisson distribution and the gamma distribution together [35]. The conditional variance can be larger than the conditional mean. α is the dispersion parameter. If $\alpha = 0$, the hypotheses $H_0: \text{Var}(y_i) = E(y_i | x_i)$ cannot be rejected. In that case, the conditional variance equals to the conditional mean and there is no over-dispersion. When $\alpha \neq 0$, the hypotheses $H_0: \text{Var}(y_i) = E(y_i | x_i)$ is rejected, and then the negative binomial regression model should be applied.

2.3. Data and Variables

Table 1 lists the definition and expected signs for variables in this study. According to the TTBD, over 8000 cases of TTBs (7121 AD cases and 923 CV duties) were observed over the period of 1995–2015 all over the world [13]. Although the database covers cases back to 1980, the year of 1995 was selected as the beginning year due to the limitation on collecting covariates in the 1980s. The end year reflects that the database has only been updated up to 2015 so far. However, this large trade barrier database is not distributed by different sectors. To identify trade cases specifically related to the forest sector from thousands of global cases, we tidied the data by two steps: keyword searches and code searches. On the one hand, we searched the data according to Harmonized Tariff Schedule (HTS) codes related to forest products, such as HTS 44 (roundwood and lumber), 45 (cork), 46 (straw), 47 (pulp), 48 (paper), 49 (printed books), and 94 (furniture). On the other hand, keywords related to the forest sector were used to search cases related to forest products, i.e., timber, wood, lumber, paper, pulp, furniture, newsprint, pellet, forest, tree, bamboo, and floor. Then, we manually removed cases irrelevant to the forest sector after a sum of 560 cases were collected based on the above methods. Finally, 392 cases of TTBs in the forest products industry (372 AD and 20 CV duties) involved in 28 economies were selected. Among them, 22 belonged to the group of developing countries. To improve the accuracy of model simulation, 87 countries were examined in this study after removing some small countries whose data was unavailable or hard to collect. Dependent variables were grouped into four groups of two scenarios: the scenario of global and developing countries, and the scenario of paper and non-paper products. Since the scenario of the developed countries was not estimated for only six developed countries employing TTBs in the forest sector, the scenario of global countries includes both developed and developing countries.

Table 1. Definitions and expected signs for dependent and independent variables.

Variable	Description	Expected Value
Dependent variables		
Z	Dummy = 1 if imposed trade barriers; 0 otherwise	-
Y	Number of trade barriers that countries implement	-
Independent variables		
<i>ForestArea</i>	Forest area (thousand sq. km)	>0
<i>ForestCov</i>	Percentage of forest area in total land area (%)	>0
<i>Employment</i>	Employment in agriculture (% of total employment)	>0
<i>Export</i>	Exports of goods and services (% of GDP)	>0
<i>Import</i>	Imports of goods and services (% of GDP)	<0
<i>Tariff</i>	Tariff rate, most favored nation, manufactured products (%)	0
<i>FDI</i>	Foreign direct investment, net inflows (% of GDP)	<0
<i>GdpCur</i>	GDP per capita (thousand US dollar)	>0
<i>Expend</i>	Expenditure on tertiary education	>0
<i>Inflation</i>	Inflation, consumer prices (annual %)	<0
<i>Income</i>	Income share held by highest 20%	<0

Note: data of dependent variables were collected from the temporary trade barriers database [13]. Data of independent variables were obtained from the World Bank Indicator at <https://data.worldbank.org/indicator>.

To conduct a comprehensive determinants analysis, the independent variables were collected from three categories: geographical environment (forest area, forest coverage rate, and employment in agriculture); trade size (export and import value of goods, average tariff rate, and foreign direct investment (FDI)); and economic capability (GDP per capita, expenditure on tertiary education, inflation, and the income share). The independent variables were collected from the World Bank Indicator. As some data sources list Taiwan as a separate economy and some include Taiwan under the classification of China, to accurately collect the data and make it consistent, the data of Taiwan came from the website of the National Statistics of the Republic of China (Taiwan) at <https://eng.stat.gov.tw/mp.asp?mp=5>. The expected signs for those independent variables are listed

in Table 1. From the perspective of the geographical environment, we assume that once the variable within this category increases (no matter for the forest area, forest coverage rate, and employment in agriculture), the use of TTBs of a country will also increase as it has a large production of forest products to satisfy the domestic demand. The employment in agriculture is defined as people of working age who produce goods or provide services for pay or profit, being engaged in activities of agriculture, hunting, forestry and fishing [34]. As the sector of agriculture includes the forest sector, the employment in agriculture was selected to reflect the employment in the forest sector due to the data constraint. Thus, an increase in the employment in agriculture will reflect a rise in the domestic production of forest products, which contributes to the use of TTBs.

From the perspective of trade size, if a country's export increases, the use of TTBs will increase to control the foreign imports. The same rule applies to the expected value of import. The variable of tariff refers to the average of most favored nation rates for all products subject to tariffs calculated for all traded goods [34], which shows a country's protection level on traded products. When a country has a large average tariff rate, more cases of TTBs may be observed. Foreign direct investment (FDI) means the direct investment equity flows in the reporting country. FDI is the sum of equity capital, reinvestment of earnings, and other capital, indicating the relationship with the reporting country [34]. Therefore, high FDI may bring a negative impact on the use of TTBs, as the country may have outsourced its production to others or have other kinds of cooperation with others. From the perspective of economic capability, a positive impact on the use of TTBs is assumed for the GDP per capita and expenditure on tertiary education. To some extent, the large GDP per capita and expenditure on tertiary education of a country can reflect a high concentration on its environmental sectors, including the forest products industry. In addition, inflation reveals the annual percentage change in the cost to the average consumer of achieving a set of goods and services that may be fixed at a specified interval [34], while the income share by the highest 20% reflects the distribution of a country's economy. Thus, a negative impact on the use of TTBs on these two factors is assumed.

3. Results

3.1. Summary Statistics and Model Selection

Table 2 lists the summary statistics for the dependent and independent variables. In this study, the sample size for the selection stage and outcome stage of the group of global economies was 86 and 28, respectively. Among all of the first stage economies, 31.40% applied the TTBs. Their application frequency changed from 1 to 52, with a mean value of 14.52. For the group of developing countries, the sample size of the outcome stage was 21 and the participation rate was 24.42%. α is the parameter to estimate the over-dispersion for the negative binomial model, which was 0.20 and significant at the 1% level in the group of global countries. This revealed that the negative binomial model was appropriate for the outcome stage in the simulation. In addition, parameter ρ was also significant, indicating that the two stages of the participation decision and application frequency were positively correlated and that the two-stage sample selection model was appropriately employed in this study. The same results were found for the group of developing countries. Thus, the results from our model justified the rationality of applying the two-stage sample selection model.

3.2. Determinants of Global and Developing Countries Scenario

Results estimated by the two-step sample selection model for the global and developing countries are listed in Table 3. In the first stage of the binary probit model for global countries, the import and employment in agriculture were statistically significant at the 5% significance level. The estimate of the import was negative, implying the possibility that a country's decisions to use TTBs would decrease as the value of imports in the forest sector increased. The estimates of the marginal effect for the import was -0.332 , indicating 0.332 unites of the possibility that a country employing TTBs decreased as one unit of the import increased. By contrast, agricultural employment influenced a

country's decision to employ TTBs, with a positive impact on an estimate being 0.046 and a marginal effect at 0.217. Thus, if the agricultural employment increased by one unit, the country's possibility to use TTBs would increase by 0.217 units.

Table 2. Summary statistics of dependent and independent variables.

Variable	Minimum	Mean	Maximum	SD
Dependent variables				
Z	0	0.31	1	-
Y	1	14.52	52	13.42
Independent variables				
<i>ForestArea</i>	0.00	369.48	7744.59	1095.98
<i>ForestCov</i>	0.01	29.21	84.39	21.30
<i>Employment</i>	0.09	12.01	56.74	11.67
<i>Export</i>	3.27	34.85	97.18	17.14
<i>Import</i>	4.87	38.94	82.65	16.78
<i>Tariff</i>	0.57	6.10	15.51	3.44
<i>FDI</i>	0.19	3.61	17.50	2.87
<i>GdpCur</i>	0.28	9.11	65.70	13.43
<i>Expend</i>	0	15.06	35.80	10.58
<i>Inflation</i>	0.11	22.52	1225.33	131.65
<i>Income</i>	0	14.92	51.45	15.38

Note: in this study, the period of 1995–2015 is covered. The number in the table is the average value within this period. SD denotes standard deviation and SD for the dummy variable was not applicable.

Table 3. Results of the global and developing countries scenario.

All Variables	Global Countries			Developing Countries		
	Coef.	t Value	ME	Coef.	t Value	ME
Selection step						
<i>Constant</i>	0.021	0.039		−0.015	−0.023	
<i>ForestArea</i>	0.001	1.058	0.000	−0.000	−0.031	−0.000
<i>Import</i>	−0.071 **	−2.104	−0.332 **	−0.085 **	−2.180	−0.396 **
<i>Export</i>	0.037	1.498	0.172	0.054 **	1.962	0.251 **
<i>GdpCur</i>	0.016	1.333	0.073	−0.014	−0.598	−0.191
<i>Employment</i>	0.046 **	2.300	0.217 **	0.050 **	2.163	0.232 **
Outcome step						
<i>Constant</i>	1.513	1.185		2.267	1.016	
<i>ForestCov</i>	−0.018 ***	−2.833	−0.137 ***	−0.018 *	−1.836	−0.104 *
<i>Inflation</i>	−0.040 ***	−3.444	−0.296 ***	−0.045 ***	−3.343	−0.258 ***
<i>Import</i>	−0.082 *	−1.723	−0.613 *	−0.113	−1.556	−0.655
<i>Export</i>	0.079 *	1.894	0.594 *	0.103	1.569	0.593
<i>Industry</i>	0.031	1.107	0.232	0.021	0.419	0.119
<i>GdpCur</i>	0.040 **	2.245	0.298 **	0.034	0.590	0.191
<i>Tariff</i>	0.068	1.405	0.512	0.051	0.907	0.293
Model statistics						
<i>LogL</i>	−138.691			−107.105		
α	0.200 **			0.200 **		
ρ	0.112 *			0.087 *		
R^2	0.869			0.857		

Note: LogL means the log-likelihood value. ME is the marginal effect. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

In the second stage of the two-step sample selection model, the forest coverage rate, inflation, import, export, and GDP per capita were statistically significant. In particular, the forest coverage was negative and significant at the 1% level, indicating that a country's one unit expansion on forest coverage rate would cause a decline by 0.137 units of TTBs employment against others in the forest sector. Inflation was another variable that discourages the frequency of TTBs, with a negative significant

estimate at the 1% level. In addition, the marginal effect of import was -0.613 and significant at the 10% level, reflecting that countries would reduce the use of TTBs by 0.613 units if they increased one unit on import. However, the export and GDP per capita had a positive impact on countries' use of TTBs, with significance levels at 10% and 1%, respectively. In particular, countries would increase by 0.594 units of employment of TTBs to protect the domestic forest industry if they increased by one unit on export.

For developing countries, the import, export, and employment in agriculture were statistically significant at the selection stage, and the forest coverage rate and inflation were statistically significant at the intensity stage. In the selection stage of the model, the import was negative and significant at the 5% level with the marginal effect being -0.396 , revealing that one unit expansion in the import of a country would decrease its possibility to use TTBs by 0.396 units. However, the export and employment in agriculture had a positive impact on a country's imposition of TTBs. Both estimates were at the 5% significance level with marginal effects of 0.251 and 0.232, respectively. In the intensity stage of the model, results show the forest coverage rate had a negative impact on countries' intensities of TTBs, with a negative estimate at the 10% significant level. Specifically, the use of TTBs would reduce by 0.104 units if a country expanded by one unit forest coverage rate. Furthermore, the inflation was negative and significant at the 1% significant level, indicating that one unit improvement on the inflation rate would discourage 0.258 units on the country's use of TTBs.

3.3. Determinants of the Paper and Non-Paper Products Scenario

The determinants of TTBs for the scenario of paper and non-paper products were evaluated using a probit regression and are listed in Table 4. For this scenario, 244 cases (62.24%) of TTBs are based on paper products and 148 cases (37.76%) on non-paper products. For the paper products sector, the forest area, import, export, GDP per capita, tariff, expenditure on education, and employment in agriculture were statistically significant on the employment of TTBs. From the perspective of trade size, the import and export were respectively negative and positive at the 5% significance level simultaneously, revealing that countries would decrease by 0.017 units and increase by 0.012 units the use of TTBs if they expanded by one unit on import and export, respectively. From the perspective of economic capability, the GDP per capita, average tariff rate, and expenditure on education had a positive impact on the use of TTBs. In particular, estimates of GDP per capita and tariff were positive and significant and both of them were at the 10% level. The tariff had the largest marginal effect, which would bring the 0.025 units expansion on the use of TTBs if a country increased by one unit on its tariff rate. The estimate of expenditure on education was also positive and significant at the 1% level, reflecting that a country would expand by 0.011 units of TTBs employment with one unit increase of the education expenditure. From the perspective of the geographical environment, the forest area and employment in agriculture were positive and significant at the 5% and 1% significance levels, respectively. A country's use of TTBs on paper products would increase by 0.016 units if it had one unit improvement on the employment in agriculture. For non-paper products, only the forest area and agricultural employment significantly influenced the number of TTBs within the forest sector. On the one hand, the forest area was positive and significant at the 10% level, which indicates that a country would impose more TTBs on non-paper products if it has a large forest area. On the other hand, employment in agriculture was positive and significant at the 5% level, revealing that 0.007 units of TTBs may be increased if countries had one unit expansion in agricultural employment.

Table 4. Results of the paper and non-paper scenario.

All Variables	Paper Products			Non-Paper Products		
	Coef.	z Value	ME	Coef.	z Value	ME
<i>Constant</i>	−2.312 **	−1.988		−1.155	−1.059	
<i>ForestArea</i>	0.000 **	1.946	0.000 **	0.001 *	1.887	0.000 **
<i>Inflation</i>	−0.001	−0.204	−0.000	−0.000	−0.023	−0.000
<i>Import</i>	−0.092 **	−2.322	−0.017 ***	−0.033	−1.056	−0.006
<i>Export</i>	0.068 **	2.125	0.012 **	0.012	0.446	0.002
<i>GdpCur</i>	0.030 *	1.753	0.005 *	0.013	0.651	0.002
<i>Tariff</i>	0.138 *	1.822	0.025 **	−0.003	−0.042	−0.000
<i>Expend</i>	0.059 ***	2.544	0.011 ***	0.026	1.194	0.005
<i>Income</i>	−0.016	−0.974	−0.003	−0.000	−0.006	−0.000
<i>FDI</i>	−0.156	−1.287	−0.028	−0.068	−0.690	−0.012
<i>Employment</i>	0.089 ***	3.316	0.016 ***	0.040 **	1.924	0.007 **
<i>R²</i>	0.432			0.371		

Note: ME is the marginal effect. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

4. Discussion and Conclusions

The emergence of TTBs as the new form of protectionism is one of the most remarkable changes in the international trade system during the past decades [5–9,42]. The trend of employing TTBs as effective remedy actions against imports has become exceedingly popular [43,44]. This study analyzed the determinants of TTBs from two levels. The first level was to examine how factors would influence the use of TTBs in the global and developing countries scenario. The second level was to investigate the main factors that had an impact on the employment of TTBs in the paper and non-paper products scenario. Methods included two empirical models: the two-step sample selection model to assess determinants of TTBs for the global and developing countries scenario; and the probit regression for the paper and non-paper products scenario.

Research findings in this study were generally in line with our expectations. For instance, a country's import, export, and employment in agriculture indeed have impacts on its use of TTBs as expected. However, the forest area and forest coverage rate have opposite signs on the use of TTBs, which was not consistent with our expectations. Results showed that forest area had a positive impact on a country's use of TTBs, whereas forest coverage rate would discourage the employment of trade barriers. On the one hand, a large forest area of a country can reflect a high production ability on the forest products to some extent, which satisfy its domestic demand and encourage the use of TTBs to protect the domestic industry. On the other hand, rather than the production ability that forest area reflects, the forest coverage rate can show the ratio of forest products industry as a whole compared with other industries within the country. To maintain a relationship with other countries, a country with a high forest coverage rate may use fewer TTBs on forest products. Thus, the distribution of forest resources indeed has an impact on countries' decisions to use trade policies, especially on the forest products industry.

Several factors related to participation and frequencies of using TTBs have potential implications for policymakers. First, the results of determinants on the use of TTBs differed between the global and developing countries. Export had a positive impact on a country's decision to implement TTBs for the group of developing countries, while it was not significant for the group of global countries in the participation stage. Results suggest that the employment of TTBs will spread among developing countries for the greater liberalization pressure as they would like to improve the ability to use TTBs to counter the trade barriers imposed against them [5]. From 1995 to 2015, a total of 392 cases relevant to 28 economies in the forest products industry were identified. Among them, over 78% belonged to developing countries. However, the largest trade barriers employment country is the developed country of Australia with 43 TTBs cases, and the second-largest petition country is the developed country of the US with 38 cases. Although countries with higher imports may outsource much of

their production to foreign countries or need to keep a good connection with them [5,45], retaliation still exists and easily continues among these countries, causing a chain effect on the use of TTBs. Thus, developing countries with large exports would impose TTBs on countries who previously employed trade barriers on them as retaliation, which may ruin the trade gains that liberalization brings rather than the original goal of using TTBs to protect the domestic forest sector.

Second, results showed that countries with large employment in agriculture and GDP per capita would impose more TTBs to protect the domestic forest products industry. As we know, cases of TTBs such as AD and CV are initiated by domestic firms on specific foreign firms. These trade measures are cost-effectively initiated and can be extended without time limitation once approved [5,45]. Under this circumstance, TTBs may be easily misused by those counties with high ability in the production of forest products, such as high employment in agriculture and GDP per capita. Thus, it may cause domestic firms to pay more attention to prove unfair trade actions of foreign exporters rather than improving their efficiencies.

In addition, the patterns of TTBs between paper and non-paper products differed vastly. All significant variables for paper products were covered by three categories of the trade size, economic capability, and geographical environment. However, for non-paper products, only two factors of the forest area and employment in agriculture had impacts on the use of TTBs. From 1995–2015, over 62% of cases of TTBs were based on paper products in the forest products industry. Compared with non-paper products, paper production has a large demand for technology and financial support as well as a high cost of mitigating environmental pollution; while the production of non-paper products such as wooden furniture requires a high input share of raw logs and depends much more on the forest resources than on economic conditions [18]. According to the financial data in the forest sector, the value of most paper firms is larger than those of non-paper firms. For the data limitation, we use an example from the US stock market. Table 5 shows the value of major financial data for selected public paper firms and wooden furniture firms, in which the values of assets and profit in the US paper firms are more than a hundred times than of those of furniture firms. Thus, countries prefer to impose more TTBs on paper products than on non-paper products for economic effectiveness.

Table 5. Comparison of the US selected public paper and wooden furniture firms in 2018 (\$ million).

Firms	Asset	Equity	Revenue	Gross Profit
<i>Paper</i>				
IP	33,576.0	7362.0	23,306.0	7748.0
MHK	13,099.1	7433.8	9983.6	2885.1
GLT	1339.8	538.9	866.3	130.4
<i>Non-paper</i>				
ETH	530.4	383.7	766.8	416.0
HOFT	350.1	229.5	620.6	134.8
BSET	291.6	190.3	456.9	277.3

Note: IP, MHK, and GLT mean the International Paper Co, Mohawk Industries Inc, and P H Glatfelter Co, respectively. ETH, HOFT, and BSET denote the Ethan Allen Interiors Inc, Bassett Furniture Industries Inc, and Hooker Furniture Corp, respectively. Data were collected from <http://www.msn.com/en-ca/money/stockdetails/>.

In conclusion, the present study first analyzed the participation and frequency of using TTBs in the forest products industry. Research findings have brought policy implications for governments or some policymakers when considering TTBs as a protectionist measure. It provides several insights about patterns that influence trade barriers participation and demand, especially in this competitive global market. However, there are some limitations to this study. First, since the number of countries who employed TTBs in the forest sector is not large enough and cases of TTBs are not evenly distributed by time, a time series analysis has not been conducted in this study. In addition, the scenario of the developed countries is not analyzed due to the data limitation, as only six developed countries employed TTBs in the forest sector. In the future, as it is expected that targeted tariff measures will be

used more frequently, we are going to conduct the research on developed countries and a time series analysis after observing more cases of TTBs.

Author Contributions: X.Z.: conceptualization, methodology, data collection, programming, draft preparation, and revision. C.S.: conceptualization, methodology, programming, and draft preparation. J.G.: conceptualization and draft preparation. I.A.M.: conceptualization and draft preparation. All authors have read and agreed to the published version of the manuscript.

Funding: Partial financial supports for this study were provided by the U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station under agreement 15-JV-11261975-024 and Southern Research Station under agreement 16-JV-11330127-080.

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

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