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Keywords: RTA; Rules of origin; Discrete choice models; Firm heterogeneity
JEL classification: F15; F53

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Tariff Schemes Choice

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Abstract

This study examines the determinants of the probability that exporters choose between a most-favored nation (MFN) scheme and multiple regional trade agreement (RTA) schemes. It estimates a nested logit model using a transaction-level import data for Thailand from other ASEAN countries in 2014. The study finds that RTA schemes are more likely to be chosen rather than the MFN scheme in case of a larger transaction value. Among RTA schemes, the one with less restrictive rules of origin or lower RTA tariff rates is more likely to be chosen. In addition to some results of simulation analyses, this study provides some quantitative interpretation of our estimation results.

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1. Introduction

During the 2010s, regional trade agreements (RTAs) were negotiated among a large number of countries worldwide in pursuit of the benefits of trade liberalization. RTAs with a large number of member countries are called "mega" RTAs. Recent examples of mega RTAs include the Trans-Pacific Partnership (TPP), Transatlantic Trade and Investment Partnership, and Regional Comprehensive Economic Partnership (RCEP). RTA networks in each country pair will likely overlap with the emergence of mega RTAs. For example, Mexico has entered into the North American Free Trade Agreement (NAFTA) with Canada and the U.S., which overlaps with the TPP. Therefore, firms in Mexico have to choose between a most-favored nation (MFN) scheme and multiple RTA schemes (NAFTA and TPP) when they export to Canada. As this example indicates, firms have more opportunities to select from multiple tariff schemes with the emergence of more mega RTAs.

However, firms find it difficult to choose a tariff scheme when multiple tariff schemes are available.[1] Firms are required to meet the so-called rules of origin (RoOs) and obtain certificates of origin (CoOs) when they use RTA tariff schemes. To certify the origin of goods, exporters need to collect the required documents, such as a list of inputs, a production flowchart, production instructions, invoices for each input, and contract documents. This process

[1] Some gravity studies have investigated the "overlapping" effects of RTAs. For example, Egger and Larch (2008) and Chen and Joshi (2010) investigated how an existing RTA affects the probability of forming another RTA (i.e., domino effects). Lee et al. (2008), Hur et al. (2010), and Sorgho (2016) examined the trade creation effects of RTAs when RTAs are overlapped. However, our concept of "overlapping" differs from that in these gravity studies. Suppose that Countries A and B formed a bilateral RTA. The above gravity studies consider "overlapping" of RTAs in Country A as the conclusion of a new bilateral RTA between Countries A and C. Our concept of "overlapping" is represented by the case where Countries A and B become members of another new RTAs. A firm in Country A faces a choice between old and new RTAs for particular transactions when exporting to Country B in our case. However, this choice does not become a matter in the former case because a firm in Country A faces only one RTA for exports to Country B even after "overlapping" (of their concept) occurs. Thus, our concept is entirely different from theirs. While we examine such an overlapping situation in Asia, it may be also serious in Africa. See, for example, Tavares and Tang (2011) and Yang and Gupta (2007).

arises as fixed costs for RTA utilization for exporters. When exporters simply choose between an MFN scheme and an RTA scheme, they examine whether the benefit from the use of RTA tariff rates, which are generally lower than that from the use of MFN rates, exceeds the fixed costs for RTA utilization. In case of multiple RTA schemes, exporters consider differences among RTA tariff schemes. These differences mainly stem from tariff rates and RoOs. Therefore, exporters must compare tariff rates and RoOs across RTA schemes to choose the best one. Furthermore, a change in tariff rates in one RTA influences the choice of own and other RTA schemes. As the number of overlapped RTAs increases, such interaction effects are more likely to be present.

The major contribution of this study is that it proposes an empirical framework to investigate firms' choice of tariff scheme when multiple RTA schemes are available. Accordingly, it uses the data of Thai imports from other ASEAN countries in 2014. There are two main reasons to use this data.[2] First, the data enables us to identify tariff schemes (e.g., MFN or RTAs) used in each transaction. We obtained the data, which covers all commodity imports, from the Customs Office of the Kingdom of Thailand. Product coverage is important for our study because we need sufficient variation in the tariff rates and RoOs across products.[3] Second, at least seven tariff schemes were available for Thai imports from ASEAN countries in 2014: an MFN scheme, ASEAN Trade in Goods Agreement (ATIGA), ASEAN–Australia–New Zealand Free Trade Agreement (AANZFTA), ASEAN–China FTA (ACFTA), ASEAN–India FTA (AIFTA), ASEAN–Japan Comprehensive Economic Partnership (AJCEP), and ASEAN–Korea FTA (AKFTA). By examining this trade flow in 2014, we can investigate how firms choose tariff schemes when multiple tariff schemes are available.

In particular, this study provides a framework to examine tariff scheme

[2] According to the World Development Indicators, Thailand ranks 29th in terms of GDP in the world as of 2014, with a GDP per capita of US$6,000.

[3] Although several recent papers have employed transaction-level trade data, few studies have employed data with the information of the tariff scheme chosen in each transaction. One of the examples is the study by Cherkashin et al. (2015). However, the dataset in this study covered only the apparel industry, whereas our dataset covers all sectors.

choice at a transaction level. Specifically, our framework is the nested logit model, which can be applied to the case of multiple tariff schemes. Our nested logit model comprises two stages. The upper stage includes two nests and describes the choice between MFN and RTA schemes. The fixed costs for RTA utilization play a key role in this stage. The existence of such costs separates an MFN scheme from RTA schemes and helps examine the exporter's two-step decision regarding tariff scheme choice using the nested logit model. Demidova and Krishna (2008) and Cherkashin et al. (2015) demonstrated that RTA schemes are likely to be chosen in the case of large transactions because the absolutely larger benefits from RTA utilization are more likely to cover the additional fixed costs for RTA utilization.[4] The lower-stage decision is with regard to a specific tariff scheme. RTA schemes differ mainly in terms of preferential tariff rates and the restrictiveness of RoOs.[5] Therefore, given that firms choose to utilize RTA schemes at the first stage, they choose an RTA scheme that yields the highest profit at the second stage while considering preferential tariff rates and RoOs employed in the available RTA schemes. Consequently, the RTA scheme with lower preferential tariff rates or less restrictive RoOs will more likely be chosen.

With our estimation results of the nested logit model, this study conducts various quantitative analyses. First, it examines how changes in tariff rates influence choice probabilities of own and other tariff schemes. Specifically, this study computes the elasticities of the probability of choosing each scheme in terms of tariff rates. Thereafter, it quantitatively demonstrates how differently the tariff reduction in one RTA influences the choices of own and other RTAs and an MFN scheme. These analyses uncover the detailed interaction effects of tariff rates on the choice probability of each tariff scheme. Second, this

[4] Although many studies have used trade values to examine this "size" effect on preference utilization, our measure of trade values, i.e., transaction values, is the most detailed. Examples of the measures used in previous studies include annual trade values (e.g., Hakobyan, 2015) or the customs district-level monthly average of trade values (e.g., Keck and Lendle, 2012). Some studies have investigated the role of firm size in terms of the number of employees (Takahashi and Urata, 2010; Hayakawa, 2014b).

[5] We will show the more detailed difference in Section 3.1.

study presents elasticity with respect to transaction values according to export countries. This elasticity might provide insight into the difference in the magnitude of fixed costs for RTA utilization across countries because larger transaction values lead to larger benefits to cover those fixed costs; thus, elasticity is expected to be higher if those fixed costs are smaller.[6] Third, this study indicates the extent to which scheduled tariff reduction influences the choice probability of each tariff scheme. Furthermore, it investigates how this choice probability changes if RoOs in all RTAs are set to the least restrictive type. These simulation analyses will help examine each RTA's utilization in the final year and the impacts of revising RoOs to a business-friendly type on RTA utilization.

This study is related to at least two bodies of literature. The first type focuses on the determinants of the use of preference schemes. Typical studies in this literature explore cases where a single preference scheme is available in addition to an MFN scheme (e.g., Cadot et al., 2006; Cadot and de Melo, 2007; Francois et al., 2006; Manchin, 2006; Hakobyan, 2015). Few studies have been conducted from a similar perspective, with two preferential schemes and an MFN scheme (e.g., Bureau et al., 2007; Hayakawa, 2014a; Hayakawa et al., 2017). This study extends the empirical framework to analyze choice among multiple tariff schemes by applying transaction-level data to the nested logit model. Furthermore, in terms of identification, our estimates of tariff rates and RoOs will be better than those in the previous studies because our analysis

[6]There are two kinds of studies that estimate the costs of preference scheme utilization. One is to estimate the tariff-equivalent costs (Francois et al., 2006; Hayakawa, 2011). Cadot and de Melo (2007) surveyed this literature, concluding that such fixed costs range between 3% and 5% of the product price. The other is to estimate the absolute values of preference utilization costs (Ulloa and Wagner-Brizzi, 2013; Cherkashin et al., 2015; Hayakawa et al., 2016). For example, by employing firm-level data from the generalized system of preferences utilization for exporting apparel products to Europe from Bangladesh, Cherkashin et al. (2015) structurally estimated the costs (called documentation costs of RoO compliance), which were US$4,240. Our method is different from the methods used in these two kinds of studies because we relate fixed costs for RTA utilization with the elasticity of the probability of choosing RTA schemes with respect to transaction values. In this sense, our approach is similar to that in Chen and Moore (2010). Our study complements the studies in this literature.

is a cross-RTA analysis within a product rather than a cross-product analysis within an RTA scheme. The other literature involves a discrete choice analysis of firms' international business activities. Estimating discrete choice models, this literature has explored various topics such as firms' location choice among domestic and overseas locations (Mayer et al., 2010), the ranking of firms' productivity according to types of FDI entry such as joint venture (Raff et al., 2012), and firms' choice of invoice currency in international trade (Chung, 2016). Unlike these studies, this study investigates the choice of tariff scheme by estimating the nested logit models.

The rest of this paper is organized as follows. Section 2 specifies the nested logit model for empirical analyses. Section 3 explains the data sources and presents a brief overview of RTAs in Thailand. Section 4 presents the estimation results. Section 5 provides some quantitative interpretation of our estimation results. Section 6 concludes the study.

2. Empirical Framework

This section specifies our empirical model. This study derives a nested logit model based on an exporter's choice of tariff schemes.[7] It considers the case wherein multiple RTA schemes are available in addition to an MFN scheme. Each exporter has a firm-specific parameter that positively depends on elements such as productivity or production capability. When a firm exports a product to a country, the exporter's decision is decomposed into two steps. First, a firm decides whether to use an MFN (M) scheme or an RTA scheme ($R(r), r = 1, \cdots, N^R$) by comparing the export profit under the MFN scheme with the largest export profit among the RTA schemes. N^R denotes the number of RTA schemes available for firms. In any case, they need to pay fixed costs for exports. Then, the exporter chooses the most profitable RTA scheme if a firm decides to use RTA schemes. This two-step decision stems from the fact that RTA schemes qualitatively differ from an MFN scheme as firms have to pay fixed costs for RTA utilization, which is not required for

[7]The details of our theoretical framework are provided in Appendix A.

an MFN scheme. Indeed, this supposition will be supported in our empirical analysis.

Tariff schemes differ from each other, and tariff rates differ across tariff schemes. In particular, those in any RTAs are not higher than MFN tariff rates. In addition, when exporting under RTA schemes, firms have to incur the costs of procurement adjustment to comply with RoOs. Various rules exist in RoOs: change in chapter (CC), change in heading (CH), change in subheading (CS), wholly obtained (WO), regional value content (RVC), and specific process (SP). For example, CC and CS, respectively, require exported products to have different two-digit and six-digit HS codes from inputs imported from non-RTA member countries. In this sense, CC potentially requires exporters to more drastically adjust their production and input sources compared with CS. RoOs are set for each product in each RTA. Therefore, the procurement adjustment cost of a product differs across RTAs.

In addition, fixed costs differ between MFN and RTA schemes. As mentioned in the introductory section, when exporting under RTA schemes, exporters need to incur additional fixed costs for RTA utilization. In this sense, the total amount of fixed costs is larger under RTA schemes than that under an MFN scheme. This study assumes that fixed costs for RTA utilization are the same across RTA schemes. This assumption is valid at least among RTAs in our empirical analysis because operational certification procedures (OCP) for RoOs are the same in most aspects across those RTAs, as confirmed in the next section. Moreover, this assumption is useful to derive a nested logit equation to estimate the conditional RTA scheme choice.[8] Similar assumptions are employed in studies on the FDI location choice such as those by Head and Mayer (2004), Amiti and Javorcik (2008), and Mayer et al. (2010).

To specify our nested logit model for tariff scheme choices, this study assumes that the exporter's unobservable production cost follows a generalized extreme value (GEV) distribution. The probability that producer k chooses

[8] See Section A.3 of Appendix A. The empirical validity of this assumption is discussed in detail in Section 3.1.

alternative Alt in $Nest$ is described as follows:

$$\mathbb{P}_{Alt}(k) = \mathbb{P}_{Alt|Nest}(k)\mathbb{P}_{Nest}(k), \tag{1}$$

where $Nest = MFN, RTA$. There is only one alternative M in the MFN nest, i.e., a degenerate nest. In contrast, as listed later, there are six alternatives in the RTA nest. Thus, $Alt = R(1), \cdots, R(6)$ given that RTA is chosen for $Nest$. $\mathbb{P}_{Alt|Nest}(k)$ is the probability that an exporter chooses Alt given that the exporter has chosen $Nest$. The probability that an exporter chooses $Nest$ is denoted by $\mathbb{P}_{Nest}(k)$. $\mathbb{P}_{MFN}(k)$ is equal to $1 - \mathbb{P}_{RTA}(k)$ as the number of nests in this study is two.

The standard nested logit model can be applied if the following two assumptions hold true: agents' utility is described by the linear combination of observable and stochastic portions, and the stochastic portion of the utility follows the GEV distribution.[9] Under these assumptions, $\mathbb{P}_{Nest}(k)$ and $\mathbb{P}_{Alt|Nest}(k)$ are, respectively, written as follows:

$$\mathbb{P}_{Nest}(k) = \exp\left\{X_{Nest}(k) + \lambda_{Nest} IV_{Nest}(k) - \widetilde{IV}(k)\right\}, \tag{2}$$

$$\mathbb{P}_{Alt|Nest}(k) = \exp\left\{\frac{Q_{Alt}(k)}{\lambda_{Nest}} - IV_{Nest}(k)\right\}, \tag{3}$$

where $X_{Nest}(k)$ comprises nest-specific determinants that explain the choice between nests, and $Q_{Alt}(k)$ comprises alternative-specific determinants. Using

[9] The study by McFadden (1978) is the seminal work that explored the nested logit model. See also Train (2003) for comprehensive explanations of discrete choice models.

matrix representations, these scalars can be written as

$$X_{Nest}(k) = \boldsymbol{\alpha} \left[\boldsymbol{x}_{Nest}(k)\right]^{\mathrm{T}} = \begin{bmatrix} \alpha_1 & \cdots & \alpha_m \end{bmatrix} \begin{bmatrix} x_{1,Nest}(k) \\ \vdots \\ x_{m,Nest}(k) \end{bmatrix},$$

$$Q_{Alt}(k) = \boldsymbol{\gamma} \left[\boldsymbol{q}_{Alt}(k)\right]^{\mathrm{T}} = \begin{bmatrix} \gamma_1 & \cdots & \gamma_n \end{bmatrix} \begin{bmatrix} q_{1,Alt}(k) \\ \vdots \\ q_{n,Alt}(k) \end{bmatrix},$$

where $\boldsymbol{\alpha}$ and $\boldsymbol{\gamma}$ are coefficient vectors, and m and n are the numbers of nest- and alternative-specific variables, respectively. $\boldsymbol{x}_{Nest}(k)$ and $\boldsymbol{q}_{Alt}(k)$ are vectors of nest- and alternative-specific determinants, respectively.

λ_{Nest} is the so-called "log-sum coefficient" or "inclusive value (IV) parameter," which is inversely related to the correlation of stochastic utility factors within each nest. $IV_{Nest}(k)$ is the IV of a respective nest given by

$$IV_{Nest}(k) \equiv \ln \sum_{Alt \in Nest} \exp\left\{\frac{Q_{Alt}(k)}{\lambda_{Nest}}\right\}.$$

$\widetilde{IV}(k)$ is the profit expected from the available nests and is presented by

$$\tilde{IV}(k) \equiv \ln \sum_{Nest} \exp\left\{X_{Nest}(k) + \lambda_{Nest} IV_{Nest}(k)\right\}.$$

Because our framework meets the above two assumptions, we can employ the standard nested logit model to examine the determinants of choice probability of each tariff scheme.

The variables in nest-specific determinants ($\boldsymbol{x}_{Nest}(k)$) include the elements that influence the decision of choosing any RTA scheme. We first include the value of a concerned transaction. This value contains the information regarding various elements, such as an exporter-specific cost parameter (e.g., exporter's production capability), export country-product-specific cost parameter (e.g., wages), physical transportation costs[10], and importer's product-specific demand. Obviously, higher production capability of an exporter, lower export country-product-specific cost parameter, lower transportation costs, and larger product-specific demand of an importer lead to a larger transaction value. Since a larger transaction value enables exporters to more likely obtain export profits under RTA schemes enough to cover the additional fixed costs for RTA utilization, the transaction value is expected to be positively related to the probability of choosing any RTA scheme rather than an MFN scheme.

Second, we explicitly introduce some of the specific elements in addition to the transaction value. We capture importer's size by import firm-product-level total imports from the world. To control for transportation costs, we use a transaction-level dummy variable that takes the value 1 for land transportation (truck or railway) and 0 otherwise (e.g., sea or air). The export country-product-level cost parameter is captured by the average export price at a country HS six-digit-level.[11] As a result, the remaining variation in the transaction value will be well related to an exporter-specific production capability. Kropf and Sauré (2014) and Hornok and Koren (2015) demonstrated that the transaction value increases with exporter's productivity. Therefore, in this specification, the transaction value is expected to be positively related to the probability of choosing any RTA scheme rather than an MFN scheme.

$\boldsymbol{q}_{Alt}(k)$ comprises determinants specific to each alternative conditional on the nest chosen. These include variable cost for RoOs compliance and preferential tariff rate of a particular RTA scheme if the RTA nest is chosen. The variable costs for RoOs compliance are captured by introducing dummy vari-

[10]Our variable of transaction values in the empirical analysis is evaluated on a cost, insurance, and freight basis.

[11]Our use of these two variables is because of the two kinds of difficulty. One is the serious data limitation because our sample export countries include least developed countries, i.e., Myanmar, Laos, and Cambodia. The other is that unlike the case of location choice analyses, we do not have sufficient variation across export countries (i.e., their number is only eight). Furthermore, our control of transportation mode is because our sample import country, Thailand, particularly its capital (Bangkok), is located in the geographical center of our sample export countries (i.e., ASEAN); geographical distance among the countries does not differ much. Rather, transportation mode will be more important in transportation costs.

ables according to types of RoOs, details of which are explained in the next section. In the case of an MFN nest, which is a degenerate nest, MFN tariff rates are included. Because no RoOs compliance costs are incurred in this case, all RoOs dummy variables take the value 0 in an alternative of an MFN scheme. Consequently, an RTA scheme with less restrictive type of RoOs or lower preferential tariff rates will be more likely chosen.

3. Data Issues

This section introduces our data sources, taking brief overviews of our sample RTAs.

3.1. Data Sources

We estimate the nested logit model represented by eqs. (1)–(3) using a full information maximum likelihood technique. This model is estimated for the transaction-level choice of tariff schemes for Thai imports from ASEAN countries in 2014. We employ transaction-level import data that cover all commodity imports and examine the choice of tariff schemes in each transaction of a product from individual ASEAN country to Thailand. Our dataset contains the customs clearing date, HS eight-digit code, exporting country, firm identification code, tariff scheme, and import values in Thai Baht. Tariff schemes comprise three categories, including an MFN scheme, RTA schemes, and other schemes. Tariff payments for imports under "the other schemes" are exempted on the basis of five schemes: bonded warehouses, free zones, investment promotion, duty drawback for raw materials imported for the production of exports, and duty drawback for re-exportation. In our study, we drop import transactions under these other schemes.

As of 2014, seven tariff schemes are available when firms in Thailand import from ASEAN countries: an MFN scheme and six RTA schemes. Among them, ATIGA was introduced in 2010 by revising the ASEAN Free Trade Area (AFTA) that became effective among 10 ASEAN countries (Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Laos, the Philippines, Singapore, Thailand, and Vietnam) in the 1990s. In addition, Thailand, together with the other ASEAN members, has concluded five plurilateral RTAs, called ASEAN+1 RTAs. ACFTA was introduced in 2005 among 10 ASEAN countries and China after signing the Framework Agreement on China–ASEAN Comprehensive Economic Cooperation at the sixth China–ASEAN Summit in November 2002. AJCEP was introduced in 2008 among several ASEAN countries and Japan. It came into effect in Brunei, Malaysia, Thailand, and Cambodia in 2009 and in the Philippines in 2010. Importantly, its effectuation for Indonesia has pended. Thus, we do not include import transactions from Indonesia in our estimation since the number of available tariff schemes is different.[12] AKFTA on trade in goods was introduced among several ASEAN countries and Korea in 2007. It became effective in Brunei, Laos, Cambodia, and the Philippines in 2008, followed by Thailand in 2010. AANZFTA was introduced in 2010 among several ASEAN countries, Australia, and New Zealand. It came into effect in Laos and Cambodia in 2011 and in Indonesia in 2012. AIFTA was introduced in 2010 among several ASEAN countries and India. It became effective in Laos, Cambodia, and the Philippines in 2011.

The difference between alternative RTAs mainly stems from preferential tariff rates and types of RoOs. There are several types of tariff reduction, or elimination, in ASEAN RTAs. For example, "immediate elimination" refers to completely eliminating tariffs just after the effectuation, and "gradual reduction" (or long phase) means to gradually reduce tariffs for some years. The tariff reduction may start some years after RTA's introduction ("late start"). In the case of "partial reduction," the final level of preferential rates is not zero but at some positive level.[13] The difference in preferential tariff rates across RTAs is yielded by the abovementioned difference in entry years and the fact that typical types of tariff reduction are not necessarily "immediate

[12] As one of the robustness checks, we will later add observations of exports from Indonesia.

[13] Theoretical studies have discussed what kind of elements are related to the choice of these liberalization patterns. For example, the extent of production factor mobility is taken as one of the elements. If the production factors in import-competing industries can be moved freely across industries, then preferential rates will immediately be set to zero due to no lobbying in such case. In addition, the speed of tariff reduction is shown to increase with the degree of capital mobility (Maggi and Rodríguez-Clare, 2007).

elimination." For example, in AJCEP in Thailand, 43% of tariff-line products follow "gradual reduction," whereas "immediate elimination" is found in 26% of tariff-line products. Consequently, preferential tariff rates are likely to differ by RTAs and years. As we will see later (i.e., Table 2), RoOs differ across RTAs because these are determined according to negotiation among member countries.[14]

As mentioned in the previous section, the OCP, which is related to additional fixed costs for RTA utilization, is the same across our sample RTAs in most aspects. For example, the cumulation rule, back-to-back CoOs, and the third country invoice are allowed in all six RTAs. In addition, the third-party certification system is adopted in all six RTAs.[15] The commission charge for CoOs differs across countries but is same across RTAs in each country (see Table 1 in the study by Hayakawa et al., 2016). One notable difference is the availability of the De Minimis rule[16], which is available in AJCEP, AKFTA, ATIGA, and AANZFTA but not in ACFTA and AIFTA. However, we believe that this difference is much less significant than qualitative difference between an MFN scheme and RTA schemes. Thus, these indifferences across RTAs will support our assumption of common fixed costs for RTA utilization across alternative RTAs in our empirical framework.[17]

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[14] In Appendix B, we show the distribution of AJCEP preferential products in Thailand according to tariff reduction types. In addition, as an example of differences in tariff rates and RoOs, we show the case of "household or laundry-type washing machines (each of a dry linen capacity not exceeding 6 kg)" (HS84501110).

[15] The cumulation rule allows inputs from other RTA member countries to be taken as "originating inputs" when certifying the origin. For more details regarding cumulation, see Appendix C. The back-to-back CoOs are issued by the second exporting party for the re-export of goods based on the CoOs issued by the first exporting party. Third country invoicing allows originating goods to qualify for preferential tariff treatment even if the accompanying sales invoice is issued by a company located in a third country. The third-party certification system is a system wherein third parties such as a relevant Ministry or a Chamber of Commerce take a role in issuing CoOs.

[16] This is a bailout measure in the change in tariff classification rule and allows non-originating inputs to have the same tariff classification if those inputs occupy only a certain small share in prices of export products (e.g., 10%).

[17] There are some differences in other non-tariff issues, such as intellectual property right or government procurement although it is not necessarily clear how these elements are related to the fixed costs for RTA utilization. However, these rules are applied specific to countries,

Our data sources for independent variables are as follows. The data on RTA preferential rates and RoOs are obtained from the legal text of each RTA. The data on MFN rates are obtained from the Customs office of Thailand. In Thailand, tariff rates are set at an HS eight-digit level, which includes 9,557 tariff lines. RoOs in all RTAs are set at an HS six-digit level, which includes 5,204 codes. The HS version in our analysis is HS 2012. The data on transportation mode and import firm-product level total imports from the world are obtained from our transaction-level import data. The average export price is constructed using the import data obtained from UN Comtrade. Specifically, we first compute unit export prices (export prices per kilogram) for each country pair at an HS six-digit level in 2014. Then, we aggregate those prices by arithmetic average according to export countries. In this aggregation, we do not include export prices to Thailand.

3.2. Data Overview

Before presenting our estimation results, we take brief overviews of RTAs in Thailand. Table 1 reports preferential status and tariff rates by RTA scheme in 2014. In 2014, the arithmetic average of MFN rates in Thailand was 11.5%. "Number" shows the number of tariff-line products in which RTA rates are lower than MFN rates (i.e., the number of lines eligible to each RTA). "Share in Total line" and "Share in Dutiable line" denote the shares of that number in all tariff-line products and in products with positive MFN rates, respectively. "Average RTA rates" indicates the arithmetic average of tariff rates among all products. In the case of products ineligible to RTA schemes, we put MFN rates when computing the average RTA rates.

Table 1 shows that ATIGA has a highest liberalization level partly because it was introduced in the earliest period among member countries (the former version of ATIGA is AFTA, which became effective in Thailand in 1993). All products have either zero MFN rates or ATIGA preferential rates lower than MFN rates. Consequently, the average ATIGA tariff rates are almost zero.

not RTA schemes. For example, once strong IPR is set in one RTA, it is effective among member countries regardless of rules set in other RTAs concluded among those countries.

Table 1: Preferential Status and Tariff Rates by RTA Schemes in 2014

	Eligible lines			Average RTA rates (%)
	Number	Share in Total line (%)	Share in Dutiable line (%)	
AANZ	7,157	75	93	1.81
AC	6,739	71	88	2.07
ATIGA	7,657	80	100	0.01
AI	5,924	62	77	5.21
AJ	6,499	68	85	3.50
AK	6,541	68	85	2.55

Source: Authors' computation using the legal text of each RTA

Despite relatively later effectuation, AANZFTA has a high liberalization level. As of 2014, more than 90% of all products already have either zero MFN rates or low AANZFTA preferential rates. Furthermore, AIFTA has the lowest liberalization level. The average RTA rates in AIFTA are still over 5%.

Table 2 reports the distribution of RoOs by RTA schemes at an HS six-digit level. It shows various types and combinations. The typical RoOs are CH/RVC in the cases of ATIGA, AANZFTA, AJCEP, and AKFTA; RVC in the case of ACFTA; and CS&RVC in the case of AIFTA. There is a relatively large number of CC in AJCEP. Notably, in the estimation, we construct dummy variables for RoOs based on a broader classification to keep a sufficient number of observations for each type of RoOs. Such RoOs are shown in the "Simplified" column. Specifically, CC, CH, and CS are categorized into change in tariff classification (CTC). Furthermore, RoOs with a very small number of observations are dropped or simplified. For example, products with "SP" in any RTAs are dropped (as shown in Table 2, such observations exist in the case of AANZFTA). In the case of RoOs combined with SP, we ignore a component of SP. For example, CTC&SP and CTC/SP are simplified to CTC.[18]

Table 3 reports the number and value of imports from eight ASEAN coun-

[18]Without these modifications, we cannot obtain the convergence of log likelihood in the estimation due to the small number of chosen observations in some types of RoOs.

Table 2: RoOs by RTA Schemes at an HS Six-digit Level

Original	Simplified	AANZ	AC	ATIGA	AI	AJ	AK
CC	CTC	247	1			1,079	5
CC&RVC	CTC&RVC						2
CC&SP	CTC	37				400	
CC/(RVC&SP)	CTC/RVC	200					
CC/RVC	CTC/RVC	606	8	340		122	524
CC/RVC/SP	CTC/RVC	35		171			
CC/SP	CTC	13					
CH	CTC	117				152	11
CH&RVC	CTC&RVC						5
CH&SP	CTC					264	
CH/(CS&RVC)/RVC	CTC/RVC	197					
CH/(RVC&SP)	CTC/RVC	6					
CH/RVC	CTC/RVC	2,151	113	4,232		2,921	3,880
CH/RVC/SP	CTC/RVC	23		327			21
CH/SP	CTC	86					
CS	CTC					7	
CS&RVC	CTC&RVC	3			5,204		
CS/RVC	CTC/RVC	1,037		129		34	74
RVC	RVC	68	4,682			222	75
RVC/SP	RVC		392	1			
SP	Drop	70					
WO	WO	300	8	4		3	607
WO/SP	WO	8					
Total		5,204	5,204	5,204	5,204	5,204	5,204

Source: Authors' computation using the legal text of each RTA
Notes: "CC," "CH," and "CS" are change in chapter, change in heading, and change in subheading rules, respectively. "WO" and "RVC" are, respectively, wholly obtained and regional value content rules. "SP" is a specific process rule. "&" and "/" indicate the rules requiring to meet both and either of rules, respectively.

Table 3: Number and Value of Imports According to Tariff Scheme in 2014 (Million THB)

	Number of transactions	Number of import-firm-product pairs	Total Imports
MFN	1,581,713	73,162	464,431
AANZ	70,029	23	2,880
AC	604	139	724
ATIGA	494,005	10,621	210,984
AI	6	5	7
AJ	285	9	80
AK	28	10	33

Source: Authors' computation using transaction-level import data from Customs

tries according to tariff schemes in 2014. Both the numbers of transactions and import-product pairs are largest in the scheme of MFN, followed by ATIGA. The frequency of the use of these two schemes is outstanding. Accordingly, the large imports can be found in the cases of these two schemes.[19] AANZFTA has the third largest imports. These findings are consistent with our observations in Table 1, which shows high liberalization levels in AANZFTA and ATIGA. Alternatively, AIFTA, AJCEP, and AKFTA are utilized less frequently. In particular, there are only six transactions under AIFTA when importing from eight ASEAN countries in 2014. In addition, compared with the number of transactions, the number of import firm-product pairs is obviously small, implying that some import firm-product pairs have multiple transactions. In other words, firms import one product from many countries and/or many times from one country.

4. Empirical Results

This section reports our estimation results. After presenting our baseline results, we introduce the results of some additional estimations. Basic statistics are provided in Table 4.

[19]Based on this outstanding use of ATIGA, one may consider ATIGA as an exceptional

Table 4: Basic Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Choice	14,906,435	0.1429	0.3500	0	1
ln (1+Tariff)	14,906,435	0.0365	0.0937	0	0.5878
1 for CTC	14,906,435	0.0184	0.1344	0	1
1 for CTC&RVC	14,906,435	0.1451	0.3522	0	1
1 for CTC/RVC	14,906,435	0.5211	0.4996	0	1
1 for RVC	14,906,435	0.1699	0.3755	0	1
1 for WO	14,906,435	0.0027	0.0518	0	1
ln Transaction Value	14,906,435	9.4886	2.6045	0	21.7082
ln Export Price	14,906,435	4.1586	1.5828	-4.3395	16.7842
Land Transport Dummy	14,906,435	0.1972	0.3979	0	1
ln Total Imports	14,906,435	17.6826	3.0787	0	26.4457

Source: Authors' computation using transaction-level import data from Customs

Our estimation results of the nested logit model are shown in Table 5.[20] Column (I) contains only the inclusive value in the upper-stage estimation. We report standard errors clustered by import firm-product pair because firms may import a given product many times or from multiple countries; thus, standard errors might be correlated within an import firm-product pair. As is consistent with our expectation, the coefficients for tariff rates and RoOs dummy variables are significantly negative. This indicates that tariff schemes with higher tariff rates or those required to comply with RoOs are less likely to be chosen. The estimated IV parameter lies between 0 and 1. This implies that our model meets a sufficient condition for global consistency with the random utility model in discrete choice analysis.

The order of absolute magnitude of coefficients for RoOs dummy variables is worth discussing. The results indicate that the negative effects become more serious in the order of CTC&RVC, WO, CTC, RVC, and CTC/RVC. This result is consistent with a natural rule that meeting all multiple types of RoOs (i.e., RoOs with "&") is more restrictive than meeting one of those

preferential scheme. This point is discussed in Section 4.

[20]In Table C.1 of Appendix C, we report the results of conditional logit model. As is well known, when the IV parameter value is 1, our model can be reduced to the conditional logit model.

Table 5: Estimation Results: Nested Logit Model

	(I)	(II)	(III)
Dependent variable: Scheme chosen			
ln (1+Tariff)	-8.087***	-9.346***	-7.826***
	[0.969]	[0.894]	[0.989]
1 for CTC	-2.484***	-6.695***	-5.874***
	[0.231]	[0.605]	[0.803]
1 for CTC&RVC	-3.065***	-7.376***	-6.480***
	[0.299]	[0.673]	[0.872]
1 for CTC/RVC	-1.988***	-6.114***	-5.356***
	[0.146]	[0.534]	[0.745]
1 for RVC	-2.089***	-6.232***	-5.461***
	[0.118]	[0.515]	[0.707]
1 for WO	-2.867***	-7.149***	-6.277***
	[0.277]	[0.654]	[0.846]
Dependent variable: Chosen nest (MFN as a base scheme)			
Inclusive value	0.112***	0.131***	0.117***
	[0.019]	[0.022]	[0.021]
ln Transaction Value		0.397***	0.293***
		[0.040]	[0.041]
ln Export Price			-0.548***
			[0.059]
Land Transport Dummy			-0.095
			[0.257]
ln Total Imports			0.143***
			[0.036]
Number of observations	14,906,435	14,906,435	14,906,435
Log likelihood	-1743477.8	-1598485.1	-1475626.2

Notes: ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses are standard errors clustered by import firm-product pairs.

types of RoOs. It is also consistent with the rule that meeting either one among multiple types of RoOs (i.e., RoOs with "/") is as restrictive as or less restrictive than meeting a particular one among multiple types of RoOs. The choice probability is lower for CTC&RVC than for WO. However, WO is known as the most restrictive type of RoOs because an exported product must be entirely produced or cultivated in RTA member countries. One reason for this result is that in our sample of RTAs, almost all cases with WO are found in agricultural goods; that is, it is not technically difficult to meet the WO criteria for the production of agricultural goods.

The result that the choice probability is lower for CTC than for RVC is another important finding. For example, Carrere and de Melo (2006) found the opposite order between CTC and RVC in the analysis of NAFTA utilization rates.[21] As mentioned in the introductory section, our results are based on a cross-RoOs analysis within a product, whereas those in the study by Carrere and de Melo (2006) are based on a cross-product analysis. That is, we are directly comparing RoOs in each product, and our results in RoOs are not driven by differences in product characteristics at all. Therefore, we believe that our results indicate a more precise order of effects of alternative types of RoOs on the choice probability. Nevertheless, we should be careful of generalizing this result because the share of labor costs, local material costs, and miscellaneous expenses, all of which are costs for "originating inputs," out of the total production costs are high in Asia.[22] Therefore, at least in Asia, it might be easy to meet a conventional cutoff in RVC (e.g., 40%).

The results in the other two columns are as follows. In Column (II), we add a log of transaction value. As is consistent with our expectation, its coefficient is estimated to be significantly positive, implying that RTA schemes are likely

[21] Carrere and de Melo (2006) found that the negative effect of RVC on NAFTA utilization rates is larger than the negative effect of CC.

[22] For example, according to the "Survey of Japanese-Affiliated Firms in Asia and Oceania (FY2014) conducted by the Japan External Trade Organization, labor costs, local material costs, and miscellaneous expenses occupy approximately 20%, 30%, and 20% in the total production cost, respectively, on average, among 2,194 Japanese manufacturing affiliates operating in Asia and Oceania. Namely, 70% out of the total production cost is a local cost.

to be chosen in case of larger transactions. The results with regard to tariff rates and RoOs dummy variables are qualitatively unchanged in terms of signs and significance. Column (III) includes all variables explained in the previous section. The estimation results with regard to tariffs and RoOs are slightly changed. The coefficient for total imports is significantly positive, indicating that RTA schemes are likely to be chosen by the larger-sized importers in terms of total import values. While the coefficient for land transportation dummy is insignificant, that for the average export price is estimated to be significantly negative. The latter result implies that lower production costs lead to a higher probability of choosing RTA schemes. Even after controlling for these elements, we still see a significantly positive coefficient for transaction values. Thus, the remaining elements, such as exporter's production capability, significantly positively impact the probability of choosing RTA schemes.

We also report some other estimation results in Appendix C. First, we introduce one more explanatory variable to capture the role of cumulation rules in the second stage. Second, we focus on trade in which firms cannot enjoy cumulation rules by restricting sample products only to finished products since cumulation rules are utilized when imported intermediate inputs are cumulated. Third, we exclude trade in products with zero MFN rates because the choice set for firms might be different between the cases of products with zero and positive MFN rates. Fourth, we add observations of exports from Indonesia to our estimation sample. Fifth, we aggregate our transaction-level data up to firm-level annual data because firms may make their decisions based on annual benefits rather than per-transaction benefits.[23] All these estimation results show that as in the previous results, the coefficients for tariff rates and RoOs dummy variables are estimated to be negatively significant. RTA schemes are also more likely to be chosen in case of larger transactions.

[23]We also estimate the three-stage nested logit model, which has a middle stage in the RTA nest (i.e., ATIGA or any other RTA scheme). In this three-stage nested logit model, IV parameters are estimated to be greater than the value 1 or be negative; and thus, they do not meet a sufficient condition for global consistency with the random utility model in discrete choice analysis. This inconsistency may indicate that ATIGA should be placed on the same decision stage as other RTAs.

5. Quantitative Interpretation

This section provides some quantitative interpretation of our estimation results. We estimate a mixed logit model, which is more flexible than a nested logit model in terms of substitution among alternatives. Finally, we conduct some simulation analyses.

5.1. Elasticities: Nested Logit Model

Following Greene (2012), we compute the elasticities of probability of choosing each tariff scheme based on the estimation results of Column (III) of Table 5. First, we examine the extent to which the probabilities change when tariff rates in each scheme change by 1%. The elasticity of probability that firm k chooses alternative Alt with respect to $\tilde{n}$th alternative-specific determinant of alternative $\widetilde{Alt}$, which is represented by $q_{\tilde{n},\widetilde{Alt}}(k)$, is given by

$$\begin{aligned}\frac{\partial \ln \mathbb{P}_{Alt}(k)}{\partial q_{\tilde{n},\widetilde{Alt}}(k)} = \Big\{ & d_1 \left[d_2 - \mathbb{P}_{\widetilde{Alt}|Nest}(k) \right] \\ & + \lambda_{Nest} \left[d_1 - \mathbb{P}_{Nest}(k) \right] \mathbb{P}_{\widetilde{Alt}|Nest}(k) \Big\} \gamma_{\tilde{n}}, \ \tilde{n} = 1, \cdots, n. \end{aligned} \tag{4}$$

d_1 is a binary variable taking the value 1 when a nest of $\widetilde{Alt}$ is the same as that of Alt and 0 otherwise. Similarly, d_2 is a binary variable taking the value 1 when alternative $\widetilde{Alt}$ is same as alternative Alt and 0 otherwise. Specifically, we examine the elasticity with respect to tariff rates.

The results are shown in Table 6. There are two noteworthy findings. First, the effect of tariff rates in a scheme on the probability of choosing that scheme is negative. We call this effect "own effect." The absolute magnitude of this effect is much larger in RTAs than in the MFN scheme. In particular, the magnitude is largest in AIFTA. In terms of elasticity, a 1% reduction in AIFTA tariff rates greatly increases the probability of choosing AIFTA by 70%. These results are partly because the probability of choosing any RTA scheme ($\mathbb{P}_{Nest}(k)$) and its conditional probability given that RTA nest ($\mathbb{P}_{\widetilde{Alt}|Nest}(k)$) is selected is small compared with the probability of choosing the MFN scheme,

Table 6: Elasticities with Respect to Tariff Rates (Mean)

	Probability change						
Tariff change	MFN	AANZ	AC	ATIGA	AI	AJ	AK
MFN	-2.070	5.756	5.756	5.756	5.756	5.756	5.756
AANZ	0.489	-52.642	14.266	14.266	14.266	14.266	14.266
AC	0.187	5.765	-61.143	5.765	5.765	5.765	5.765
ATIGA	0.795	19.135	19.135	-47.772	19.135	19.135	19.135
AI	0.000	0.001	0.001	0.001	-66.907	0.001	0.001
AJ	0.242	9.827	9.827	9.827	9.827	-57.080	9.827
AK	0.358	12.190	12.190	12.190	12.190	12.190	-54.718

Note: The elasticities reported in this table are based on the estimation result in Column (III) of Table 5.

as implied from Table 3.[24] As indicated in Eq. (4), these probabilities are negatively related to the own effect.

Second, the effect of tariff rates in a scheme on the probability of choosing other schemes is positive. We call this effect "cross effect." Importantly, the cross effects of tariff rates in an RTA scheme are common across the other RTA schemes but different between RTA schemes and an MFN scheme. This consequence stems from the nature of nested logit models and is one advantage over conditional logit models. The table indicates that the reduction in tariff rates in an RTA scheme more greatly decreases the probability of choosing other RTA schemes than that of choosing the MFN scheme. This result is partly based on the fact that an IV parameter is estimated to be less than the value 1 and near 0, which implies more similarity among RTA schemes than between RTA and MFN schemes.

Next, we compute the elasticity of probability that firm k chooses alternative Alt with respect to $\tilde{m}$th nest-specific determinant of nest $\widetilde{Nest}$, which is represented by $x_{\tilde{m},\widetilde{Nest}}(k)$. The elasticity is given by

$$\frac{\partial \ln \mathbb{P}_{Alt}(k)}{\partial x_{\tilde{m},\widetilde{Nest}}(k)} = \alpha_{\tilde{m}} \left(d_3 - \mathbb{P}_{\widetilde{Nest}}(k) \right), \ \tilde{m} = 1, \cdots, m.$$

[24]These probabilities are reported in Appendix F.

d_3 is a binary variable taking the value 1 when Alt belongs to the nest $\widetilde{Nest}$ and 0 otherwise. We examine the elasticity with respect to the transaction value. This elasticity indicates the extent to which the probability of choosing any RTA scheme increases with a 1% increase in the transaction value. Because exporters with larger transaction are more likely to cover additional fixed costs for RTA utilization, this elasticity is related at least partly to those fixed costs. [25]

Table 7 indicates the mean of elasticities according to export country. We find that the mean of the elasticities is relatively high for relatively developed countries in our sample export countries, including Singapore (0.24), the Philippines (0.24), and Malaysia (0.22). This result is consistent with the fact that developed countries are supposed to have better knowledge and experience in dealing with documentation works for RTA utilization and thus have lower fixed costs for RTA utilization. Alternatively, the three least developed countries, i.e., Cambodia (0.15), Laos (0.16), and Myanmar (0.14), have lower elasticities.

5.2. Elasticities: Mixed Logit Model

Next, we again compute the elasticity with respect to tariff rates using the estimation results of a mixed logit model. The nested logit model produces common cross effects of tariff rates in an RTA scheme across the other RTA schemes, as shown in Table 6. However, cross effects may differ across the other RTA schemes. To examine this possibility, we estimate mixed logit models, which are more flexible in terms of substitution among alternatives than the nested logit model. The specification takes a random coefficients form. We assume that all variables have normally distributed coefficients. This flexibility in coefficients enables us to examine the possibility that cross effects differ across RTA schemes.

[25] Chen and Moore (2010) examined how multinational firms with heterogeneous total factor productivity (TFP) self-select into different host countries. Specifically, they estimated a probit model on firms' investment abroad and decomposed the coefficient for TFP by introducing the interaction terms of TFP with various elements (e.g., market potential, fixed costs of investment, or import tariffs).

Table 7: Elasticities with Respect to Transaction Values According to Export Country

	Mean	S.D.
Brunei	0.1889	0.0815
Cambodia	0.1513	0.0571
Laos	0.1601	0.0885
Myanmar	0.1425	0.0623
Malaysia	0.2198	0.0735
Philippines	0.2359	0.0604
Singapore	0.2448	0.0568
Vietnam	0.1748	0.0885

Note: The elasticities reported in this table are based on the estimation result in Column (III) of Table 5.

Table 8 shows the mean elasticities of probability of choosing each tariff scheme with respect to tariff rates.[26] It is found that unlike the case of nested logit models, the cross effects of tariff rates in an RTA scheme differ not only between RTA schemes and an MFN scheme but also across RTA schemes. There are some more interesting results. For example, a 1% reduction in MFN rates more greatly decreases the probabilities of choosing ACFTA (by 13%) and AIFTA (by 14%) than those of choosing the other RTAs. In addition, a 1% reduction in ATIGA tariff rates lowers the probabilities of choosing AANZFTA (by 0.38%), AJCEP (by 0.31%), and AKFTA (by 0.49%) more greatly than those of choosing the other RTAs (i.e., ACFTA and AIFTA) and the MFN scheme. These results indicate that ACFTA and AIFTA belong to a group different from the other RTAs. One source of such grouping might be that

[26] The estimation results of the mixed logit models are available in Table C.5. For estimation, we use the MIXLOGIT command in STATA (Hole, 2007). All variables have significant coefficients with expected signs. The order of coefficients for RoOs dummy variables is unchanged with that in the previous results. Our procedures for the computation of elasticities are as follows. After the estimation of the mixed logit model with all independent variables, we first calculate the predicted probabilities in the base scenario. Second, we increase logged tariff variable in a tariff scheme by one unit and calculate the predicted probabilities in the alternative scenario. Third, we calculate the log difference between the two probabilities, which is taken as elasticity.

Table 8: Elasticities with Respect to Tariff Rates (Mean): Mixed Logit Model

	Probability change						
Tariff change	MFN	AANZ	AC	ATIGA	AI	AJ	AK
MFN	-26.380	2.138	13.455	1.618	13.961	2.947	1.809
AANZ	0.154	-42.388	0.264	0.248	0.253	0.454	0.468
AC	0.037	0.020	-42.761	0.010	0.103	0.060	0.035
ATIGA	0.073	0.382	0.088	-41.104	0.080	0.307	0.493
AI	0.000	0.000	0.000	0.000	-42.871	0.000	0.000
AJ	0.007	0.170	0.014	0.172	0.013	-42.695	0.169
AK	0.010	0.206	0.022	0.223	0.015	0.174	-42.645

Note: The elasticities reported in this table are based on the estimation result in Column (III) of Table 8.

RoOs in ACFTA and AIFTA are relatively restrictive compared with those in the other RTAs. Thus, for example, the reduction in MFN rates induces ACFTA/AIFTA users to switch to the MFN scheme due to the high costs of RoOs compliance.[27]

5.3. Simulation

Finally, we conduct two types of simulation analyses using the estimation result of Column (III) of Table 5.[28] First, we demonstrate how the probability changes when scheduled tariff reduction is completed in all RTAs. In other words, we calculate the expected changes in the choice probability of each RTA scheme from 2014 to the final year of tariff reduction. In some products, tariff reduction further continues after 2014 because tariff rates in some products are scheduled to be reduced gradually or to begin several years after the enactment of RTAs (see Table B.1 of Appendix B). The official final implementation

[27]Indeed, we also estimate the three-stage nested logit model, which has a middle stage in the RTA nest. Specifically, given the choice of RTA schemes, firms choose either a group of ATIGA, AANZFTA, AJCEP, and AKFTA or a group of ACFTA and AIFTA before choosing a specific RTA scheme. The results are reported in Table C.4 of Appendix C. Estimated IV parameters lie in the unit interval. Log likelihoods are also higher than those in Table 5.

[28]The simulation analyses based on the results in the mixed logit model are presented in Table C.6 and show similar results as in Table 10.

Table 9: Remaining Tariff Reduction in Each RTA

	$G = 0$	$0 < G < 5$	$5 \leq G < 10$	$10 \leq G$
AANZ	8,270	267	317	703
AC	9,069	10	258	220
ATIGA	9,557	0	0	0
AI	7,859	704	227	767
AJ	7,941	323	904	389
AK	8,662	88	529	278

Note: "G" indicates the difference between final preferential rates and preferential rates in 2014.

years of ATIGA, AKFTA, ACFTA, AJCEP, AIFTA, and AANZFTA are 2015, 2017, 2018, 2018, 2020, and 2020, respectively. The magnitude and number of remaining tariff reduction in each RTA are shown in Table 9. "G" indicates the difference between final preferential rates and the preferential rates in 2014. The largest number of products with further tariff reduction can be found in AIFTA, whereas no further reduction occurs in ATIGA.

We indicate the percentage points by which the probability changes between 2014 and the final year. To do that, we first calculate the predicted probabilities in the base scenario. Second, we replace the level of a tariff variable in 2014 with tariff rates scheduled in the final year of each RTA and calculate the predicted probabilities in the alternative scenario. Third, we calculate the mean difference between the two probabilities according to tariff schemes. The results are shown in the "Tariffs" column of Table 10. AANZFTA (0.38 percentage points) and AJCEP (0.80 percentage points) are RTAs that are expected to experience a rise of probability from 2014 to the final year. Such rise is due to the fact that further reduction remains in a relatively large number of products in those RTAs as shown in Table 9. Although AIFTA also has a large number of products with further tariff reduction, the restrictive RoOs in AIFTA hamper the rise of probability. The largest decline is found in ATIGA (-0.80 percentage points) because tariff reduction is already completed in 2014 as shown in Table 9.

Second, we indicate the percentage points by which the probability changes

Table 10: Probability Change: Tariff Reduction in Final Year and Least Restrictive RoOs (Percentage Points)

	Tariffs	RoOs
AANZ	0.38	-0.02
AC	-0.18	1.35
ATIGA	-0.80	-2.67
AI	0.00001	2.69
AJ	0.80	0.08
AK	-0.08	-0.97
MFN	-0.12	-0.46

Note: The probability changes are based on the estimation result in Column (III) of Table 5.

if RoOs in all RTAs are set to the least restrictive type. As found in the previous estimation results, RoOs are found to be restrictive in the order of CTC&RVC, WO, CTC, RVC, and CTC/RVC. Therefore, we set RoOs in all RTAs to CTC/RVC, calculate predicted probabilities in the alternative scenario, and compute the mean difference according to tariff schemes. The results are shown in the "RoOs" column of Table 10. In most cases, the absolute magnitude in this simulation is larger than that in the previous simulation, i.e., "Tariffs." ACFTA (1.35 percentage points) and AIFTA (2.69 percentage points) are RTAs that experience a great rise of probability. This result is reasonable because these two RTAs have relatively restrictive RoOs, as shown in Table 2. The most restrictive RoOs, i.e., CTC&RVC, are originally set in all products in AIFTA, whereas the least restrictive RoOs, i.e., CTC/RVC, are set in few products in ACFTA. The probability of choosing the other RTAs (except for AJCEP) is expected to decline. The largest decline is found in ATIGA (2.67 percentage points) due to the fact that the least restrictive RoOs are already set in almost all products in ATIGA, as shown in Table 2.

6. Concluding Remarks

This study examined the determinants of choice probability of tariff schemes when an MFN scheme and multiple RTA schemes are present. Specifically, we used transaction-level data of Thai imports from other ASEAN countries in 2014. In this flow, seven tariff schemes, including six RTA schemes and an MFN scheme, are available. By estimating theoretically consistent nested logit models with this data, we found that tariff schemes with lower tariff rates are more likely to be chosen. Further, we revealed that RTA schemes with more restrictive RoOs are less likely to be chosen. In particular, tariff schemes with "WO rule" or "CTC and RVC rule" are less likely to be chosen, while firms are more likely to choose tariff schemes with "CTC or RVC rule." In addition, any RTA scheme is likely to be chosen in the case of large transactions.

Using the estimates, we further conducted some quantitative analyses. For example, we examined the extent to which the probability of choosing each scheme changes when tariff rates decline by 1% and the extent to which the probability of choosing any RTA scheme changes when transaction values increase by 1%. In the latter analysis, we found a relatively large effect when exporting from Singapore, the Philippines, and Malaysia, which are relatively developed in our sample of export countries. We also examined how the probability changes when scheduled tariff reduction is completed in all RTAs or if RoOs in all RTAs are set to the least restrictive type, i.e., CTC/RVC. The largest rise of choice probability from 2014 to the final year is found in AJCEP due to the fact that further reduction remains in a relatively large number of products. The change in RoOs to the least restrictive RoOs raises probabilities of choosing ACFTA and AIFTA because these two RTAs originally have relatively restrictive RoOs.

These results imply that firms choose the best tariff scheme according to tariff rates and RoOs. Therefore, firms face a choice problem when the number of available RTAs increases. This issue might be one form of the spaghetti bowl phenomenon (Bhagwati et al., 1998). If one RTA scheme has the lowest preferential tariff rates and most business-friendly RoOs (e.g., CTC or RVC) in all tariff lines, then firms do not need to make a choice regarding tariff schemes. In the context of Asia in particular, RCEP just covers all of our sample RTAs (i.e., ATIGA and the five ASEAN+1 RTAs) in terms of member countries. Therefore, RTA utilization costs will be lowered and spaghetti bowl phenomena may disappear if RCEP is designed to provide lowest preferential tariff rates and most business-friendly RoOs in each tariff line among the existing six RTAs.

Appendix A. Theoretical Framework

In this Appendix, we provide the theoretical framework concerning our nested logit model. Specifically, it extends the model of tariff scheme choice developed by Demidova and Krishna (2008) and Cherkashin et al. (2015) by introducing multiple RTA schemes into the choice set of tariff schemes. We also introduce an unobservable component in marginal cost to derive a theoretically consistent nested logit model. Intermediate goods are assumed to be tradable, and producers of these goods make decisions regarding exports and tariff schemes.

Appendix A.1. Final- and Intermediate-Good Producers

There are J countries, including the home country, in the economy. The representative final-good producer combines L types of intermediate inputs without paying any additional costs and produces its output in the competitive market. The production function of the representative final-good producer in a country is given by a Cobb-Douglas function

$$y = \prod_{l=1}^{L} [y(l)]^{\beta(l)}, \quad \sum_{l=1}^{L} \beta(l) = 1.$$

y denotes the output, and $y(l)$ denotes the amount of the intermediate input l. Let k represent each of intermediate inputs. $y(l)$ is defined as

$$y(l) = \left(\sum_{i=1}^{J} \int_{k \in \Omega_i(l)} [y_i(l,k)]^{\frac{\nu-1}{\nu}} \, dk \right)^{\frac{\nu}{\nu-1}}, \quad 1 < \nu < \infty.$$

ν denotes the demand elasticity of intermediate inputs. Each variety is produced by one intermediate-good producer. $\Omega_i(l)$ is a set of varieties of product

l purchased from country i by the representative final-good producer. Final-good producers use both domestic and foreign inputs.

Cost minimization leads to demand schedules

$$y_i(l,k) = \left(\frac{p_i(l,k)}{p(l)}\right)^{-\nu} y(l), \quad y(l) = \beta(l)\left(\frac{p(l)}{P}\right)^{-1} y.$$

Thus, a higher relative price leads to lower demand. $p_i(l,k)$ denotes the import price of each variety, and price indices are defined as follows:

$$p(l) = \left(\sum_{i=1}^{J} \int_{k\in\Omega_i(l)} [p_i(l,k)]^{1-\nu}\, dk\right)^{\frac{1}{1-\nu}}, \quad P = \sum_{l=1}^{L} \left[\frac{p(l)}{\beta(l)}\right]^{\beta_l}.$$

Each intermediate-good producer k is assumed to be so small that we can ignore the effect of each intermediate-good producer's (exporter's) behavior on macroeconomic variables in the importing country such as price index. Combining the above equations, the demand function is explicitly derived as

$$y_i(l,k) = [p_i(l,k)]^{-\nu}\,[p(l)]^{\nu-1}\,Y(l),$$

where $Y(l)$ captures the input value of intermediate input l and is defined by

$$Y(l) \equiv \beta(l)Py.$$

Intermediate-good producers sell the outputs to domestic and foreign final-good producers. Following Mayer et al. (2010), we assume that the marginal cost of each intermediate-good producer k, which produces product l in country i, is given by

$$mc_i(l,k) = \frac{\omega_i(l)\epsilon_i(l,k)}{\varphi(k)},$$

where $\varphi(k)$ represents the firm-specific production capability. $\omega_i(l)$ is the export county-product specific component of marginal cost such as the wage level and various transaction costs. These two terms are assumed to be observable.

$\epsilon_i(l,k)$ is an unobservable component of marginal cost and will become the residual term in our empirical equation. Profit-maximizing price is derived as

$$\tilde{p}_i(l,k) = \frac{\nu}{\nu-1}\frac{\omega_i(l)\epsilon_i(l,k)}{\varphi(k)}.$$

Thus, the profit-maximizing price is obtained as the product of markup and marginal cost. $\tilde{p}_i(l,k)$ represents the so-called "free on board" price when we consider exports.

Appendix A.2. Export Profits

For simplicity, we do not assume any fixed costs of domestic supply. Suppose that firms in a country i can choose a tariff scheme from among MFN and multiple RTA schemes when exporting to a concerned country. The decision is decomposed into two steps: a firm decides whether to use MFN (M) or RTA schemes ($R(r), r = 1, \cdots, N^R$) and selects the most profitable RTA scheme if a firm decides to use RTA schemes. N^R is the number of RTA schemes available for firms. In any case, they need to pay fixed costs for exports, denoted by f_i.[29] Furthermore, when exporting under RTA schemes, they need to incur additional fixed costs for RTA utilization denoted by f_i^R. These two types of fixed costs are assumed to be specific to each export country and same across products without loss of generality. We assume that fixed costs for RTA utilization are the same across RTA schemes. This assumption is useful to derive a nested logit equation to estimate the conditional RTA scheme choice.[30] Similar assumptions are employed in studies on FDI location choice such as

[29] We assume that exporters pay fixed costs for exports to each destination following Helpman et al. (2004) and Helpman et al. (2008). In other words, exporters do not save on the total fixed cost of dealing with export processes for multiple destinations at the same time. We also assume a similar situation for the fixed cost for RTA utilization, i.e., exporters pay the fixed cost for RTA utilization for each transaction. Furthermore, given that the model is static, mitigation of these fixed costs through the exporters' experiences is not considered. Consideration of these possibilities would provide richer theoretical consequences; however, we do not examine such cases to keep the model tractable and focus on deriving the nested logit model.

[30] The empirical validity on this assumption is discussed in Section 3.2.

those by Head and Mayer (2004), Amiti and Javorcik (2008), and Mayer et al. (2010).

We assume the presence of three types of variable costs to export. First, we let T_M and $T_{R(r),i}$ represent one plus per-unit MFN and RTA tariff rates, respectively ($T_M, T_{R(r),i} > 1$). We assume that MFN rates do not depend on export countries following the practical application of MFN tariffs.[31] Second, the iceberg physical transport costs ($\tau_i > 1$) are introduced. Finally, we assume the costs for procurement adjustment to comply with RoOs ($\theta_{R(r),i} > 1$). When utilizing RTA schemes, exported products must meet RoOs. To comply with these RoOs, exporters may need to change their procurement sources, resulting in a rise of procurement costs. Such additional procurement costs for RoOs compliance are captured by $\theta_{R(r),i}$. Thus, $\theta_{R(r),i}$ is higher for RTA schemes with more restrictive, or more costly, RoOs. Because these rules are set at an RTA-product level, $\theta_{R(r),i}$ is also different across RTAs. Letting $\overline{R}$ represent the RTA scheme with the highest variable cost among available RTA schemes, we assume that $\theta_{\overline{R},i} T_{\overline{R},i} < T_M$ so that both MFN users and RTA users exist in imports of a product from a country.

The respective export prices under MFN and RTA schemes are given by

$$p_{M,i}(l,k) = T_M \tau_i \tilde{p}_i(l,k),$$
$$p_{R(r),i}(l,k) = \theta_{R(r),i} T_{R(r),i} \tau_i \tilde{p}_i(l,k).$$

Further, export profits under respective regimes can be derived as follows:

$$\pi_{M,i}(l,k) = \Phi(k) Y(l) \zeta(l) \frac{[\omega_i(l) \epsilon_{M,i}(l,k)]^{1-\nu}}{[T_M \tau_i]^{\nu}} - f_i,$$
$$\pi_{R(r),i}(l,k) = \Phi(k) Y(l) \zeta(l) \frac{[\omega_i(l) \epsilon_{R(r),i}(l,k)]^{1-\nu}}{[\theta_{R(r),i} T_{R(r),i} \tau_i]^{\nu}} - f_i - f_i^R,$$

[31] Our sample countries in the empirical work do not include non-WTO member countries.

where

$$\Phi(k) \equiv [\varphi(k)]^{\nu-1}, \quad \zeta(l) \equiv (\nu-1)^{\nu-1} \nu^{-\nu} [p(l)]^{\nu-1}.$$

Thus, export profits are found to be increasing in productivity φ. It is also straightforwardly indicated that tariff rates in respective schemes (T), importer's demand (Y), observable and unobservable marginal costs (ω and ϵ), and transportation cost (τ) affect export profits. For RTA schemes, the variable costs for RoO compliance (θ) also affect export profits.

Appendix A.3. Choice of Tariff Schemes

To simplify the description, we drop index l hereafter. We also drop i because we focus on trade in particular country pairs in our empirical sections. In addition, we assume that destination markets are segmented and that each exporter makes decision regarding tariff scheme choice for each destination market. Consequently, we can analyze the behavior of an exporter in the exporting country to an importing country independently. The probability that an exporter chooses the RTA scheme r' given that the exporter chooses RTA schemes rather than an MFN scheme is given by

$$\begin{aligned}
\mathbb{P}_{R(r')|RTA}(k) &= \mathbb{P}\left\{\pi_{R(r')}(k) > \pi_{R(r)}(k)\right\} \\
&= \mathbb{P}\left\{\theta^{\nu}_{R(r)} T^{\nu}_{R(r)} \left[\epsilon_{R(r)}(k)\right]^{\nu-1} > \theta^{\nu}_{R(r')} T^{\nu}_{R(r')} \left[\epsilon_{R(r')}(k)\right]^{\nu-1}\right\} \\
&= \mathbb{P}\Big\{ (\nu-1)\left[\ln \epsilon_{R(r)}(k) - \ln \epsilon_{R(r')}(k)\right] \\
&- \nu\left[\ln \theta_{R(r')} - \ln \theta_{R(r)}\right] - \nu\left[\ln T_{R(r')} - \ln T_{R(r)}\right] > 0\Big\}. \quad \text{(A.1)}
\end{aligned}$$

for all $r' \neq r \in RTA$. The right-hand side of Eq. (A.1) presents the determinants of the choice probability of $R(r')$ among alternative RTA schemes. The probability rises when variable costs of RoOs compliance ($\theta_{R(r')}$) or preferential tariff rates ($T_{R(r')}$) fall relative to other RTA schemes. Firms' production capability does not affect the choice among RTA schemes as fixed costs for RTA utilization are assumed to be the same for all the available RTA schemes.

Letting R^* represent the RTA scheme with the highest export profit among the available RTA schemes, the probability that an exporter chooses RTA schemes rather than an MFN scheme is obtained in the following manner:

$$
\begin{aligned}
\mathbb{P}_{RTA}(k) = \mathbb{P}\left\{\pi_{R^*}(k) > \pi_M(k)\right\} = \mathbb{P}&\left\{\varphi(k) > \left(\frac{\omega^{\nu-1} f^R \tau^\nu}{Y\zeta\Delta\pi^{op}(k)}\right)^{\frac{1}{\nu-1}}\right\} \\
= \mathbb{P}\Big\{ (\nu-1)\ln\varphi(k) &- \ln f^R - (\nu-1)\ln\omega - \nu\ln\tau \\
+ \ln Y + \ln\zeta &+ \ln\Delta\pi^{op}(k) > 0\Big\}, \qquad \text{(A.2)}
\end{aligned}
$$

where

$$
\Delta\pi^{op}(k) \equiv \left[\theta_{R^*} T_{R^*}\right]^{-\nu} \left[\epsilon_{R^*}(k)\right]^{1-\nu} - T_M^{-\nu} \left[\epsilon_M(k)\right]^{1-\nu}.
$$

The elements that affect the choice between RTA and MFN schemes are shown on the right-hand side of Eq. (A.2). Firms with higher capability are more likely to use RTA schemes rather than an MFN scheme. The probability falls with costs for production and transportation (ω and τ). Furthermore, the probability is positively associated with MFN tariff rates (T_M). All these results are consistent with those by Demidova and Krishna (2008) and Cherkashin et al. (2015) although they do not examine the choice probability explicitly. Further, the probability rises with the demand value of each import firm, which is represented by Y in our theoretical framework, as larger customers (importers) would benefit exporters more as a result of larger sales and larger export profits.

Appendix B. Differences in Tariff Rates and RoOs

Table B.11 shows the distribution of AJCEP preferential products in Thailand. Table B.12 presents the differences in tariff rates and RoOs in Thailand for household or laundry-type washing machines.

Appendix C. Other Estimation Results

In this Appendix, we report some other estimation results. First, we start from the estimation of conditional logit model rather than nested logit model

Table B.11: Distribution of AJCEP Preferential Products in Thailand

		Number	Share (%)
Zero-MFN		1,619	19.5
Immediate Elimination		2,184	26.3
Late Start		384	4.6
	5 Years	3	0.0
	6 Years	16	0.2
	9 Years	320	3.9
	10 Years	45	0.5
Gradual Elimination		3,590	43.26
	1 Year	189	2.3
	2 Years	873	10.5
	3 Years	27	0.3
	4 Years	1,611	19.4
	5 Years	20	0.2
	6 Years	116	1.4
	7 Years	415	5.0
	9 Years	339	4.1
Partial Reduction		84	1.0
Exclusion		439	5.3

Source: Authors' calculation using the legal text of AJCEP

Table B.12: Differences in Tariff Rates and RoOs in Thailand for Household or Laundry-Type Washing Machines (Each of a Dry Linen Capacity Not Exceeding 6 kg: HS84501110)

	Tariff (%)	RoOs
MFN	30	
AANZ	0	CH / (CS&RVC35) / RVC40
AC	20	RVC40
ATIGA	0	CH / RVC40
AI	11	CS & RVC35
AJ	0	CH / RVC40
AK	20	CH / RVC40

Source: Authors' computation using the legal text of each RTA for comparisons. The results are shown in Table C.1 and are qualitatively unchanged with those in Table 5. The tariff schemes with lower tariff rates are more likely to be chosen. All coefficients for RoOs dummy variables are significantly estimated. The order of their absolute magnitude is not changed. RTA schemes are also more likely to be chosen in larger transactions or by larger-sized importers.

Second, we focus on imports of finished products. Namely, to exclude the effects of cumulation rules, we focus on trade in which firms cannot enjoy such rules, that is, on imports of finished products, because cumulation rules are utilized when imported intermediate inputs are cumulated. Specifically, we restrict sample products categorized into 112, 122, 51, 61, 62, or 63 in the Broad Economic Categories. In this restricted sample, there are few import transactions under AI or AK. Therefore, we drop import observations under AI and AK and their choices. Due to the same reason, we drop "CTC&RVC" and "WO" from the category of our RoOs dummy variables. The results are shown in Column (I) of Table C.1. As in the previous results, the coefficients for tariff rates and RoOs dummy variables are estimated to be negatively significant. RTA schemes are also more likely to be chosen in larger transactions.

Third, we estimate our model only for trade in products with positive MFN rates. Firms have an incentive to utilize RTA schemes even when importing products with zero MFN rates (i.e., to enjoy cumulation rule). Indeed, in products with zero MFN rates, there are 41,720 transactions under RTA schemes, which constitute 7% of all transactions under RTA schemes.[32] Nevertheless, the motivation to utilize RTA schemes will differ between the cases of products with zero and positive MFN rates. At least in the case of products with zero MFN rates, firms do not have an incentive to lower duty payment on those products by utilizing RTA schemes; therefore, we restrict sample products only to those with positive MFN rates and show the estimation results in Column (II) of Table C.2, which are qualitatively unchanged from the previous results.

Fourth, we add observations of exports from Indonesia to our estimation

[32]The more detailed figures are shown in Appendix D.

sample. So far, we did not include those observations since the number of available tariff schemes is different between Indonesia and the other ASEAN countries (i.e., Indonesia is not a member of AJCEP). However, it is possible to include those observations because the nested logit model requires only defining a universal choice set (Greene, 2002). This is another advantage of the use of nested logit models in the analysis of tariff scheme choice when multiple tariff schemes are available. The results are shown in Column (III) of Table C.1. The number of observations greatly rises. The results are qualitatively unchanged in terms of signs and the order of coefficients for RoOs dummy variables.

Fifth, firms may make their decisions based on annual benefits rather than per-transaction benefits. An ideal way to examine this case is to estimate our nested logit model for the data aggregated according to export firms (and products). However, we cannot take this strategy because our dataset is import data and cannot identify export firms. Instead, we use the data aggregated according to import firms (and products and export countries). The gap between the data aggregated according to export and import firms depends on whether each import firm trades a product with a single firm in an export country. Transaction values used as an independent variable are also aggregated as above. We drop import firm-product-export country observations in which multiple tariff schemes are chosen. For example, one firm imports a product from Singapore under four schemes: ACFTA, ATIGA, AJCEP, and MFN. Approximately 10% of observations are dropped by this treatment.[33] The estimation results are shown in Column (IV) of Table C.1. Overall, the results are qualitatively unchanged through these treatments in terms of signs and significance. One notable difference is that the coefficient for land transport dummy turns out to be significantly negative, indicating higher costs in transportation by truck or railway.

Sixth, we introduce one more explanatory variable in the second stage. So

[33]The patterns of tariff scheme choice for dropped observations is introduced in Appendix E.

far, we have differentiated across RTA schemes only in terms of tariff rates and RoOs. However, member countries differ across RTA schemes. Each ASEAN+1 RTA includes at least one non-ASEAN country (e.g., Japan in the case of AJCEP, and AANZFTA includes two non-ASEAN countries, Australia, and New Zealand). Suppose that a firm in Thailand produces a product using inputs imported from ASEAN countries and exports that product to a plus-one country under the corresponding ASEAN+1 RTA scheme. If the firm "cumulates" those inputs when certifying the origin of the exported product (i.e., the firm enjoys cumulation rules), then those inputs need to be imported under the same ASEAN+1 RTA.[34] As a result, import firms that export to a plus-one country may be more likely to choose the corresponding ASEAN+1 RTA.[35]

To examine this additional element, we introduce a variable of export dummy that takes the value 1 if a firm has a record of exports to a plus-one country in case of the choice of the corresponding ASEAN+1 RTA and 0 otherwise. For example, this variable takes the value 1 in case of the choice of AJCEP if a firm exports any products to Japan and the value 0 in case of the choice of the other schemes. Naturally, this variable always takes the value 0 in the case of the choices of MFN and ATIGA because ATIGA does not have any non-ASEAN plus-one countries.[36] The estimation results are shown in

[34] This is an important requirement to cumulate imported inputs in ASEAN's RTAs. For example, when a firm in Thailand imports intermediate products (including those with zero MFN rates) under the MFN scheme from Malaysia, which is another member of AJCEP, those intermediate products are not taken as originating inputs in AJCEP when exporting to Japan. Only the intermediate products imported under AJCEP can be taken as originating inputs in AJCEP.

[35] Although Bombarda and Gamberoni (2013) theoretically examined the role of diagonal cumulation, their model does not incorporate this mechanism. For more details of cumulation rules or empirical analysis of the trade creation effect of cumulation rules, see Augier et al. (2005), Estevadeordal et al. (2008), and Hayakawa (2014b) in addition to Bombarda and Gamberoni (2013).

[36] Another possible pattern of production is that exporters to Thailand use inputs from a plus-one country (e.g., Malaysian firms import key parts from Japan under AJCEP and export their products to Thailand under AJCEP). Obviously, it is impossible to statistically examine this case because we need the import data of exporters in the other ASEAN countries.

Column (V) of Table C.1. The coefficient for export dummy is insignificantly estimated. This result may indicate that firms in Thailand do not enjoy cumulation rules much in exports to plus-one countries of final goods produced using intermediate inputs imported from other RTA members.[37] The results in the other variables are qualitatively unchanged.

Seventh, based on the outstanding use of ATIGA schemes as found in Table 3, one may consider ATIGA as an exceptional preferential scheme. To examine this possibility, we estimate the three-stage nested logit model, which has a middle stage in the RTA nest. Specifically, given the choice of RTA schemes, firms choose either ATIGA or any other RTA scheme before choosing a specific RTA scheme. The results are shown in Table C.3. IV parameters are estimated to be greater than the value 1 or be negative; thus, they do not meet a sufficient condition for global consistency with the random utility model in discrete choice analysis. This inconsistency may indicate that ATIGA should be placed on the same decision stage as other RTAs. In addition, we estimate another three-stage nested logit model in which firms choose either a group of ATIGA, AANZFTA, AJCEP, and AKFTA or a group of ACFTA and AIFTA at a middle stage. The results are reported in Table C.4. IV parameters are estimated to lie in the unit interval. Log likelihoods are also higher than those in Table 5.

Finally, the results of the mixed logit model are available in Table C.5. Our simulation results using those results are shown in Table C.6.

Appendix D. Zero MFN Rates

Table D.1 shows the number of transactions in products with zero MFN Rates.

[37] Indeed, the number of users of cumulation rules is small in ASEAN. According to the "Survey of Japanese-Affiliated Firms in Asia and Oceania (FY2014)" conducted by the Japan External Trade Organization, only 26 Japanese affiliates in ASEAN enjoy cumulation rules, constituting 2% of all surveyed affiliates in ASEAN, 3% of the exporters, and 7% of the RTA users. It is also worth noting the possibility that firms may meet RoOs even without cumulating imported inputs if domestic content (e.g., labor inputs or local intermediate inputs) is sufficiently high.

Table C.1: Estimation Results: Transaction-level Conditional logit

	(I)	(II)	(III)
ln (1+Tariff)	-10.856***	-12.185***	-10.933***
	[0.792]	[0.716]	[0.841]
1 for CTC	-8.195***	-12.474***	-11.958***
	[0.981]	[1.091]	[1.206]
1 for CTC&RVC	-13.171***	-17.471***	-16.919***
	[0.478]	[0.673]	[0.865]
1 for CTC/RVC	-3.421***	-7.718***	-7.119***
	[0.172]	[0.550]	[0.774]
1 for RVC	-4.353***	-8.654***	-8.079***
	[0.725]	[0.810]	[0.815]
1 for WO	-10.913***	-15.601***	-15.101***
	[1.007]	[1.124]	[1.214]
RTA * ln Transaction Value		0.417***	0.308***
		[0.042]	[0.044]
RTA * ln Export Price			-0.556***
			[0.062]
RTA * Land Transport Dummy			-0.06
			[0.264]
RTA * ln Total Imports			0.153***
			[0.037]
Number of observations	14,906,435	14,906,435	14,906,435
Log likelihood	-178861	-1635408	-1547997

Notes: ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses are standard errors clustered by import firm-product pairs.

Table C.2: Robustness Check: Nested Logit Model

	Finished	Zero MFN	Indonesia	Annual	Export
Dependent variable: Scheme chosen					
ln (1+Tariff)	-4.973***	-6.082***	-5.319***	-7.711***	-7.927***
	[1.189]	[1.284]	[1.207]	[0.192]	[0.902]
1 for CTC	-6.537***	-6.426***	-5.236***	-7.698***	-6.116***
	[0.838]	[0.999]	[0.738]	[0.148]	[0.761]
1 for CTC&RVC		-6.885***	-5.593***	-7.920***	-6.859***
		[1.075]	[0.805]	[0.180]	[0.805]
1 for CTC/RVC	-6.259***	-6.028***	-4.892***	-7.179***	-5.492***
	[0.864]	[0.941]	[0.679]	[0.125]	[0.725]
1 for RVC	-6.671***	-6.104***	-4.994***	-7.601***	-5.552***
	[0.822]	[0.910]	[0.651]	[0.138]	[0.687]
1 for WO		-6.736***	-5.505***	-7.957***	-6.612***
		[1.046]	[0.784]	[0.186]	[0.789]
Export Dummy					-0.176
					[0.142]
Dependent variable: Chosen nest (MFN as a base scheme)					
Inclusive value	0.061	0.09	0.076	0.095	0.145
	[0.015]	[0.023]	[0.021]	[0.008]	[0.024]
ln Transaction Value	0.503***	0.318***	0.365***	0.718***	0.293***
	[0.073]	[0.046]	[0.038]	[0.016]	[0.041]
ln Export Price	-0.690***	-0.440***	-0.497***	-0.485***	-0.541***
	[0.138]	[0.078]	[0.049]	[0.010]	[0.060]
Land Transport Dummy	-0.296	-0.056	-0.299	-0.185***	-0.086
	[0.341]	[0.280]	[0.243]	[0.040]	[0.259]
ln Total Imports	0.121*	0.168***	0.090**	-0.238***	0.149***
	[0.068]	[0.041]	[0.035]	[0.015]	[0.035]
Number of observations	1,681,639	10,345,210	19,059,255	584,970	14,906,435
Log likelihood	-222003.59	-1313377.2	-2120269.4	-25228.745	-1475626.2

Notes: ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses are standard errors clustered by import firm-product pairs. In the "Finished Products" column, we restrict sample products only to finished products, which are categorized into 112, 122, 51, 61, 62, or 63 in the BEC. In column "Zero MFN," we exclude trade in products with zero MFN rates. Column "Indonesia" adds observations of exports from Indonesia to our estimation sample. In column "Annual," we aggregate our transaction-level data up to firm-level annual data and drop import firm-product-export country observations in which multiple tariff schemes are chosen. The export dummy variable takes the value 1 if a firm has a record of exports to a plus-one country in case of the choice of the corresponding ASEAN+1 RTA and 0 otherwise.

Table C.3: Robustness Check: Nested Logit Model

Dependent variable: Scheme chosen	
ln (1+Tariff)	-5.696***
	[0.018]
1 for CTC	59.232***
	[1.662]
1 for CTC&RVC	34.180***
	[0.272]
1 for CTC/RVC	-1.666***
	[0.002]
1 for RVC	47.100***
	[0.375]
1 for WO	-5.744***
	[0.198]
Middle: ATIGA or Other RTAs	
Inclusive value	-25.823***
	[0.211]
Top: MFN or RTA (RTA as a base scheme)	
Inclusive value	1.718*
	[0.011]
Number of observations	14,906,435
Log likelihood	-1262013.9

Notes: This table reports the estimation result of the three-stage nested logit model, which has a middle stage in the RTA nest. Specifically, given the choice of RTA schemes, firms choose either ATIGA or any other RTA scheme before choosing a specific RTA scheme. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses are standard errors clustered by import firm-product pairs. The specification with other explanatory variables did not reach the convergence of log pseudo likelihood.

Table C.4: Results of Three-Stage Nested Logit Model: ACFTA/AIFTA

	(I)	(II)	(III)
Dependent variable: Scheme chosen			
ln (1+Tariff)	-8.270***	-9.541***	-8.016***
	[0.017]	[0.020]	[0.021]
1 for CTC	-3.098***	-7.374***	-6.451***
	[0.016]	[0.021]	[0.023]
1 for CTC&RVC	-3.802***	-8.189***	-7.187***
	[0.084]	[0.097]	[0.090]
1 for CTC/RVC	-2.126***	-6.263***	-5.465***
	[0.003]	[0.010]	[0.015]
1 for RVC	-2.154***	-6.297***	-5.496***
	[0.004]	[0.010]	[0.015]
1 for WO	-2.703***	-6.977***	-6.115***
	[0.013]	[0.020]	[0.022]
Middle: (ACFTA/AIFTA) or Other RTAs			
Inclusive value	0.223***	0.256***	0.226***
	[0.001]	[0.002]	[0.002]
Top: MFN or RTA (RTA as a base scheme)			
Inclusive value	0.048***	0.056***	0.049***
	[0.000]	[0.000]	[0.000]
ln Transaction Value		-0.397***	-0.293***
		[0.001]	[0.001]
ln Export Price			0.550***
			[0.001]
Land Transport Dummy			0.098***
			[0.005]
ln Total Imports			-0.142***
			[0.001]
Number of observations	14,906,435	14,906,435	14,906,435
Log likelihood	-1685560.2	-1540836	-1453929

Notes: This table reports the estimation result of the three-stage nested logit model, which has a middle stage in the RTA nest. Specifically, given the choice of RTA schemes, firms choose either ACFTA/AIFTA or any other RTA scheme before choosing a specific RTA scheme. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses are standard errors clustered by import firm-product pairs.

Table C.5: Estimation Results: Mixed Logit Model

	(I)	(II)	(III)
ln (1+Tariff)	-62.560***	-45.636***	-42.872***
	[5.103]	[6.518]	[5.932]
1 for CTC	-22.691***	-38.628***	-35.133***
	[1.677]	[4.851]	[5.775]
1 for CTC&RVC	-41.859***	-46.889***	-44.372***
	[4.318]	[5.982]	[6.832]
1 for CTC/RVC	-23.610***	-33.385***	-28.874***
	[8.016]	[3.814]	[4.035]
1 for RVC	-21.169***	-36.156***	-33.177***
	[1.707]	[5.293]	[6.302]
1 for WO	-27.025***	-43.844***	-40.769***
	[2.060]	[5.539]	[6.159]
RTA * ln Transaction Value		1.979***	1.391***
		[0.253]	[0.217]
RTA * ln Export Price			-2.570***
			[0.620]
RTA * Land Transport Dummy			-0.212
			[1.179]
RTA * ln Total Imports			0.665***
			[0.227]
Number of observations	14,906,435	14,906,435	14,906,435
Log likelihood	-1547355.8	-1652942.1	-1476333.1

Notes: ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses are standard errors clustered by import firm-product pairs. The specification takes a random coefficients form. All variables are assumed to have normally distributed coefficients. The results in standard deviations are omitted.

Table C.6: Probability Change: Tariff Reduction in Final Year and Least Restrictive RoOs (Percentage Points)

	Tariffs	RoOs
AANZ	0.35	-0.59
AC	-0.002	2.53
ATIGA	-0.74	-3.30
AI	-0.0001	2.56
AJ	0.66	-0.14
AK	-0.05	-1.24
MFN	-0.22	0.18

Notes: The probability changes are based on the estimation result in Column (III) of Table C5.

Table D.1: Number of Transactions in Products with Zero MFN Rates

	All	MFN = 0	Share
AANZ	70,029	19	0.00
AC	604	31	0.05
ATIGA	494,005	41,667	0.08
AI	6	0	0.00
AJ	285	1	0.00
AK	28	2	0.07
Total	564,957	41,720	0.07

Source: Authors' computation

Table E.1: Combination of Two RTA Schemes in Three-Scheme Users

	AANZ	AC	ATIGA
ATIGA	1	26	
AI			1
AJ			2
AK			2

Source: Authors' computation

Table E.2: Combination of Two Schemes in Two-Scheme Users

	AANZ	AC	ATIGA	AJ	AK
ATIGA	1	46			
AI			3		
AK			3		
MFN	4	25	3,209	2	2

Source: Authors' computation

Appendix E. Utilization of Multiple Tariff Schemes

In this Appendix, we introduce the patterns of tariff scheme choice by firms who import a given product from a given country under multiple tariff schemes in 2014. First, one firm imports a product from Singapore under four schemes, including ACFTA, ATIGA, AJCEP, and MFN schemes. Second, there are 32 firm-product pairs that import from a given country under an MFN scheme and two RTA schemes. The combination of the latter two schemes is reported in Table E.1. Most of the three-scheme users utilize AANZFTA, ACFTA, and MFN schemes. Furthermore, more than 3,000 firm-product pairs import from a given country under two schemes, of which the combination is shown in Table E.2. MFN and ATIGA schemes are utilized by most of the two-scheme users.

Appendix F. Choice Probabilities

Table F.1 shows choice probabilities of respective nests and alternatives.

Table F.1: Choice Probabilities of Respective Nests and Alternatives

	$\mathbb{P}_{Alt\|Nest}(k)$	$\mathbb{P}_{Alt}(k)$
AANZ	0.23318	0.06246
AC	0.09441	0.02388
ATIGA	0.31042	0.10162
AI	0.00001	0.00000
AJ	0.16224	0.03089
AK	0.20025	0.04580
MFN	1	0.73549

Source: Authors' computation

References

Amiti, M., Javorcik, B.S., 2008. Trade costs and location of foreign firms in China. Journal of Development Economics 85, 129–149.

Augier, P., Gasiorek, M., Tong, C.L., 2005. The impact of rules of origin on trade flows. Economic Policy 20, 567–624.

Bhagwati, J., Greenaway, D., Panagariya, A., 1998. Trading preferentially: Theory and policy. Economic Journal 108, 1128–1148.

Bombarda, P., Gamberoni, E., 2013. Firm heterogeneity, rules of origin, and rules of cumulation. International Economic Review 54, 307–328.

Bureau, J.C., Chakir, R., Gallezot, J., 2007. The utilisation of trade preferences for developing countries in the agri-food sector. Journal of Agricultural Economics 58, 175–198.

Cadot, O., Carrere, C., de Melo, J., Tumurchudur, B., 2006. Product-specific rules of origin in EU and US preferential trading arrangements: An assessment. World Trade Review 5, 199–224.

Cadot, O., de Melo, J., 2007. Why OECD countries should reform rules of origin. World Bank Research Observer 23, 77–105.

Carrere, C., de Melo, J., 2006. Are different rules of origin equally costly? estimates from NAFTA, in: Cadot, O., Estevadeordal, A., Suwa-Eisenmann, A., Verdier, T. (Eds.), The Origin of Goods, Rules of Origin in Regional Trade Agreements. Oxford University Press, Oxford. chapter 7.

Chen, M.X., Joshi, S., 2010. Third-country effects on the formation of free trade agreements. Journal of International Economics 82, 238–248.

Chen, M.X., Moore, M.O., 2010. Location decision of heterogeneous multinational firms. Journal of International Economics 80, 188–199.

Cherkashin, I., Demidova, S., Kee, H.L., Krishna, K., 2015. Firm heterogeneity and costly trade: A new estimation strategy and policy experiments. Journal of International Economics 96, 18–36.

Chung, W., 2016. Imported inputs and invoicing currency choice: Theory and evidence from UK transaction data. Journal of International Economics 99, 237–250.

Demidova, S., Krishna, K., 2008. Firm heterogeneity and firm behavior with conditional policies. Economics Letters 98, 122–128.

Egger, P., Larch, M., 2008. Interdependent preferential trade agreement memberships: an empirical analysis. Journal of International Economics 76, 384–399.

Estevadeordal, A., , Suominen, K., 2008. What are the trade effects of rules of origin?, in: Estevadeordal, A., , Suominen, K. (Eds.), Gatekeepers of Global Commerce: Rules of Origin and International Economic Integration. Inter-American Development Bank, Washington D.C.. chapter 5, pp. 161–219.

Francois, J., Hoekman, B., Manchin, M., 2006. Preference erosion and multilateral trade liberalization. World Bank Economic Review 20, 197–216.

Greene, W.H., 2002. Nlogit reference guide: Version 3.0. Econometric Software, Incorporated, New York.

Hakobyan, S., 2015. Accounting for underutilization of trade preference programs: U.S. generalized system of preferences. Canadian Journal of Economics 48, 408–436.

Hayakawa, K., 2011. Measuring fixed costs for firms' use of a free trade agreement: Threshold regression approach. Economics Letters 113, 301–303.

Hayakawa, K., 2014a. Does firm size matter in exporting and using FTA schemes? Journal of International Trade and Economic Development 24, 883–905.

Hayakawa, K., 2014b. Impact of diagonal cumulation rule on FTA utilization: Evidence from bilateral and multilateral FTAs between Japan and Thailand. Journal of the Japanese and International Economies 32, 1–16.

Hayakawa, K., Laksanapanyakul, N., Urata, S., 2016. Measuring the costs of FTA utilization: Evidence from transaction-level import data of Thailand. Review of World Economics 152, 559–575.

Hayakawa, K., Urata, S., Yoshimi, T., 2017. Choosing between multiple preferential tariff schemes: Evidence from Japan's imports. RIETI Discussion Paper 17002, Research Institute of Economy, Trade and Industry (RIETI).

Head, K., Mayer, T., 2004. Market potential and the location of Japanese investment in the European Union. Review of Economics and Statistics 86, 959–972.

Helpman, E., Melitz, M., Rubinstein, Y., 2008. Estimating trade flows: Trading partners and trading volumes. Quarterly Journal of Economics 123, 441–487.

Helpman, E., Melitz, M.J., Yeaple, S.R., 2004. Export versus FDI with heterogeneous firms. American Economic Review 94, 300–316.

Hole, A.R., 2007. Fitting mixed logit models by using maximum simulated likelihood. Stata Journal 7, 388–401.

Hornok, C., Koren, M., 2015. Administrative barriers to trade. Journal of International Economics 96, S110–S122.

Hur, J., Alba, J.D., Park, D., 2010. Effects of hub-and-spoke free trade agreements on trade: A panel data analysis. World Development 38, 1105–1113.

Keck, A., Lendle, A., 2012. New evidence on preference utilization. World Trade Organization, Staff Working Paper ERSD-2012-12.

Kropf, A., Sauré, P., 2014. Fixed costs per shipment. Journal of International Economics 92, 166–184.

Lee, J.W., Park, I., Shin, K., 2008. Proliferating regional trade arrangements: Why and whither? The World Economy 31, 1525–1557.

Maggi, G., Rodríguez-Clare, A., 2007. A political-economy theory of trade agreements. American Economic Review 97, 1374–1406.

Manchin, M., 2006. Preference utilisation and tariff reduction in EU imports from ACP countries. The World Economy 29, 1243–1266.

Mayer, T., Mejean, I.J., Nefussi, B., 2010. The location of domestic and foreign production affiliates by French multinational firms 68, 115–128.

McFadden, D.L., 1978. Modelling the choice of residential location, in: Karlqvist, A., Snickars, F., Weibull, J. (Eds.), Spatial Interaction Theory and Planning Models. North Holland, Amsterdam, pp. 75–96.

Raff, H., Ryan, M., Stähler, F., 2012. Firm productivity and the foreign-market entry decision. Journal of Economics & Management Strategy 21, 849–871.

Sorgho, Z., 2016. RTAs' proliferation and trade-diversion effects: Evidence of the 'spaghetti bowl' phenomenon. The World Economy 39, 285–300.

Takahashi, K., Urata, S., 2010. On the use of FTAs by Japanese firms: Further evidence. Business and Politics 12, 1–17.

Tavares, R., Tang, V., 2011. Regional economic integration in africa: Impediments to progress? South African Journal of International Affairs 18, 217–233.

Train, K., 2003. Discrete Choice Methods with Simulation. Cambridge University Press, Cambridge.

Ulloa, A., Wagner-Brizzi, R., 2013. Why don't all exporters benefit from free trade agreements? estimating utilization costs. Mimeograph, Tufts University.

Yang, Y., Gupta, S., 2007. Regional trade arrangements in africa: Past performance and the way forward. African Development Review 19, 399–431.