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Firm-level Utilization Rates of Regional Trade Agreements: Importers' Perspective

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Abstract: While previous theoretical studies have examined exporters' choice of tariff schemes without considering explicit heterogeneity of importers, an empirical analysis on regional trade agreement (RTA) utilization is, in general, possible by employing trade data covering the importers' side. To better link the empirical analysis with a theoretical model, this study develops a model that sheds light on the role of both importers' and exporters' characteristics in RTA utilization. The model enables us to replicate stylized facts concerning importers' RTA utilization. Based on this model, we derive some propositions on the determinants of RTA utilization rates (i.e., share of imports under RTA schemes out of total imports) at an import firm-product level. Finally, we found that these theoretical predictions are supported by highly detailed import data in Thailand from Australia from 2007 to 2009.

Keywords: RTA; Utilization; Thailand

JEL Classification: F15; F53

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1. Introduction

Recent studies on regional trade agreements (RTAs) employ trade data according to tariff schemes such as RTA schemes or most-favored-nation (MFN) schemes. Traditionally, RTAs have been empirically investigated by employing regular trade data, i.e., trade data that cannot differentiate between tariff schemes. Such studies have mainly examined the existence of trade creation effects arising from RTAs.[1] More recently, on the other hand, trade researchers have started to employ product-level trade data according to tariff schemes. In particular, such studies show that not all exporters necessarily utilize RTA schemes even when exporting to RTA partner countries.[2] Furthermore, prior studies have also examined the determinants of preferential trade utilization rates and found that the utilization rates are higher for products with a larger preference margin (i.e., difference between MFN rates and preference rates), larger trade volumes, and less restrictive rules of origin (RoOs).[3] Namely, these studies have obtained interesting findings that have yet to be clarified in traditional studies employing regular trade data.

Along with this trend in empirical analysis on RTAs, some theoretical studies have examined exporters' choice of tariff schemes while keeping settings for importers as simple as possible. For example, Demidova and Krishna (2008) introduce exporters' choice of tariff schemes into the firm-heterogeneity model of Melitz (2003). They assume that exporters need to pay additional variable and fixed costs to utilize RTA schemes. Such variable costs arise owing to the need to adjust procurement sources so as to comply with RoOs. Fixed costs for RTA utilization are assumed to be administrative costs for collecting required documents, including a list of inputs, a production flow chart, production instructions, invoices for each input, and contract documents. By incurring these costs, RTA users can utilize RTA schemes, which provide lower tariff rates than MFN schemes. Under these settings, they theoretically demonstrate that more productive exporters use RTA schemes to a greater extent than less productive exporters. The latter type of exporters make less use of MFN schemes because they cannot earn sufficient operating profits to cover the fixed costs for RTA utilization. A similar theoretical model is also developed in Cherkashin et al. (2015).

In contrast to these theoretical studies that consider RTA utilization from the

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[1] Some studies using such trade data include those by Baier and Bergstrand (2007) and Magee (2006).
[2] Also, several other studies investigated the effects of preferential utilization on prices and found export prices rise after RTA schemes are utilized. Those include studies by Bureau et al. (2007), Cadot et al. (2006), Francois et al. (2006), Manchin (2006), and Hakobyan (2015).
[3] Examples are Cadot et al. (2005), Olarreaga and Ozden (2005), Ozden and Sharma (2006), and Cirera (2014).

export side, trade data according to tariff schemes are usually available from the import side. This reflects the fact that data on RTA utilization for export is technically difficult to obtain. In the case of imports, RTA utilization data can usually be obtained from customs records. Those data are obtained from the issuance of certificates of origin (CoOs) in the case of exports.[4] However, when a self-certification system is adopted,[5] there is no way of knowing the tariff scheme used by the exporter since CoOs information is retained by the exporting companies. Furthermore, exporters do not necessarily export products under RTA schemes even after they have obtained CoOs. Thus, export-side data based on the issuance of CoOs are likely to overestimate the true value of RTA exports. Therefore, as in the case of regular trade data, import-side data are believed to be more accurate than export-side data regarding RTA scheme use.

In order to better link the empirical analysis with the theoretical model, it is important to develop a model that can shed light on the role of importers' characteristics in RTA utilization. There are two main reasons. First, it seems difficult to empirically investigate variables specified in the exporter-side model. For example, as shown in Demidova and Krishna (2008), such a model elucidates the significant contribution of exporters' productivity to their choice of tariff schemes. Therefore, at a product-level, preference utilization rates will be closely related to export-side variables such as average *export values* among exporters. On the other hand, we can empirically examine the size of "import transactions" because preference eligibility is set at a tariff line–level for importing countries and it is difficult to obtain trade data at such a level from the exporting country's side.[6] As a result, export values are measured by annual import values (e.g., Hakobyan, 2015), the monthly average of import values (e.g., Hayakawa and Laksanapanyakul, 2016), the customs district-level monthly average of import values (e.g., Keck and Lendle, 2012), or the average of firm-level import values (e.g., Hayakawa et al., 2014). Obviously, these measures are not necessarily consistent with the average of firm-level export values, particularly when country–product–level matching of exporters and importers is not one-to-one.

Second, it is difficult to conduct a detailed analysis on RTA utilization without specifying the role of importer characteristics. As mentioned above, firm-level empirical analyses are possible only when we investigate each *importer*'s utilization of RTA

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[4] One notable exception is Cherkashin et al. (2015), who employ firm-level export data on the utilization of the Generalized System of Preferences/Program from Bangladesh to Europe and the U.S. However, their dataset covers only the apparel industry.

[5] For example, these include NAFTA, the U.S.-Australia Free Trade Agreement (FTA), the U.S.–Singapore FTA, the Trans-Pacific Partnership, the Singapore–New Zealand FTA, the Thailand–New Zealand FTA, the Australia–New Zealand FTA, the Mexico–Chile FTA, and the U.S.–Korea FTA.

[6] As is well known, a most detailed internationally comparable level of HS codes is six digits.

schemes, not each *exporter*'s utilization. As introduced in the next section, significant differences exist in RTA utilization across importers. In particular, some importers utilize only MFN schemes, whereas some importers use only RTA schemes. Furthermore, some importers utilize both MFN and RTA schemes despite importing the identical product from the same country. However, usual theoretical studies consider homogeneous importers and provide no way to explain or rationalize such differences in RTA utilization across importers. In other words, the theoretical predictions derived from a model that does not consider importers' heterogeneity cannot serve as a good guide to analyze *importer*'s utilization of RTA schemes.

Against this backdrop, this paper is an attempt to fill this gap by developing a theoretical model of RTA utilization from the importers' perspective by providing a theoretical framework to reveal the link between importers' characteristics and RTA utilization. We also empirically examine the predictions derived from the proposed framework. Regarding exporters' choice of tariff schemes, we follow existing studies such as Demidova and Krishna (2008) and Cherkashin et al. (2015). Thus, decisions on tariff scheme choices are in the exporters' hands. However, importers are supposed to be heterogeneous in our model and exporters explicitly refer to importers' characteristics when making decisions. Specifically, following Bernard et al. (2015), we assume that importers are heterogeneous in terms of productivity and bundle inputs into a final product. As a result, not every exporter sells to every buyer in a country. Highly productive exporters reach many customers, i.e., importers. In addition, highly productive importers buy from many exporters. Since highly productive exporters are more likely to utilize RTA schemes, highly productive importers have a higher share of import transactions under RTA schemes. This implies that importers with some range of productivity have import transactions under both RTA and MFN schemes, which is consistent with the above-mentioned fact on importers' RTA utilization.

Using this theoretical model, we derive some propositions regarding firm-level utilization on RTA schemes in importing. We examine import firm-product-level utilization rates on RTA schemes, which are defined as the share of imports under RTA schemes in total imports at a firm-product level. Specifically, we derive two main propositions. One is that such importer RTA utilization rates are positively correlated with importer size, which is captured by imports from the world. The other is that those rates are higher when the preference margin is larger. Then, using detailed import data for Thailand, we empirically examine the validity of these theoretical propositions. Our data for Thailand enable us to identify not only the firm, source country, and commodity at a harmonized system (HS) eight-digit level but also the tariff scheme (e.g., RTA or

MFN scheme) used by the importing firm. Therefore, this dataset enables us to compute RTA utilization rates in importing at a firm-product level. As a result, we will show empirical results consistent with the above theoretical predictions.

The rest of this paper is organized as follows. Section 2 offers an overview of firm-level RTA utilization and presents some evidences. In this section, the significance of RTA scheme "partial users" (i.e., importers that use both RTA and MFN schemes), which has never been highlighted in the literature, will be pointed out. We provide the theoretical model on import firms' RTA utilization in Section 3 and derive the above-mentioned theoretical predictions in Section 4. Those theoretical propositions are empirically examined in Section 5. In addition, since almost all previous studies on RTA utilization are conducted at the product level, we also derive some theoretical predictions on product-level RTA utilization from our theoretical model, which will be also empirically tested. Section 6 discusses the implications of our results and concludes this paper.

2. Stylized Facts

This section provides some facts on firm-level RTA utilization. To this end, we employ transaction-level import data obtained from the Customs Office of the Kingdom of Thailand and cover all commodity imports in Thailand. Our dataset contains customs clearing date, HS eight-digit code, exporting country, firm identification code, tariff scheme (e.g., RTA or MFN), and import values in Thai Baht (THB). We use data on imports aggregated by years in addition to source countries, HS eight-digit codes, firms, and tariff schemes. We classify tariff schemes into three categories, namely MFN scheme, RTA scheme, 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.

We first show the number of RTA users in 2008. In that year, Thailand had seven RTAs. The first RTA concluded by Thailand was the ASEAN free trade agreement (FTA), which entered into force in 1993. It became effective among Brunei, Indonesia, Malaysia, the Philippines, Singapore, and Thailand. More countries later joined into this FTA (Vietnam in 1995, Laos and Myanmar in 1997, and Cambodia in 1999). Thailand also has bilateral RTAs with India, Japan, Australia, and New Zealand, which entered into force in 2004, 2007, 2005, and 2005, respectively. In the case of a bilateral RTA with India, only the early harvest program (i.e., limited coverage of liberalized products)

has been available. The RTA with China, concluded with ASEAN members as the ASEAN–China FTA, entered into force in 2005. Except for the bilateral RTA with Japan, tariff rates in all RTAs are basically reduced on January 1 every year.[7]

Table 1 reports the number/share of import firm-product-level observations according to RTA use and export countries. "Product" is defined at an HS eight-digit level. The export country-product observations are restricted to those in which RTA rates are lower than MFN rates.[8] We can immediately see that the majority of importers do not use RTA schemes. The highest share of RTA users can be found in the case of importing from Indonesia, followed by New Zealand, at 29% and 22%, respectively. In terms of absolute numbers, the number of RTA users is outstanding in the case of importing from China. While greater than 10,000, its share is 19%. Our finding here can be simply summarized as follows.

Stylized Fact 1. *Both RTA users and non-users import from RTA partner countries.*

=== Table 1 ===

Next, we decompose RTA users into partial users and full users. The former are defined as those who import under both MFN and RTA schemes, whereas the latter import only under RTA schemes. The number and share of each type are shown in Table 2. Although the number of full users is larger than that of partial users in most cases, the number of partial users is a non-negligible number. For example, the share of partial users is around 30% in the cases of Australia, China, India, Malaysia, and the Philippines. Moreover, it is larger than the share of full users in the case of Japan.[9] The case of Singapore also reports the relatively high share of partial users (48%). In short, there are a significant number of partial users when we examine RTA utilization from the viewpoint of importers. This fact has never been revealed in the literature. The

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[7] More precisely, in the ASEAN–China FTA, tariff rates are reduced not later than January 1. Thus, it is unclear exactly when tariff rates are reduced each year. Also, in the early-harvest program of the Thailand–India FTA, tariff reduction was completed on September 1, 2006, which is before our sample period.

[8] In the case of exports from ASEAN, not only the ASEAN FTA but also the ASEAN–China FTA is available. In this case, we restrict our analysis to products in which either/both of these two FTAs provide lower preferential rates than MFN rates.

[9] This larger share of partial users may be partly attributable to the timing of tariff reduction in RTAs with Japan. Every year, RTA rates are changed on April 1, which is the start date of the Japanese fiscal year. Therefore, in the case of the first year of tariff reductions during the phase-in period, firms may import under MFN schemes from January to March and then under RTA schemes from April. Namely, when the timing of the introduction of RTA tariff rates is different from the calendar year, the number of partial users will likely be larger.

finding is simply summarized as follows.

Stylized Fact 2. *There are both full users and partial users among firms who import from RTA partner countries under RTA schemes.*

=== Table 2 ===

Finally, we offer an overview of the distribution of firm-product-level RTA utilization rates for partial users to show how varied firm-product-level RTA utilization rates are in a range of (0, 1). Those rates are computed at a value-basis, i.e., share of imports under RTA schemes out of total imports at a firm-product level. The tendency is similar across export countries, so we only report the case of Australia.[10] Figure 1 depicts such a distribution in imports from Australia. Note that tariff rates in the case of the RTA with Australia are reduced on January 1 every year. The figure shows that the density rises with the utilization ratio. In particular, it dramatically rises at around 0.8. From these findings, we can see that partial users mainly use RTA schemes rather than MFN schemes.

=== Figure 1 ===

3. The Model

The previous section revealed striking facts on RTA use by Thai importing firms. Several recent studies such as those by Demidova and Krishna (2008) and Cherkashin et al. (2015) succeeded in replicating the fact that some exporters use RTA schemes and others use MFN schemes even among RTA member countries by assuming the existence of fixed costs for RTA utilization, which typically represents the documentation cost to comply with RoOs. If this cost is significantly high for exporters, exports can be made using MFN tariff rates even when exporting to RTA member countries. Here, we examine RTA use by importing firms. The above Stylized Facts 1 and 2 suggest that some importers use RTA schemes and others use MFN schemes, and there are full and partial users among RTA users. These facts cannot be replicated with typical models where importers are homogeneous.

In this section, we develop a theoretical model that replicates those stylized facts by assuming both exporters and importers are heterogeneous in their productivity.

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[10] Figures for other countries are available upon request.

Heterogeneity in exporters does not necessarily need to be considered to replicate Stylized Fact 1. However, to replicate Stylized Fact 2, it is natural to assume heterogeneity not only of importers but also of exporters. As in Bernard et al. (2015), in order to replicate the partial use of an RTA scheme, we assume dual heterogeneity in the productivity of exporters and importers and provide some empirically testable propositions. Setup for other aspects of the model can be briefly described in the following manner. Final-good producers combine domestic and imported intermediate inputs, produce outputs, and sell them to the representative household in their home countries. Thus, final-good producers are importers of intermediate inputs in our model. Intermediate-good producers input domestic labor force, produce outputs, and sell them to domestic and foreign final-good producers.

3.1. Representative Household

In the economy, there are J countries. The representative household consumes varieties of final goods. The utility function of the representative household in the country j is given by

$$U_j = c_j = \left(\int_0^1 c_{jk}^{\frac{\sigma-1}{\sigma}} dk \right)^{\frac{\sigma}{\sigma-1}} \qquad 1 < \sigma < \infty.$$

where c_j is the consumption index, c_{jk} is the consumption amount of the final-good variety k, and σ is the elasticity of substitution between varieties. The demand function of each variety is derived as

$$c_{jk} = \left(\frac{p_{jk}}{P_j} \right)^{-\sigma} c_j,$$

where p_{jk} is the price of each variety, and P_j is the consumer price index, which is defined by

$$P_j = \left(\int_0^1 p_{jk}^{1-\sigma} dk \right)^{\frac{1}{1-\sigma}}.$$

We assume that nominal income Y_j is exogenously endowed and that it is used only for final-goods consumption. Thus,

$$c_j = \frac{Y_j}{P_j} \qquad \text{and} \quad c_{jk} = \left(\frac{p_{jk}}{P_j} \right)^{-\sigma} \frac{Y_j}{P_j}.$$

3.2. Final-Good Producers (Importers)

Final-good producers combine domestic and imported intermediate inputs,

produce outputs, and sell them to the representative household in their home countries. Thus, final-good producers are importers of intermediate inputs in our model. The production technology of each final-good producer k is represented by the following CES aggregator:

$$y_{jk} = a_k \left(\int_0^1 q_{jkl}^{\frac{\kappa-1}{\kappa}} dl \right)^{\frac{\kappa}{\kappa-1}} \quad 1 < \kappa < \infty.$$

where κ is the elasticity of substitution between varieties of intermediate goods.[11] a_k is importer-specific productivity. Furthermore, q_{jkl} is the input index of intermediate good l and is defined by

$$q_{jkl} = \left(\sum_{i=1}^{J} \int_{\omega \in \Omega_{jkl}(i)} [q_{jkl}(i,\omega)]^{\frac{\nu-1}{\nu}} d\omega \right)^{\frac{\nu}{\nu-1}}, \quad 1 < \nu < \infty,$$

where $q_{jkl}(i,\omega)$ is the input amount of intermediate good l produced by intermediate-good producer ω in the country i, ν is the elasticity of substitution between l inputs produced by alternative firms, and $\Omega_{jkl}(i)$ is the set of firms that sell intermediate goods to the final-good producer. Cost minimization implies the following demand schedules:

$$q_{jkl}(i,\omega) = \left(\frac{z_{jkl}(i,\omega)}{z_{jkl}} \right)^{-\nu} q_{jkl} \quad \text{and} \quad q_{jkl} = a_k^{\kappa-1} \left(\frac{z_{jkl}}{z_{jk}} \right)^{-\kappa} y_{jk},$$

where

$$z_{jkl} = \left(\sum_{i=1}^{J} \int_{\omega \in \Omega_{jkl}(i)} [z_{jkl}(i,\omega)]^{1-\nu} d\omega \right)^{\frac{1}{1-\nu}} \quad \text{and} \quad z_{jk} = a_k^{-1} \left(\int_0^1 z_{jkl}^{1-\kappa} dl \right)^{\frac{1}{1-\kappa}}.$$

Following Helpman et al. (2008) we assume that a_k follows a bounded Pareto distribution given by

$$G_a(a) = \frac{1 - (a^L)^\alpha a^{-\alpha}}{1 - \left(\frac{a^L}{a^H} \right)^\alpha}, \quad 0 < a^L < a^H,$$

where a^L and a^H, respectively, represent lower and upper bounds of a_k. This distribution enables us to replicate not only zero trade but also RTA non-, partial-, and

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[11] We assume that intermediate-good varieties are continuously distributed in $[0,1]$, which indicates that the number of those varieties in our model is infinite. In other words, each variety is assumed to be small in the input basket so that the price of each variety does not affect the input price index. This assumption enables us to derive clear propositions on the effects of the tariff ratio. We believe that this assumption is acceptable as the number of varieties in our dataset is 8,300 and each variety is supposed to be small enough.

full-users in a given product between two particular countries. Following Demidova and Krishna (2008), we also assume $\alpha > \nu$. Through profit maximization by each final-good producer, the price of each variety k is derived as

$$p_{jk} = \frac{\sigma}{\sigma - 1} z_{jk}.$$

The final-good market clearing condition is given by

$$y_{jk} = c_{jk} = \left(\frac{p_{jk}}{P_j}\right)^{-\sigma} \frac{Y_j}{P_j} \quad \text{or} \quad y_{jk} = c_{jk} = a_k^{\sigma} \left(\frac{\sigma}{\sigma - 1} \left[\int_0^1 z_{jkl}^{1-\kappa} dl\right]^{\frac{1}{1-\kappa}} \frac{1}{P_j}\right)^{-\sigma} \frac{Y_j}{P_j}.$$

3.3. Intermediate-Good Producers (Exporters)

Intermediate-good producers input domestic labor force, produce outputs, and sell them to domestic and foreign final-good producers. We suppose that production technology of each intermediate-good producer ω follows the simple linear function over labor force given by

$$o_l(i, \omega) = \varphi(\omega) n_l(i, \omega).$$

where $\varphi(\omega)$ is exporter-specific productivity, and $n_l(i, \omega)$ is the labor input. We assume that $\varphi(\omega)$ follows a bounded Pareto distribution given by

$$G(\varphi) = \frac{1 - (\varphi^L)^{\alpha} \varphi^{-\alpha}}{1 - \left(\frac{\varphi^L}{\varphi^H}\right)^{\alpha}}, \quad 0 < \varphi^L < \varphi^H,$$

where φ^L and φ^H, respectively, represent lower and upper bounds of $\varphi(\omega)$. The marginal cost of each intermediate-good producer is given by

$$mc_i(\omega) = \frac{w_i}{\varphi(\omega)},$$

where w_i is the wage rate.

3.4. Choice of Tariff Schemes

In the model, exporters, i.e., intermediate-good producers, choose a tariff scheme such to maximize their sales profits. Sales profits when each intermediate-good producer ω exports to a foreign final-good producer under MFN and RTA schemes, respectively, are given by

$$\pi_{jkl}^M(i, \omega) = \left(\tilde{z}_{jkl}(i, \omega) - \frac{w_i}{\varphi(\omega)}\right) q_{jkl}^M(i, \omega) - f_{ij},$$

$$\pi_{jkl}^R(i, \omega) = \left(\tilde{z}_{jkl}(i, \omega) - \frac{w_i}{\varphi(\omega)}\right) q_{jkl}^R(i, \omega) - f_{ij} - f_{ij}^d.$$

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where f_{ij} is fixed costs for trading. Without loss of generality, we assume that those costs are zero for domestic trading ($f_{ii} = 0$) for simplicity. f_{ij}^d is fixed costs for RTA scheme utilization such as documentation preparation cost.[12] $\tilde{z}_{jkl}(i, \omega)$ is the mill price and is given by

$$\tilde{z}_{jkl}(i, \omega) = \frac{\nu}{\nu - 1} \frac{w_i}{\varphi(\omega)} \equiv \tilde{z}(i, \omega).$$

Under respective schemes, export prices are represented by

$$z_{jkl}^M(i, \omega) = x_{ijl} \tau_{ij} \tilde{z}(i, \omega) \equiv z_{jl}^M(i, \omega),$$
$$z_{jkl}^R(i, \omega) = \theta_{ijl} \mu_{ijl} x_{ijl} \tau_{ij} \tilde{z}(i, \omega) \equiv z_{jl}^R(i, \omega).$$

where x_{ijl} is per-unit MFN tariff ($x_{ijl} > 1$), τ_{ij} is iceberg trade cost ($\tau_{ij} > 1$), μ_{ijl} is the share of tariff escaped paying under the RTA scheme ($1 > \mu_{ijl} > 0$), and θ_{ijl} is per-unit cost for RTA utilization ($\theta_{ijl} > 1$). Specifically, μ_{ijl}^{-1} is interpreted as the preference margin. We assume $\theta_{ijl} \mu_{ijl} < 1$ so that not all exports are undertaken under the RTA scheme. To obtain testable hypotheses for the preference margin's effect on RTA utilization rate, we assume $\kappa = \sigma = \nu$.[13] As a result, profits are rewritten as

$$\pi_{jkl}^M(i, \omega) = A_k \Phi(\omega) \Psi_{ij} \left(\frac{1}{x_{ijl}}\right)^\nu - f_{ij},$$

$$\pi_{jkl}^R(i, \omega) = A_k \Phi(\omega) \Psi_{ij} \left(\frac{1}{\theta_{ijl} \mu_{ijl} x_{ijl}}\right)^\nu - f_{ij} - f_{ij}^d,$$

where

$$\Phi(\omega) = [\varphi(\omega)]^{\sigma-1}, \quad A_k = a_k^{\nu-1},$$
$$\Psi_{ij} = P_j \left(\frac{1}{w_i/P_j}\right)^{\nu-1} (\nu - 1)^{2\nu-1} \left(\frac{1}{\tau_{ij}}\right)^\nu \left(\frac{1}{\nu}\right)^{2\nu} \frac{Y_j}{P_j}.$$

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[12] Helpman et al. (2004) and Helpman et al. (2008) assume that exporters pay fixed costs for exporting to each destination and do not consider a case where exporters deal with exporting processes for multiple destinations at the same time, thus saving the total fixed cost. In other words, they do not suppose economies of scale for the fixed costs. Regarding the fixed cost for RTA utilization, we simply follow these studies and assume that exporters pay the fixed cost for RTA utilization as part of each transaction. Mitigation of those fixed costs through exporters' learning is not considered as the model is static. Although these extensions would lead to richer theoretical consequences, we do not examine such cases to keep the model simple and tractable. Furthermore, we do not suppose entry and exit of final-good producers into or from international transactions of intermediate inputs. This consequence relies on our assumption that the fixed costs for market entry, importing, and RTA utilization are zero for final-good producers, i.e., importers. Relaxing this assumption does not induce any qualitative changes to our results if importers' decisions on market entry are settled before exporters' decisions are made.

[13] In our model, the number of countries is assumed to be finite, and time-series changes in the preference margin impact the price index. As a result, the effect of the preference margin on the RTA utilization rate becomes too complicated to derive clear testable hypotheses. Therefore, we assume a simplification assumption, $\kappa = \sigma = \nu$, and try to obtain clear testable hypotheses. As shown in a later section, our theoretical predictions are strongly supported by our empirical investigations.

Thus, we find that profits are increasing in importer's (a_k) and exporter's $[\varphi(\omega)]$ productivity. Furthermore, the difference in profits under MFN and RTA schemes can be rewritten as

$$\pi_{jkl}^R(i,\omega) - \pi_{jkl}^M(i,\omega) = A_k \Phi(\omega)\Psi_{ij}\left(\frac{1}{x_{ijl}}\right)^\nu \left[\left(\frac{1}{\theta_{ijl}\mu_{ijl}}\right)^\nu - 1\right] - f_{ij}^d.$$

This implies that RTAs are more beneficial than MFNs when both exporter and importer have higher productivity.

Taking importer's productivity as given, we now derive three thresholds for exporter productivity. The first and second thresholds, respectively, define ranges of exporters that gain positive profits by trading with an importer with productivity a_k under MFN and RTA schemes. Respective threshold conditions are given by $\pi_{jkl}^M(i,\omega) = 0$ and $\pi_{jkl}^R(i,\omega) = 0$, which are rewritten as

$$\bar{\varphi}_{jkl}^M(i) = \left[\frac{f_{ij}}{a_k^{\nu-1}\Psi_{ij}}x_{ijl}^\nu\right]^{\frac{1}{\nu-1}} \quad \text{and} \quad \bar{\varphi}_{jkl}^R(i) = \left[\frac{f_{ij} + f_{ij}^d}{a_k^{\nu-1}\Psi_{ij}}(\theta_{ijl}\mu_{ijl}x_{ijl})^\nu\right]^{\frac{1}{\nu-1}}.$$

Exporters with productivity above those thresholds can gain positive profits by trading with an importer with productivity a_k under the respective schemes. The third threshold defines the range of exporters that gain larger profits under the RTA scheme than the MFN scheme. The threshold condition is represented by $\pi_{jkl}^R(i,\omega) = \pi_{jkl}^M(i,\omega)$, which is rewritten as

$$\bar{\varphi}_{jkl}^{R\geq M}(i) = \left[\frac{f_{ij}^d}{a_k^{\nu-1}\Psi_{ij}}\frac{x_{ijl}^\nu}{(\theta_{ijl}\mu_{ijl})^{-\nu}-1}\right]^{\frac{1}{\nu-1}}.$$

Thus, exporters with productivity above $\bar{\varphi}_{jkl}^{R\geq M}(i)$ prefer RTAs to MFNs to trade with an importer with productivity a_k.

There are two possible cases of tariff scheme use. First, some exporters use an RTA scheme to trade with an importer, whereas others use an MFN scheme with that same importer when the relative attractiveness of RTA to MFN is not so significant. This case happens when $\bar{\varphi}_{jkl}^M(i) < \bar{\varphi}_{jkl}^R(i)$, which can be rewritten as

$$\left(1 + \frac{f_{ij}^d}{f_{ij}}\right)^{\frac{1}{\nu}} > \frac{1}{\theta_{ijl}\mu_{ijl}}. \tag{1}$$

Following the literature, we call this case the heterogeneous regime. Condition (1) implies that the heterogeneous regime appears when (i) fixed costs for RTA utilization are sufficiently large relative to those for exporting, (ii) the share of tariffs avoided under the RTA scheme is sufficiently low, or (iii) per-unit costs for RTA utilization are

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sufficiently small.

Figure 2 graphically demonstrates how the difference in profits under RTA and MFN schemes, i.e., $\pi_{jkl}^R(i,\omega) - \pi_{jkl}^M(i,\omega)$, is related to importer and exporter productivity in the heterogeneous regime using hypothetical parameter values.[14] The figure shows that either importer or exporter productivity has to be high so that the RTA scheme is employed. In other words, given the distribution of exporter productivity, an importer's share of RTA transactions is supposed to rise with its productivity. This implies that more productive importers are likely to have higher RTA utilization rates. In the next section, we will formally demonstrate that firm-product-level RTA utilization rates are positively associated with importer productivity. Furthermore, Figure 3 demonstrates a case where the lower-bound productivity of exporters is significantly high. In this case, consistent with Stylized Fact 1, we find some importers use only an RTA scheme and others use only an MFN scheme even for the same product. Furthermore, the figure also shows that there are full and partial users of RTA schemes, replicating Stylized Fact 2.

===   Figures 2 and 3   ===

All the transactions will use the RTA scheme when Condition (1) does not hold. In other words, firms import solely under RTA schemes when (i) fixed costs for RTA utilization are sufficiently low compared with those for exporting, (ii) RTA rates are sufficiently low compared with MFN rates, or (iii) the restrictiveness of RTA utilization is sufficiently weak. This case is referred to as the homogeneous regime. In the homogeneous regime, all importers become RTA full users, and partial use of RTA schemes does not appear. As our aim is to examine partial use, we rule out the homogeneous regime and focus on the heterogeneous regime in our main investigation. However, as noted above and demonstrated in Figure 3, RTA full users can appear even in the heterogeneous regime when the lower bound of exporters' productivity is sufficiently high.

4. Importers' Characteristics and Firm-Product-Level RTA Utilization

This section considers how importers' characteristics are related to firm-product-level RTA utilization based on the proposed model. The model assumes

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[14] Parameter values are chosen so that Equation (1) holds and those values do not contradict estimations in existing studies such as Gali and Monacelli (2005) and Cherkashin et al. (2015).

that importers are heterogeneous in terms of productivity. However, because of data limitations, we cannot directly identify each importer's productivity. Thus, we consider how the "size" of each importer, which is defined as each importer's total imports of a given product from the world and which is observable, is related to RTA utilization.

4.1. Import Firm-Product-Level RTA Utilization

To be consistent with the above stylized facts, we focus on importers' RTA utilization rates, which are defined as share of imports under RTA schemes out of total imports at an import firm-product level. In the model, exporters optimally choose the tariff scheme for each international transaction considering not only their own productivity but also the importers' productivity. When the importer is more productive, exporters can gain larger profits from exporting in general because a more productive importer purchases more from each exporter. Therefore, the more productive exporters will export to such importers under RTA schemes because their profits from exporting can cover fixed costs arising from RTA utilization. Also, more productive importers will import from a larger number of exporters. As a result, importers with sufficiently low productivity have transactions only with exporters using MFN schemes, whereas importers with sufficiently high productivity trade not only with exporters using MFN schemes but also with those using RTA schemes. Trading partners of the more productive importers are more likely to be exporters under RTA schemes. In short, firm-product-level RTA utilization rates are positively associated with importer productivity levels.

The above assertion on the relationship between importer productivity and firm-product-level RTA utilization rates is derived from the fact that more productive importers are larger customers for exporters in the sense that they purchase more than less productive importers. Furthermore, more productive importers import from a larger number of exporters. Thus, it is natural to expect that the extent of total imports of a given product from the rest of the world by more productive importers, which we call the size of importers, is larger than for those of less productive importers.[15] Thus, we predict a positive correlation between importer size and the firm-product-level RTA utilization rates when importing from a concerned country. We summarize this prediction as the following testable proposition:[16]

Proposition 1. *Import firm-product-level RTA utilization rates are higher for*

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[15] Appendix A1 formally proves this prediction.

[16] Proofs of propositions on firm-product-level RTA utilization are shown in Appendix A2.

larger-sized importers.

Our theoretical framework also suggests the effect of RTA rates on firm-product-level RTA utilization rates. When RTA rates are low relative to MFN rates, exporters are supposed to prefer the RTA tariff scheme. In contrast, exporters do not perceive the relative attractiveness of the RTA tariff scheme when RTA rates are close to MFN rates. Thus, defining the preference margin as the ratio of MFN rates to RTA rates, we formally propose this prediction in the following manner:

Proposition 2. *Import firm-product-level RTA utilization rates are higher when preference margins are larger.*

As mentioned in the empirical sections, previous empirical studies have examined the role of the preference margin, which is defined as the difference between MFN rates and RTA rates. Although our theoretical analysis uses the above-defined ratio as the preference margin simply for tractability, these two measures are qualitatively the same.

We should also emphasize some other characteristics that affect import firm-product-level utilization rates. In particular, as noted above, exporters have to comply with RoOs when exporting under an RTA scheme. For instance, exporters have to prove that the share of the total value of the inputs imported from non-member countries is less than a certain percentage (e.g., 40%) of prices in exported products when the regional value content (RVC) rule is applied to their exporting products.[17] In our model, θ_{ijl} captures the restrictiveness of RoOs. If the RoOs are more restrictive for exporters, more exporters hesitate to use the RTA scheme. As a result, other things being equal, RTA utilization rates become lower for each importer when the RTA scheme is more restrictive.

4.2. Product-Level RTA Utilization

Most previous studies examine preference utilization at a product level. Thus, it is worth discussing how product-level RTA utilization rates, which are defined as the share of imports under RTA schemes out of total imports at a product level, are theoretically related to importer characteristics. As counterparts to firm-level productivity in the above firm-level analysis, we first examine how the average size of importers can be

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[17] Other examples of RoOs are the change-in-tariff classification rule, the technical requirement/specific process rule, and the wholly obtained rule.

correlated with product-level RTA utilization rates.[18] Accordingly, we suppose an extreme case where the upper bound of importers' productivity is infinity, take the shape parameter of productivity distribution as given, and consider the case where changes in average importer sizes are purely generated by changes in the lower bound of importer productivity. As a result, the following corollary is derived:

Corollary 1. *Product-level RTA utilization rates in imports are higher for products with larger average importer sizes.*

Product-level RTA utilization rates are higher when the share of importers that provide exporters enough profits to cover the fixed cost of RTA utilization is larger. This is more likely to happen when importers' average productivity is higher. Importer size is found to be increasing in its productivity. Thus, average importer size is positively correlated with average productivity. As a result, product-level RTA utilization rates for imports are revealed to increase in average importer size.

Regarding preference margins, the same discussion as per Proposition 2 straightforwardly provides the following corollary:

Corollary 2. *Product-level RTA utilization rates in imports are higher when the preference margin is larger.*

When the preference margin is larger, more exporters can gain export profits that cover the fixed costs for RTA utilization. Taking importers' productivity as given, a larger preference margin enhances the utilization of RTA schemes in each firm's import transactions. Furthermore, owing to lower tariff rates, exporters under RTA schemes have larger trade values than those under MFN schemes. As a result, product-level RTA utilization rates in imports rise with the preference margin.

5. Empirical Analysis

Using the detailed import data for Thailand, which are the same as those used in Section 2, this section empirically examines the validity of the above theoretical predictions. We first analyze import firm-product-level utilization rates of RTA schemes (i.e., Propositions 1 and 2) and then their product-level utilization rates (i.e., Corollaries 1 and 2). Basic statistics for empirical analysis are provided in Table 3.

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[18] Appendix A3 provides proofs of corollaries on product-level RTA utilization.

=== Table 3 ===

5.1. Empirical Framework

We investigate the determinants of import firm-product-level utilization rates. The analysis focuses on one specific export country, which is explained below. Thus, our sample dimension is import firm-product-year. To be consistent with our theoretical discussion, we estimate the following simple equation:

$$U_{fpt}^{Firm-Product} = \gamma_1 Margin_{pt} + \gamma_2 \ln Total\ Imports_{fpt} + u_{RoO} + u_t + \epsilon_{fpt} \quad (2)$$

The dependent variable is import firm-product-level RTA utilization rates, which lie in the range of [0, 1]. $Margin_{pt}$ represents the preference margin of product p in year t and is defined as the difference between MFN and RTA rates, as in most previous empirical studies.[19] $\ln Total\ Imports_{fpt}$ is a log of firm f's total imports of product p from the world in year t. As stated in Propositions 1 and 2, the sign on coefficients for these two variables should be positive. Section 4 also points out the role of RoOs, which is controlled for by introducing RoO dummy variables (u_{RoO}). Year fixed effects (u_t) capture the effects of year-specific macro shocks such as changes in exchange rates.

We estimate this model by employing a fractional logit estimation technique proposed by Papke and Wooldridge (1996) because our dependent variable lies in the unit interval. The fractional logit model (FRAC) ensures that, unlike the ordinary least-squares (OLS) method, predicted values for the dependent variable are in the unit interval. Also, unlike the log-odds ratio model and beta regression model, it can naturally define dependent variables for the boundary values 0 and 1. It imposes less-restrictive assumptions than the Tobit model, which requires the normality and homoscedasticity of the dependent variables (for more details, see Ramalho et al., 2011). For comparison purposes, we also estimate our model by OLS.

We employ the same dataset as in Section 2. In particular, we focus on imports by Thailand from Australia during 2007–2009. This aim is to obtain a significant number of observations and to avoid analyzing firms' complicated decisions on tariff schemes. In this period, Australia had only one RTA with Thailand, a bilateral RTA that entered into force in 2005. On the other hand, for example, Japan has not only a bilateral RTA but also a plurilateral RTA with Thailand, particularly from 2009. When multiple RTA schemes are available, firms can choose a tariff scheme from among MFN rates,

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[19] The preference margin is defined in the form of ratio (μ_{ijl}^{-1}) in the theoretical section (i.e., Appendix A) mainly for ease of mathematical computation. In the empirical section, on the other hand, we use its measure that is most frequently used in the empirical literature, i.e., the difference between MFN and RTA rates.

bilateral RTA rates, and plurilateral RTA rates rather than simply choosing between MFN and RTA rates. We also avoid examining plurilateral RTAs. In this period, for example, the other ASEAN member states and China have such RTAs with Thailand. However, those include diagonal cumulation rules among several countries. Since our theoretical model does not take such rules into consideration, we focus on bilateral RTAs. Finally, although India and New Zealand also have single bilateral RTAs with Thailand in this period, as shown in Table 1, the number of import observations is too small to be empirically investigated.

5.2. Baseline Results

The estimation results are shown in column "All" in Table 4. This column includes all products including those in which RTA rates are the same as MFN rates. We cluster standard errors at various levels. In cases of both OLS and FRAC and at any level of clustering, both coefficients for Margin and Total Imports are estimated to be significantly positive at a 1% significance level. Namely, import firm-product-level utilization rates of RTA schemes are higher for products with a larger preference margin and when importer sizes are larger in terms of total imports from the world. These results are consistent with Propositions 1 and 2 and are unchanged even when excluding products in which RTA rates are the same as MFN rates, as shown in column "Positive margin."[20]

===   Table 4   ===

5.3. Robustness Checks

We conduct three types of robustness checks on the above results. First, we exclude importers who have positive import values under "other schemes." This exclusion reflects the fact that importers may follow a different decision process whenever "other schemes" are available to them. At least, in this case, importers' choice becomes not binary but multiple-choice (i.e., MFN, RTA, and other schemes), unlike our theoretical discussion in the previous section. Therefore, we drop the above-mentioned importers, i.e., other-scheme users. The results are shown in the "Excluding Others" column in Table 5. As in Table 4, we estimate the model for all products and products with a positive preference margin. Both cases show the significantly positive coefficients on both preference margin and importer size.

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[20] To save space, we do not report the estimation results in RoO dummy variables, which are available upon request. The sample distribution of RoOs is provided in Appendix B.

=== Table 5 ===

Second, we restrict sample products only to materials or parts. In the theoretical framework, we assumed that intermediate inputs are tradable and final goods are non-tradable, and focused on imports of intermediate inputs. Although this assumption was merely for simplicity and was not crucial, we estimate only for imports of materials or parts to make the empirical analysis consistent with the model setup. Specifically, we restrict our analysis to products categorized into 111, 112, 21, 31, 42, and 53 in the Broad Economic Categories. The results are reported in the "Materials" column in Table 5. We again found significantly positive coefficients on preference margin and importer size.

Finally, we introduce various fixed effects in our OLS estimation. The results are reported in Table 6. In columns (I) and (II), we add import firm fixed effects. Instead of firm fixed effects and year fixed effects, import firm-year fixed effects are introduced in columns (III) and (IV). Then, we introduce import firm-year fixed effects and import firm-product fixed effects in columns (V) and (VI). We estimate each model for all products and products with a positive preference margin. The results show that except for column (VI), the estimation results are qualitatively unchanged. Namely, coefficients on both Margin and Total Imports are estimated to be significantly positive, consistent with Propositions 1 and 2. Owing to our estimation of linear models, it is easy to quantitatively interpret our results. For example, column (I) indicates that a 10-percentage-point rise of preference margin leads to a 3-percentage-point rise of firm-level utilization rates. Also, a double (i.e., 100%) increase of importer size raises the utilization rates by 0.76 of a percentage point. Namely, the quantitative effect on firm-level utilization rates looks trivial in the case of firm sizes, compared with the case of preference margin.

=== Table 6 ===

5.4. Product-Level Analysis

Next, we investigate the determinants of product-level utilization rates by aggregating our firm-product-level dataset to product-level data, i.e., data at an HS eight-digit level. This analysis aims not only to test the validity of our theoretical prediction in the product level but also to examine the consistency with previous product-level studies. On the basis of the aggregated dataset, we estimate the following

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equation:
$$U_{pt}^{Product} = \beta_1 Margin_{pt} + \beta_2 \ln Mean_{pt} + u_{RoO} + u_t + \epsilon_{pt}. \qquad (3)$$
The dependent variable is product-level RTA utilization rates. As suggested in Corollary 1, we introduce $\ln Mean_{pt}$, which is the log of averaged imports of a given product over all sample importers. Its coefficient is expected to be positive. As stated in Corollary 2, a larger margin is supposed to lead to higher product-level RTA utilization rates. Thus, β_1 is expected to be positive.

The estimation results are reported in Table 7. For all products, results from both OLS and FRAC show a significantly positive coefficient on Margin, indicating that product-level RTA utilization rates are higher for products with a larger preference margin. The mean in firm-level imports also has significant coefficients. Consistent with Corollary 1, its sign is positive. Namely, product-level RTA utilization rates are higher for products with a higher mean importer size. This result is consistent not only with Corollary 2 but also with the findings in previous studies on the determinants of product-level RTA utilization.

===   Table 7   ===

6. Concluding Remarks

While previous theoretical studies have examined exporters' choice of tariff schemes without considering the heterogeneous characteristics of importers, empirical analysis of RTA utilization is in general possible only by employing trade data from the importers' side. In order to better link empirical analyses with the theoretical model, this paper developed a model that sheds light on the role of heterogeneity among importers in RTA utilization additional to that among exporters. Specifically, we introduce productivity heterogeneity for both exporters and importers into the model on exporter choice of tariff schemes and used the resulting theoretical model to derive some propositions. Our main propositions are that import firm-product-level utilization rates of RTA schemes are positively correlated with importer sizes and preference margin. Similarly, we also demonstrate that product-level utilization rates of RTA schemes are higher for products with a larger preference margin and larger average importer size. Finally, we found that these theoretical predictions are supported by the highly detailed import data for Thai imports from Australia during the 2007–2009 period.

Our results have the following policy implication. In public, policy measures for exporters have been proposed to enhance the utilization of RTA schemes. In particular,

since the major costs of RTA utilization arise in the process of complying with RoOs and obtaining CoOs, discussions have considered how to change such processes to become more business-friendly. Namely, this discussion concerns how to encourage exporters to utilize RTA schemes because exporters basically need to undertake these processes. However, our results show that policy measures for importers also have potential to enhance RTA scheme utilization in international trade. In particular, we theoretically found positive effects arising from importers' productivity in terms of their sizes and RTA scheme utilization rates. Furthermore, consistent with that theoretical prediction, it is empirically revealed that importers' sizes and RTA scheme utilization rates are positively correlated. Therefore, policy measures to help importers improve their productivity and expand in size should in turn enhance the use of RTA schemes in imports. Although these measures for importers are indirect ones in terms of addressing RTA issues, they will nonetheless contribute to enhancing RTA utilization in international trade.

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Table 1. Numbers of RTA Non-Users and Users in Thailand's Imports in 2008

| | Non-users | | Users | |
	Number	Share (%)	Number	Share (%)
Australia	10,835	89	1,356	11
China	44,582	81	10,501	19
India	1,220	96	57	4
Japan	91,585	98	1,565	2
New Zealand	1,427	78	401	22
Indonesia	6,613	71	2,679	29
Cambodia	352	91	36	9
Lao PDR	740	88	102	12
Myanmar	1,178	94	69	6
Malaysia	17,747	87	2,704	13
Philippines	3,358	86	529	14
Singapore	31,967	98	590	2
Vietnam	4,213	83	879	17

Source: Authors' computation

Note: The table shows the number/share of firm-HS eight-digit observations according to RTA use. The export country-product observations are restricted to those in which RTA rates are lower than MFN rates.

Table 2. Numbers of RTA Partial Users and Full Users in Thailand's Imports in 2008

| | Partial-users | | Full-users | |
	Number	Share (%)	Number	Share (%)
Australia	376	28	980	72
China	2,719	26	7,782	74
India	17	30	40	70
Japan	994	64	571	36
New Zealand	77	19	324	81
Indonesia	590	22	2,089	78
Cambodia	4	11	32	89
Lao PDR	17	17	85	83
Myanmar	12	17	57	83
Malaysia	802	30	1,902	70
Philippines	182	34	347	66
Singapore	281	48	309	52
Vietnam	184	21	695	79

Source: Authors' computation

Note: The table shows the number/share of firm-HS eight-digit observations according to the extent of RTA use. The export country-product observations are restricted to those in which RTA rates are lower than MFN rates.

Table 3. Basic Statistics

	Obs	Mean	Std. Dev.	Min	Max
Import firm-product-level					
Utilization rates	45,971	0.0690	0.2480	0	1
Margin	45,971	0.0738	0.0899	0	2.5971
ln Total Imports	45,971	11.7757	3.3658	0	26.0343
Product-level					
Utilization rates	9,655	0.0976	0.2724	0	1
Margin	9,655	0.0735	0.1009	0	2.5971
Mean in firm-level imports	9,655	14.3377	1.6904	5.8406	25.1926

Table 4. Firm-Product-Level Regression

	All		Positive margin	
	(I)	(II)	(III)	(IV)
	OLS	FRAC	OLS	FRAC
Margin	0.6909	8.0278	0.724	7.371
Heteroscedasticity-consistent	[0.0238]***	[0.2275]***	[0.0302]***	[0.2486]***
Cluster firm	[0.0709]***	[0.4767]***	[0.0823]***	[0.5473]***
Cluster product	[0.0748]***	[0.5949]***	[0.0889]***	[0.6539]***
ln Total Imports	0.0118	0.1937	0.0166	0.227
Heteroscedasticity-consistent	[0.0003]***	[0.0057]***	[0.0005]***	[0.0064]***
Cluster firm	[0.0009]***	[0.0165]***	[0.0012]***	[0.0183]***
Cluster product	[0.0011]***	[0.0133]***	[0.0015]***	[0.0156]***
Log pseudolikelihood		-8705.31		-7663.61
R-squared	0.1449		0.1588	
Number of observations	45,971	45,971	34,916	34,916

Notes: ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain various kinds of standard errors. In all specifications, RoO dummy variables in addition to year fixed effects are included. "OLS" and "FRAC" indicate that we estimate this model by OLS and fractional logit model, respectively. In the "Positive margin" column, we restrict sample products only to those with a positive preference margin.

Table 5. Robustness Checks by Fractional Logit Model: Firm-Product-Level Regression

	Excluding Others		Materials	
	(I)	(II)	(III)	(IV)
Margin	7.7844***	7.2294***	11.2457***	10.8847***
	[0.2418]	[0.2659]	[0.4353]	[0.4459]
ln Total Imports	0.1829***	0.2168***	0.0626***	0.0963***
	[0.0061]	[0.0069]	[0.0131]	[0.0150]
Product	All	Positive	All	Positive
Log pseudolikelihood	-7723.02	-6772.54	-1794.58	-1620.57
Number of observations	44,549	33,684	10,653	8,280

Notes: ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain heteroscedasticity-consistent standard errors. In the "Excluding Others" column, we exclude importers who have positive import values under "other schemes." In the "Materials" column, we restrict to products categorized into 111, 112, 21, 31, 42, and 53 in the Broad Economic Categories. In Product category, "Positive" means that we restrict sample products only to those with a positive preference margin.

Table 6. Robustness Checks by OLS: Firm-Product-Level Regression

	(I)	(II)	(III)	(IV)	(V)	(VI)
Margin	0.3117***	0.3282***	0.2591***	0.2909***	0.3012**	0.2296
	[0.0184]	[0.0239]	[0.0181]	[0.0237]	[0.1475]	[0.1546]
ln Total Imports	0.0076***	0.0100***	0.0074***	0.0097***	0.0087***	0.0102***
	[0.0004]	[0.0005]	[0.0004]	[0.0006]	[0.0019]	[0.0022]
RoO Dummy	YES	YES	YES	YES	NO	NO
Year Dummy	YES	YES	NO	NO	NO	NO
Firm Dummy	YES	YES	NO	NO	NO	NO
Firm-year Dummy	NO	NO	YES	YES	YES	YES
Firm-product Dummy	NO	NO	NO	NO	YES	YES
Product	All	Positive	All	Positive	All	Positive
R-squared	0.6329	0.6578	0.7385	0.756	0.9309	0.941
Number of observations	45,971	34,916	45,971	34,916	14,380	10,820

*Notes*: ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain heteroscedasticity-consistent standard errors. In the "Positive" column, we restrict sample products only to those with a positive preference margin.

Table 7. Product-Level Regression

	All		Positive margin	
	(I)	(II)	(III)	(IV)
	OLS	FRAC	OLS	FRAC
Margin	0.714	6.6488	0.6676	5.6575
Heteroscedasticity-consistent	[0.0595]***	[0.4279]***	[0.0656]***	[0.4560]***
Cluster HS 6-digit code	[0.0931]***	[0.5629]***	[0.1023]***	[0.6010]***
Mean in firm-level imports	0.0164	0.1832	0.0283	0.2585
Heteroscedasticity-consistent	[0.0018]***	[0.0197]***	[0.0026]***	[0.0232]***
Cluster HS 6-digit code	[0.0026]***	[0.0275]***	[0.0036]***	[0.0320]***
Log pseudolikelihood		-2374.884		-2075.833
R-squared	0.1565		0.1582	
Number of observations	9,655	9,655	7,020	7,020

*Notes*: ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain heteroscedasticity-consistent standard errors. In all specifications, RoO dummy variables in addition to year fixed effects are included. "OLS" and "FRAC" indicate that we estimate this model by OLS and fractional logit model, respectively. In the "Positive margin" column, we restrict sample products only to those with a positive preference margin.

Figure 1. Density of Partial Utilization Rates in Imports from Australia in 2008

kernel = epanechnikov, bandwidth = 0.0504
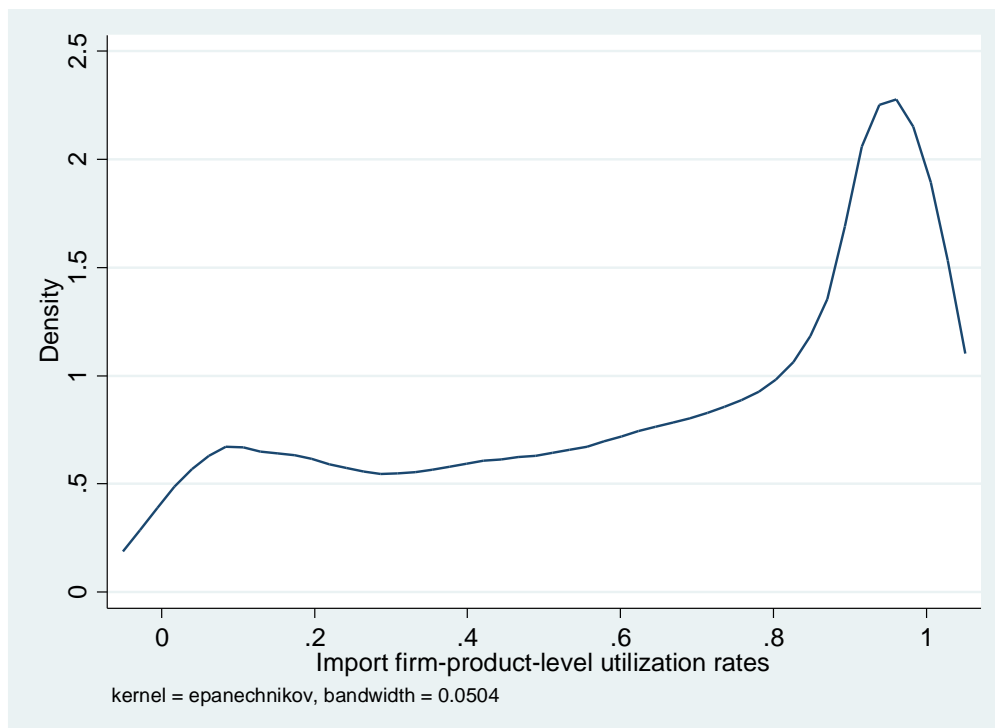
Source: Customs, Kingdom of Thailand

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Figure 2. Heterogeneous Regime
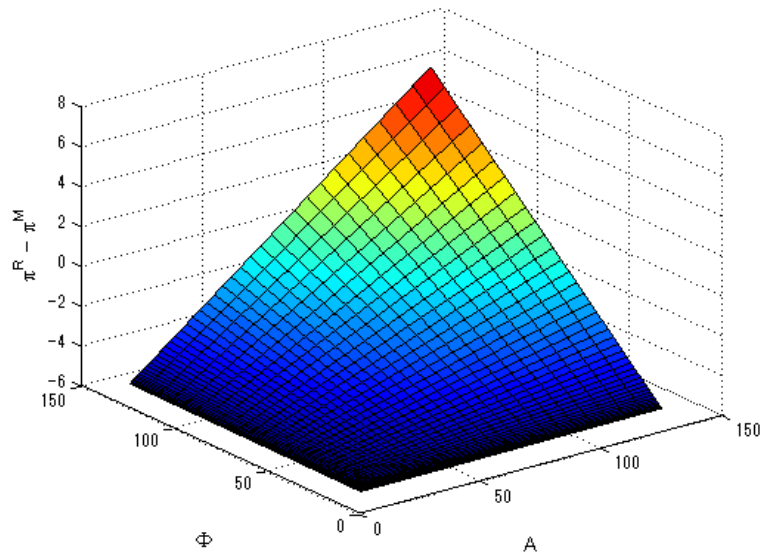
Note: Author's computation with the following parameter values: $\sigma = 4$, $\nu = 4$, $f = 10$, $w = 1$, $\tau = 1.1$, $P = 1$, $Y = 1$, $x = 1.3$, $\theta = 1.15$, $\mu = 0.85$, $f^d = 5$, $\varphi^L = a^L = 1$, and $\varphi^H = a^H = 5$.

Figure 3. Heterogeneous Regime with High Value for Lower-Bound Productivity of Exporters
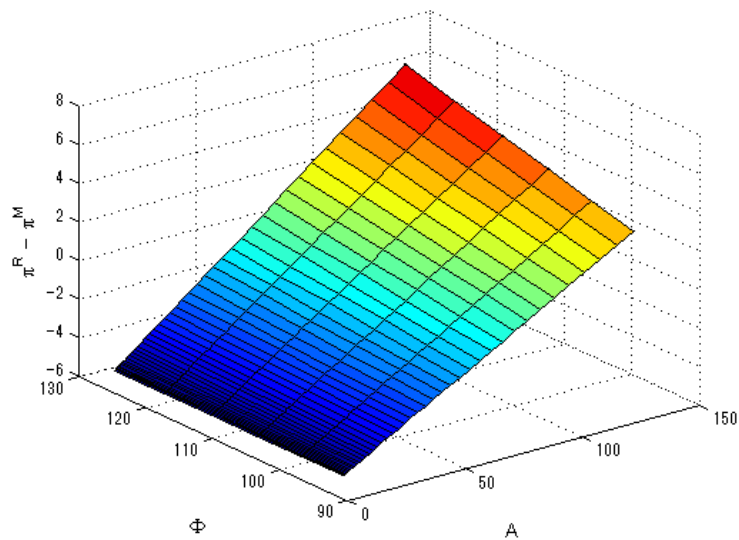
Note: Author's computation with the following parameter values: $\sigma = 4$, $\nu = 4$, $f = 10$, $w = 1$, $\tau = 1.1$, $P = 1$, $Y = 1$, $x = 1.3$, $\theta = 1.15$, $\mu = 0.85$, $f^d = 5$, $\varphi^L = 4.5$, $a^L = 1$, and $\varphi^H = a^H = 5$.

Appendix A. Proofs of Propositions

A1. Productivity and Firm-Level Imports

Total imports by each importer can be derived in the following manner:

$$Q_{jk} = \sum_{i=1}^{J} \int_0^1 \left[Q_{jkl}^M(i) + Q_{jkl}^R(i) \right] dl.$$

We can prove that

$$\frac{\partial Q_{jk}}{\partial a_k} > 0,$$

which implies that each firm's total imports, which we call *size* of each firm, are increasing in its productivity. This is straightforward because both $Q_{jkl}^M(i)$ and $Q_{jkl}^R(i)$ are increasing in importer's productivity as shown above. It is also straightforwardly proved that the mean of the size of importers increases with the mean of importers' productivity.

A2. Firm-Product-Level RTA Utilization in Imports (Propositions 1 and 2)

Now we move our focus to importer characteristics. We assumed heterogeneity not only in exporter productivity but also in importer productivity to reveal the link between the latter's heterogeneity and share of imports under the RTA scheme in total imports, which we call RTA utilization rates. To do that, we first derive each final-good producer's total imports of a particular intermediate input under the RTA scheme to derive RTA utilization rates in imports at a firm-product level. We assume Condition (1) to see the case where multiple tariff schemes are utilized in the trade of given product l between two countries. As discussed in Section A4, an intermediate-good producer exports to a final-good producer under the RTA scheme when $\varphi(\omega) > \bar{\varphi}_{jkl}^{R \geq M}(i)$, or

$$\varphi(\omega) > \left[\frac{f_{ij}^d}{a_k^{\nu-1} \Psi_{ij}} \frac{x_{ijl}^{\nu}}{(\theta_{ijl}\mu_{ijl})^{-\nu} - 1} \right]^{\frac{1}{\nu-1}}.$$

Thus, importer k's imports of intermediate input l from country i's exporters under the RTA scheme is derived as

$$Q_{jkl}^R(i) = \int_{\left[\frac{f_{ij}^d}{A_k \Psi_{ij}(\theta_{ijl}\mu_{ijl})^{-\nu}} \frac{x_{ijl}^{\nu}}{-1} \right]^{\frac{1}{\nu-1}}}^{\varphi^H} z_{jkl}(i,\omega) q_{jkl}(i,\omega) G(\varphi)$$

$$= \left[\frac{\Psi_{ij}}{f_{ij}^d} \frac{(\theta_{ijl}\mu_{ijl})^{-\nu} - 1}{x_{ijl}^\nu} \right]^{\frac{1+\alpha-\nu}{\nu-1}} (\theta_{ijl}\mu_{ijl})^{1-\nu}\lambda_{ijkl}\dot{a}_k - \left[\frac{1}{\varphi^H} \right]^{1+\alpha-\nu} (\theta_{ijl}\mu_{ijl})^{1-\nu}\lambda_{ijkl},$$

where

$$\dot{a}_k = a_k^{1+\alpha-\nu} \text{ and } \lambda_{ijkl} = \frac{1}{1+\alpha-\nu} \frac{\alpha(\varphi^L)^\alpha}{1 - \left(\frac{\varphi^L}{\varphi^H}\right)^\alpha} \left[x_{ijl}\tau_{ij} \frac{\nu}{\nu-1} w_i \right]^{1-\nu} \left(\frac{1}{z_{jkl}}\right)^{-\nu} q_{jkl}.$$

Thus, total imports under the RTA scheme are revealed to be increasing in importer's productivity (a_k).

Next, we derive imports under the MFN scheme. An intermediate-good producer exports to a final-good producer under the MFN scheme when $\bar{\varphi}_{jkl}^M(i) < \varphi(\omega) < \bar{\varphi}_{jkl}^{R \geq M}(i)$. This condition is rewritten as

$$\left[\frac{f_{ij}^d}{A_k\Psi_{ij}} \frac{x_{ijl}^\nu}{(\theta_{ijl}\mu_{ijl})^{-\nu} - 1} \right]^{\frac{1}{\nu-1}} > \varphi(\omega) > \left[\frac{f_{ij}}{A_k\Psi_{ij}} x_{ijl}^\nu \right]^{\frac{1}{\nu-1}}.$$

Thus, importer k's imports of intermediate input l from country i's exporters under the MFN scheme is derived as

$$Q_{jkl}^M(i) = \int_{\left[\frac{f_{ij}}{A_k\Psi_{ij}} x_{ijl}^\nu \right]^{\frac{1}{\nu-1}}}^{\left[\frac{f_{ij}^d}{A_k\Psi_{ij}(\theta_{ijl}\mu_{ijl})^{-\nu}-1} \right]^{\frac{1}{\nu-1}}} z_{jkl}(i,\omega)q_{jkl}(i,\omega)G(\varphi)$$

$$= \left(\left[\frac{\Psi_{ij}}{x_{ijl}^\nu f_{ij}} \right]^{\frac{1+\alpha-\nu}{\nu-1}} - \left[\frac{\Psi_{ij}}{x_{ijl}^\nu f_{ij}^d} \left(\left[\frac{1}{\theta_{ijl}\mu_{ijl}} \right]^\nu - 1 \right) \right]^{\frac{1+\alpha-\nu}{\nu-1}} \right) \lambda_{ijkl}\dot{a}_k$$

Thus, total imports under the MFN scheme are revealed to be increasing in importer's productivity (a_k). The relation is shown by Figure A1.

As a result, firm-product-level RTA utilization rates are given by

$$\tilde{R}_{jkl}^R(i) = \frac{Q_{jkl}^R(i)}{Q_{jkl}^M(i) + Q_{jkl}^R(i)}. \tag{A1}$$

We can prove

$$\frac{\partial \tilde{R}_{jkl}^R(i)}{\partial a_k} > 0,$$

which implies that firm-product-level RTA utilization rates for imports are increasing in importers' productivity (Proposition 1). Figure A2 depicts the relation between importer's productivity and firm-product-level RTA utilization rates. The effect of importer productivity can be decomposed into intensive and extensive margins. When

importer's productivity becomes higher, the importer increases import amounts both under MFN and RTA schemes (intensive margin). This effect is captured by λ_{ijkl} above. This does not affect $\tilde{R}^R_{jkl}(i)$ as impacts through the intensive margin on $Q^M_{jkl}(i)$ and $Q^R_{jkl}(i)$ are same. [21] Also, a part of MFN transactions is switched to RTA transactions when importer's productivity becomes higher (extensive margin). This switching is because RTA transactions become more beneficial for exporters that used to utilize the MFN scheme. This increases the numbers of RTA-trade partners and RTA imports $Q^R_{jkl}(i)$. The improvement of an importer's productivity scoops up foreign intermediate-good producers that did not export to this importer, resulting in an increased number of MFN-trade partners. However, this positive effect is partly offset by the above switching effect. As a result, $\tilde{R}^R_{jkl}(i)$ is found to be increasing in a_k.

Furthermore, we can prove the following relation:

$$\frac{\partial \tilde{R}^R_{jkl}(i)}{\partial \mu_{ijl}} < 0.$$

This relation implies that firm-product-level RTA utilization rates in imports are higher when the preference margin (μ^{-1}_{ijl}) is larger (Proposition 2). We also find that $\partial \tilde{R}^R_{jkl}(i) / \partial \theta_{ijl} < 0$, which states that firm-product-level RTA utilization rates in imports are lower for the more restrictive RTA scheme. The preference margin's effect can be decomposed into intensive and extensive margins. As in the effect of importers' productivity discussed in Proposition 1, the extensive margin is revealed to be the major driver of Proposition 2.

A3. Product-Level RTA Utilization in Imports (Corollaries 3 and 4)

As in existing studies such as Demidova and Krishna (2008), suppose an extreme case where $a^H \to \infty$. In this extreme case, importers' mean productivity is given by

$$M = \frac{\alpha}{\alpha - 1} a^L.$$

Thus, the lower bound of importers' productivity has to rise when its mean rises, taking the shape of parameter α as given. Further, $\tilde{R}^R_{jl}(i)$ can be rewritten as

$$\tilde{R}^R_{jl}(i) = \left(1 + \frac{\zeta_1 \left[\frac{1}{a^L} \right]^{\nu-1}}{\zeta_2 - \zeta_3} \right)^{-1},$$

where

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[21] Note that λ_{ijkl} is canceled out in the numerator and denominator in Equation (A1).

$$\zeta_1 \equiv \left(\left[\frac{\Psi_{ij}}{x_{ijl}^\nu f_{ij}}\right]^{\frac{1+\alpha-\nu}{\nu-1}} - \left[\frac{\Psi_{ij}}{x_{ijl}^\nu f_{ij}^d}\left\{\left[\frac{1}{\theta_{ijl}\mu_{ijl}}\right]^\nu - 1\right\}\right]^{\frac{1+\alpha-\nu}{\nu-1}}\right)^{-1} \frac{[\theta_{ijl}\mu_{ijl}]^{\nu-1}}{\nu-1},$$

$$\zeta_2 \equiv \left[\frac{\Psi_{ij}}{x_{ijl}^\nu f_{ij}^d}\left\{\left[\frac{1}{\theta_{ijl}\mu_{ijl}}\right]^\nu - 1\right\}\right]^{\frac{\alpha}{\nu-1}} \frac{[\varphi^H]^{\nu-1}}{\nu-1},$$

$$\zeta_3 \equiv [\varphi^H]^{\nu-1}\frac{1}{\alpha}\left(\frac{\Psi_{ij}}{x_{ijl}^\nu f_{ij}^d}\left\{\left[\frac{1}{\theta_{ijl}\mu_{ijl}}\right]^\nu - 1\right\}\right)^{\frac{\alpha}{\nu-1}}.$$

Thus, $\tilde{R}_{jl}^R(i)$ becomes higher when a^L increases. The average importer size becomes larger when average importer productivity becomes higher as importer size is monotonically increasing in its productivity. As a result, $\tilde{R}_{jl}^R(i)$ becomes higher when the mean importer size becomes higher as stated in Corollary 1.

We examine product-level RTA utilization rates in imports. Aggregating $Q_{jkl}^M(i)$ and $Q_{jkl}^R(i)$ over importers' productivity a_k, we obtain country j's total imports of each product l from country i under each tariff scheme as follows:

$$Q_{jl}^M(i) = \int_{a^L}^{a^H} Q_{jkl}^M(i)dG_a(a),$$

$$Q_{jl}^R(i) = \int_{a^L}^{a^H} Q_{jkl}^R(i)dG_a(a) = \int_{(\dot{a}_k^{R=0})^{\frac{1}{1+\alpha-\nu}}}^{a^H} Q_{jkl}^R(i)dG_a(a).$$

Thus, product-level RTA utilization rates are given by

$$\tilde{R}_{jl}^R(i) = \frac{Q_{jl}^R(i)}{Q_{jl}^M(i) + Q_{jl}^R(i)}.$$

We can derive the following relation:

$$\frac{\partial \tilde{R}_{jl}^R(i)}{\partial \mu_{ijl}} < 0.$$

Analogous to the case of firm-product-level RTA utilization rates represented by Proposition 2, this relation implies that product-level RTA utilization rates in imports are higher when the preference margin (μ_{ijl}^{-1}) is larger (Corollary 2). It is also revealed that $\partial \tilde{R}_{jl}^R(i)/\partial \theta_{ijl} < 0$, which states that product-level RTA utilization rates in imports are lower for the more restrictive RTA scheme. We can apply analogous discussions on the intensive and extensive margins that we examined in the case of firm-product-level RTA utilization rates.

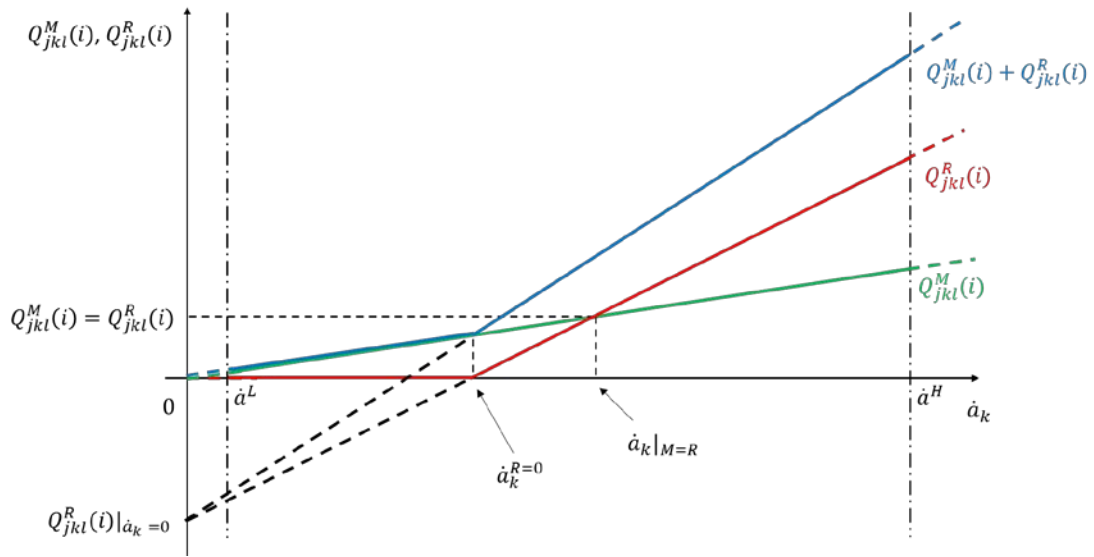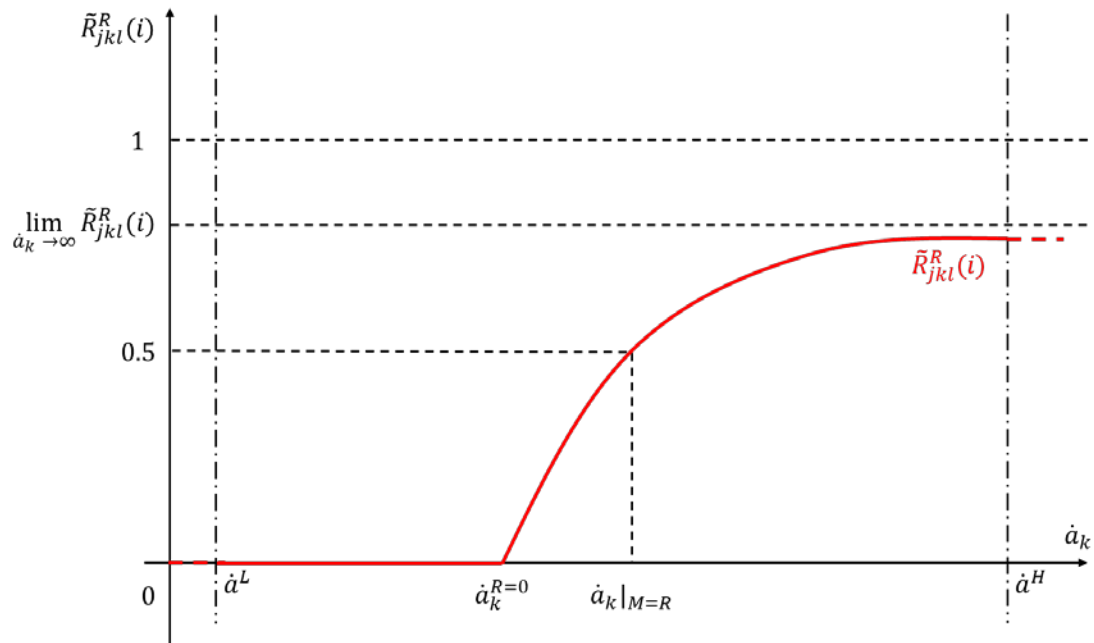Figure A1. Importer Productivity and Imports under Respective Tariff Schemes

Figure A2. Importer Productivity and Firm-Product-Level RTA Utilization Rates

Appendix B. Sample Rules of Origin in Import Firm-Product-Level Analysis

RoOs	Freq.	Share (%)
CC	5,668	12
CC&RVC	633	1.4
CC&RVC&SP	841	1.8
CH	20,283	44
CH&RVC	1,977	4.3
CH&SP	226	0.5
CS	14,761	32
CS&RVC	607	1.3
CS&SP	13	0.03
RVC	201	0.4
SP	37	0.1
WO	724	1.6

Notes: "CC," "CH," and "CS" indicate change-in-chapter, change-in-heading, and change-in-subheading, respectively. "RVC," "SP," and "WO" are regional value content rule, technical requirement/specific process rule, and wholly obtained rule, respectively. Two or three of these rules might be combined.