Fixed Costs for Utilizing Regional Trade Agreement[§]

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Abstract: This paper proposes methods to quantify fixed costs for utilizing preferential tariff schemes in regional trade agreement (RTA) based on the model of international trade where heterogeneous exporters make decisions on tariff scheme choice. Specifically, our methods enable us to compute the ratio of additional fixed costs for utilizing RTA schemes to general fixed costs for exporting, which we call "fixed cost ratio (FCR)." Our estimates of the FCR from Japan's import data reveal that RTA utilization in exporting requires 13-25% of additional fixed effects. We also empirically show that the FCR is higher in the products produced with a larger number of inputs. By using these estimates of the FCR, furthermore, we conduct simulation analyses. For example, we show that a decrease of the FCR by 10% raises the share of imports under RTAs out of total imports by 3.6 percentage points on average.

Keywords: RTA; Preference utilization; Fixed costs; Japan

JEL Classification: F15; F53

[§] This study is conducted as a part of the Project "A Study of Free Trade Agreements" undertaken at Research Institute of Economy, Trade and Industry (RIETI). Hayakawa acknowledges financial support from the JSPS under KAKENHI Grant Number JP17H02530. All remaining errors are ours.

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1. Introduction

Fixed costs play a significant role when firms make decision on whether or not to utilize preferential tariff schemes including regional trade agreement (RTA) schemes. Utilizing preferential tariff schemes, firms can enjoy the lower tariff rates than general tariff rates such as most favoured nation (MFN) rates. At the same time, however, they must comply with rules of origin (RoOs) and obtain certificates of origin (CoOs). At this process, firms need to collect various kinds of documents, such as a list of inputs, a production flow chart, production instructions, invoices for each input, or contract documents. This documentation preparation may require firms to establish a division or assign staff in charge and incur a non-negligible amount of fixed costs for preference utilization. Only the firms who can gain the benefits enough to cover these fixed costs can utilize preferential schemes when they export. Indeed, as shown in the next section, the share of imports under RTAs out of total imports is approximately 80% in the case of Japan's imports from RTA partner countries. To enhance firms' utilization of preferential schemes, it is important to reveal how large those fixed costs are.

Several studies have quantified fixed costs for preference utilization. Applying the threshold regression approach to the utilization rate of Cotonou preferences, Francois et al. (2006) found that the tariff equivalent costs of using the scheme ranged between 4% and 4.5%. Hayakawa (2011) showed that by employing the threshold regression method, the average tariff equivalent of fixed costs for use of free trade agreement (FTA) for all existing regional trade agreements (RTAs) in the world is estimated to be around 3%. Some studies estimated the absolute values of RTA utilization costs. Ulloa and Wagner (2013) computed the fixed costs for FTA utilization directly by employing the data on FTA utilization for exports from Chile to the United States (US). They found that the 75th percentile was around US$3,000 in the year of entry into force (around US$200 for the median). By employing the firm-level export data from the Generalized System of Preferences (GSP) utilization for exporting apparel products to the European Union (EU) from Bangladesh, Cherkashin et al. (2015) structurally estimated the costs (they called these the documentation costs of RoO compliance), which were US$4,240. Hayakawa et al. (2016) applied the detailed customs data in Thailand to the modified version of Ulloa and Wagner (2013)'s method and found that the median costs for RTA utilization are approximately US$2,000 for exports from China, US$300 for exports from Australia, and US$1,000 for exports from Japan.

In this paper, we propose alternative methods to quantify fixed costs for utilizing RTA schemes. Specifically, our methods enable us to compute the ratio of additional fixed costs for preference utilization to those for exporting. We call this ratio "fixed cost ratio

(FCR)." Our method relies on the partial equilibrium model of tariff scheme choice developed by Demidova and Krishna (2008) and Cherkashin et al. (2015). These models incorporate exporter's tariff scheme choice into the heterogeneous firm model of Melitz (2003) and demonstrate that more productive exporters choose a preferential scheme, but less productive exporters do an MFN scheme. In this separation, FCR plays a crucial role; the lower FCR leads to the higher share of RTA users. Our method on the computation of FCR requires the data on imports according to tariff schemes (e.g., MFN and RTA schemes). Such data are publicly available in some developed countries, such as the US, EU, or Japan. In this paper, as an example, we quantify the FCR by applying the product-level (Japan's tariff line-level) data on Japan' imports from several RTA partner countries to this model.

We propose two approaches to quantify the FCR. The first one, which is called the "tariff-ratio approach," exploits the theoretical conditions on dividing two trade regimes in product-level imports including "homogeneous regime" and "heterogeneous regime." The former indicates that all imports in a concerned product are under RTA schemes while the latter does that only part of imports are under RTA schemes (i.e., the rest are under MFN schemes). In our data, we can identify these trade regimes for each product in each sample year. The theory indicates that the homogeneous (heterogeneous) regime is likely to be realized for a product if the ratio of the RTA rate to the MFN rate is significantly low (high) relative to the FCR. Based on this prediction, the first approach infers the range of the FCR by investigating time-series change of trade regimes. The advantage of the first approach is twofold. First, we need only three kinds of information (i.e., demand elasticity, MFN rates, and RTA preferential rates) in addition to the trade data according to tariff schemes. Second, the validity of this approach is independent of the assumption on firms' productivity distribution (e.g., Pareto or log-normal distribution).[1]

We call the second approach the "import-ratio approach." When we assume firms' productivity follows a Pareto distribution, the FCR under the heterogeneous regime can be written as a function of the imports and tariffs by tariff schemes and two model parameters (i.e., demand elasticity and a shape parameter in the Pareto distribution). Therefore, using these information, we can directly compute the FCR. Compared with the first approach, this approach has advantage in terms of yielding the point estimate of FCR rather than its range. In addition, while the first approach can be applied only when we observe the regime switch during multiple sample years, we only need one sample

[1] Recently, there is some debate on the choice of productivity distribution (e.g., Head et al., 2014; Bas et al., 2017; Nigai, 2017). However, our tariff-ratio approach is robust to any types of productivity distribution.

year under the heterogeneous regime in this second approach. Given the limitation of the second approach that it needs the assumption of the Pareto distribution for firms' productivity, these two approaches are complementary to each other. We found that the median of the estimates is 0.13 in the tariff-ratio approach and 0.25 in the import-ratio approach. These estimates imply that RTA utilization in exporting requires 13-25% of additional fixed effects.

Using the FCR obtained from the import-ratio approach, we conduct various additional analyses. First, we investigate its determinants to uncover the source of its difference across countries and products. For example, we find that the FCR tends to be higher in the products produced with a larger number of inputs because costs of document preparation for RTA (i.e., the numerator of FCR) are higher in such products. Some differences in the FCR across RoOs are also revealed. We next conduct some simulation analyses. Specifically, we simulate how much RTA utilization rates rise if the FCR decreases by 10%. We show that such a decrease of the FCR raises the utilization rates by 3.6 percentage points on average. With our estimates of FCR, we also simulate how much the RTA utilization rate rises when tariff reduction through RTAs is completed. We show that from the year 2016 to the final year of RTA tariff reduction, the share of RTA imports in total imports rises by 14 percentage points.

This paper is related to at least three strands of the literature. The first literature includes studies that quantify fixed costs for preference utilization, which are listed above. These studies show that fixed costs for preference utilization range between 3% and 5% (Cadot and de Melo, 2007) in terms of tariff equivalent rates and a few thousand USD in terms of absolute magnitude. Clear advantage of our method is the easiness of our way to compute the FCR, compared with the techniques as used in Cherkashin et al. (2015).[2] Also, for our method, we only need product-level data by tariff schemes and do not need firm/transaction-level data by tariff schemes as used in Cherkashin et al. (2015) or Hayakawa et al. (2016), which are available only for selected countries. Therefore, although only the FCR is estimated and absolute magnitude of fixed costs for RTA utilization *per se* is not, our method can be applicable to many countries. This is important because according to the estimates in Cherkashin et al. (2015), FCR when exporting from Bangladesh to EU is 0.66 (= US$4,240/US$6,404), which is higher than our estimates. Our method is useful to be applied to many countries and then to uncover how FCRs are

[2] Ulloa and Wagner (2013) ignore fixed costs for exporting that all exporters have to pay regardless of tariff schemes in order to calculate the level of fixed costs for RTA utilization. In contrast, to incorporate the extensive margin between exporters and non-exporters, we consider fixed costs for both exporting and RTA utilization.

different across countries.[3]

Second, our paper is related to studies using the trade data according to tariff schemes. For example, with such data, some studies analyze the determinants of the utilization of preferential schemes (e.g., Cadot et al., 2006; Carrere and de Melo, 2006; Francois et al., 2006; Manchin, 2006; Hakobyan, 2015). Those found the significant roles of preference margin (i.e., MFN rates minus preferential rates) and restrictiveness of RoOs. Our paper sheds light on the role of fixed costs for preference utilization and demonstrates how much preferential trade increases when such fixed costs are reduced. Also, there are some studies examining exporters' benefits from the preference utilization (Cadot et al., 2005; Olarreaga and Ozden, 2005; Ozden and Sharma, 2006; Cirera, 2014). Specifically, those studies have empirically quantified how much export prices rise through the utilization of preferential schemes.[4] In contrast to these studies on the benefit of preference utilization, we quantify costs for preference utilization for exporters. Therefore, our paper will complement studies in this literature.

Last, our simulation analysis is related to several studies that quantified the effects of tariff reduction through RTAs on trade and welfare (e.g., Karemera and Ojah, 1998; Clausing, 2001; Romalis, 2007; Caliendo and Parro, 2015). One important difference from these studies is that we take into account fixed costs for RTA utilization. As mentioned above, due to the existence of such costs, all exporters do not necessarily use RTA tariff rates even after RTA's entry into force. Indeed, as shown in the next section, in reality, the share of imports under RTA schemes in total imports is below 100%, approximately 80%. Therefore, we believe that it is important to consider the presence of fixed costs for RTA utilization when evaluating the effects of RTAs. There is also a growing literature that quantify the effects of trade liberalization on welfare (Arkolakis et al., 2012; Ossa, 2015; Felbermayr et al., 2015; Edmond et al., 2015; Federico and Tena-Junguito, 2017). This literature focuses on a special pattern of trade liberalization, which is the change from autarky to free trade, and does not explicitly pay attention to fixed costs for RTA utilization that we focus.

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[3] Similar to fixed costs for preference utilization, those for exporting have been quantified in several studies (e.g., Das et al., 2007; Morales et al., 2014; Albornoz et al., 2016). In these studies, the magnitude relationship between the sunk and fixed costs for exporting receives a central interest. For example, using the plant-level data in Colombia, Das et al. (2007) found that the sunk components are about US$400,000 and that the annual fixed costs are almost zero. Morales et al. (2014) used the firm-level export data in Chile and found their magnitude relationship similar to that in Das et al. (2007). However, using the firm-level export data in Argentine, Albornoz et al. (2016) found the opposite magnitude relationship, namely that fixed costs for exporting are higher than the sunk costs. In addition, Kropf and Sauré (2014) computed fixed costs per export shipment using Swiss export data.

[4] Feenstra (1989) is one of the earlier studies that examined the effects of tariff rates on trade prices though he did not examine the tariff changes of RTAs.

The rest of this paper is organized as follows. Section 2 overviews RTA utilization in Japan to show evidence that all exporters do not necessarily choose RTA schemes when exporting even to RTA partner countries. In Section 3, we present our theoretical setup to demonstrate such exporter's tariff scheme choice and then the methods to quantify the FCR. Section 4 provides the results of FCR in Japan's RTA imports. In Section 5, we investigate its determinants and conduct some simulation analyses. Finally, Section 6 concludes on this paper.

2. RTAs in Japan

In this section, we overview RTA utilization in Japan to show that all exporters do not necessarily utilize RTA schemes when exporting even to RTA partner countries. Japanese government announced Japan's RTA strategy in October 2002.[5] The statement says that RTAs offer a means of strengthening partnerships in areas not covered by the World Trade Organization (WTO) and achieving liberalization beyond levels attainable under the WTO. The RTA with Singapore, which is the first RTA for Japan, was entry into force in the next month (November 2002). After that, Japan has concluded RTAs with many countries. As of November 2016, 15 RTAs in total are entry into force in Japan. Those include RTAs with Singapore (2002), Mexico (2005), Malaysia (2006), Chile (2007), Thailand (2007), Indonesia (2008), Brunei (2008), Association of Southeast Asian Nations (ASEAN) (2008), the Philippines (2008), Switzerland (2009), Vietnam (2009), India (2011), Peru (2012), Australia (2015), and Mongolia (2016). Also, as one of the member countries, Japan signed Trans-Pacific Partnership (TPP) in February 2016 in New Zealand.

One unique feature of Japan's RTAs is to conclude not only a bilateral RTA but also a plurilateral RTA with several ASEAN countries. As listed above, ASEAN-Japan Comprehensive Economic Partnership Agreement (AJCEP), which is an RTA between Japan and ASEAN, entered into force in 2008. In addition, Japan concludes bilateral RTAs with seven ASEAN countries. Therefore, when trading with those countries, firms in Japan can utilize two RTA schemes: bilateral RTA and AJCEP. One reason for such a duplication of RTAs is that AJCEP mainly reduces tariff rates for products in which the international production networks are well developed. As is well known, Japanese multinationals have developed international production/distribution networks in ASEAN since the 1990s (see, for example, Baldwin, 2006). Therefore, cumulation rules in RoOs within ASEAN enables Japanese affiliates to comply with RoOs easily. On the other hand,

[5] http://www.mofa.go.jp/policy/economy/fta/strategy0210.html

bilateral RTAs are designed to reduce tariff rates for products in which two countries have special interest. Those also include deeper economic rules such as those on intellectual property or labor standards.

In this paper, we focus on Japan's imports from partner countries in which only single RTA is available. This focus is to avoid mixing firms' decisions between MFN and single RTA and firms' decisions among MFN and multiple RTA schemes. Indeed, our framework presented in the next section does not consider the case where two RTA schemes coexist. As a result, we investigate RTAs with six countries including Switzerland (CHE), Chile (CHL), Indonesia (IDN), India (IND), Mexico (MEX), and Peru (PER). Since Indonesia is not a member of AJCEP despite that it is an ASEAN member country, Japan has only a bilateral RTA with Indonesia. Thus, we include the RTA with Indonesia in our analysis. Also, since, as explained later, our method to quantify the FCR requires us to employ the data for multiple years, we exclude RTAs with Australia and Mongolia.

In the below, we take a brief overview of RTA utilization in Japan's imports during 2012-2016. To this end, we use the information on MFN rates, RTA rates, imports under RTA schemes, imports under all tariff schemes (i.e., total imports). The data sources for these variables are as follows. The data on MFN rates and RTA rates are obtained from Tariff Analysis Online (TAO) in the WTO. The tariff line-level data on imports under RTA schemes and total imports are obtained from Trade Statistics in Ministry of Finance in Japan. The data on the former type of imports are available only from 2012. The tariff-line is defined at an HS nine-digit level in Japan and includes approximately 9,500 codes. These data cover all commodity imports in Japan. Importantly, we aggregate our import data according to Japanese fiscal years (start from April and end in March) because Japan's RTA rates change in April 1st.

Table 1 reports Japan's imports from six RTA partner countries by years. Row (A) shows total imports and row (B) the share of imports of products with zero MFN rates (duty-free imports) in total imports. These two rows reveal that all countries have high shares of duty-free exports, which are mostly above 70%. Particularly from Switzerland and Peru, the duty-free import shares are approximately 90%. Row (C) reports imports under RTA schemes. Their shares in total imports are calculated as row (C) over row (A) and shown in row (D). The share of RTA imports in total imports is about 20%. It is about 10% in the case of imports from countries with about 90% duty-free import shares. Namely, most of the imports from RTA partners are either duty-free in terms of MFN rates or imports under RTAs.

=== Table 1 ===

Row (E) reports the number of tariff line-products eligible to RTA schemes while the share of imports under RTA out of total imports in those eligible products is shown in row (F). "Eligible" in this paper includes the cases that (i) both RTA and MFN rates are ad-valorem rates and RTA rates are lower than MFN rates or (ii) MFN rates are specific rates and RTA rates ad-valorem rates. We exclude the case that both RTA and MFN rates are specific rates because of the difficulty of identifying eligibility. Mostly due to the difference of the entry year across RTAs, the number of eligible products is different. It is more than one thousand in the cases of Indonesia and India while Chile and Peru have a few hundreds of eligible products. The RTA import share in those products shows about 80%. Table 4 in Keck and Lendle (2012) reports the share of RTA imports comparable to this figure to some extent, for imports in some developed countries (Australia, Canada, EU, and the US), which also shows around 80%. In other words, the share of RTA imports in RTA eligible products in Japan is comparable to those in other developed countries.

3. Theoretical Setup

Based on the model developed by Demidova and Krishna (2008) and Cherkashin et al. (2015), we propose the way to quantify the FCR. In the model, two types of tariff schemes coexist: MFN and RTA schemes. Exporters choose one from those two to maximize expected profits. As is consistent with the facts presented in Section 2, this model shows that some exporters do not choose the RTA scheme in exporting even to RTA partner countries. To let the model structure be consistent with our data, we assume the presence of multiple products. Also, a continuum of monopolistically competitive firms engages in the production of each product.

3.1. Representative Household and Final-good Producers

There are J countries, including the home country, in the economy. We consider import and domestic consumption in the home country. The representative household consumes L types of products. The utility function of the representative household is given by

$$u = c = \prod_{l=1}^{L} [c(l)]^{\beta(l)}, \qquad \sum_{l=1}^{L} \beta(l) = 1.$$

$c(l)$ is the consumption index for product l, and L is the number of products. $c(l)$ is defined as

$$c(l) = \left(\sum_{i=1}^{J} \int_{k\in\Omega_i(l)} [c_i(l,k)]^{\frac{v(l)-1}{v(l)}} dk\right)^{\frac{v(l)}{v(l)-1}}, \qquad 1 < v(l) < \infty.$$

$v(l)$ represents the demand elasticity of each product. Each final-good producer is indexed by k. $\Omega_i(l)$ is the set of firms in country i that export product l. Cost minimization implies demand schedules

$$c_i(l,k) = \left(\frac{p_i(l,k)}{p(l)}\right)^{-v(l)} c(l), \qquad c(l) = \beta(l)\left(\frac{p(l)}{P}\right)^{-1} c.$$

Price indices are defined as follows:

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

Final-good producers input the domestic labor force, produce outputs, and sell the outputs to domestic and foreign households. We assume that the production technology of each final-good producer k, that produces product l in country i, follows the simple linear function about the labor force, given by

$$y_i(l,k) = \varphi(k) n_i(l,k),$$

where $\varphi(k)$ represents the firm-specific productivity and $n_i(l,k)$ is the labor input. Firms draw their productivity, $\varphi(k)$, from a distribution, $\mathrm{G}(\varphi)$, which is assumed to be common across industries and countries. As a result of profit maximization, the free on board (FOB) price is derived as

$$\tilde{p}_i(l,k) = \frac{v(l)}{v(l)-1}\frac{w_i}{\varphi(k)},$$

where w_i is the wage rate.

3.2. Choice of Tariff Schemes

Final-good producers in countries other than the home country make the decisions on exports and tariff schemes. For simplicity, we assume away fixed costs of domestic supply without loss of generality. Further, for simplicity, it is also assumed that destination markets are segmented each other and each final-good producer makes decision for each destination market. As a result, we can analyze trade in each pair of countries independently from other country pairs. Also, each exporter is assumed to be so small that we can ignore the effect of each exporter's behavior on macroeconomic variables in destination markets such as price index. We focus on the pair of exporting and importing countries which have an RTA to examine the FCR. When exporting, firms can choose a tariff scheme, either an MFN scheme (*M*) or an RTA scheme (*R*).[6] In any case, they need to pay fixed costs for exports, denoted by $f_i(l)$.[7] Furthermore, when exporting under RTA schemes, they also need to incur *additional* fixed costs, such as document preparation costs, which are denoted by $f_i^R(l)$. These two types of fixed costs are assumed to be export-country specific. Final-good producers do not face tariff scheme choice when they provide to their home country.

Focusing on exports (not domestic sales), the respective export prices under MFN and RTA schemes are given by

$$p_i^M(l,k) = T(l)\tau_i(l)\tilde{p}_i(l,k), \qquad p_i^R(l,k) = \mu_i(l)T(l)\tau_i(l)\tilde{p}_i(l,k).$$

τ_i is the ice-berg physical transport costs ($\tau_i > 1$) for exports from country i. $T(l)$ is the (one plus) per-unit MFN tariff rate ($T(l) > 1$) and $\mu_i(l)$ is called the "tariff ratio," which is defined as

$$\mu_i(l) \equiv \frac{T_i^R(l)}{T(l)}.$$

$T_i^R(l)$ is the (one plus) per-unit RTA tariff rate ($T_i^R(l) > 1$). RTA rates are assumed to be export country (i.e., country pair)-product specific. Given that RTA rates are lower than MFN rates in general, $\mu_i(l)$ is supposed to range in $(0,1)$.[8]

Under these settings, export profits can be derived as follows:

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[6] We customarily call the general tariff scheme "MFN" putting aside the fact that some of exporting countries are non-WTO members. Indeed, all our sample countries in the empirical part are WTO members, thus MFN rates are available for all sample country pairs. Also, some of the other countries, i.e., $J-2$ countries, may also have an RTA with the home country. The availability of RTAs in each country pair affects price indices in the home country but does not our methods to compute the FCR.

[7] Following Helpman et al. (2004) and Helpman et al. (2008), we assume that exporters pay fixed costs for exports to each destination ignoring the case where exporters deal with export processes for multiple destinations at the same time and save on the total fixed cost. In other words, the economies of scale are not considered for $f_i(l)$. Also in terms of the fixed cost for RTA utilization, we assume a similar situation; i.e., exporters pay the fixed cost for RTA utilization for each transaction. Given that the model is static, mitigation of these fixed costs through the exporters' experiences is not considered. Investigating these possibilities would provide richer theoretical consequences, but we do not examine such cases in order to keep the model tractable and to obtain explicit FCR.

[8] Although we assume that the use of RTA schemes does not require exporters to incur additional variable costs, it would be more natural to assume product-specific additional variable costs, which are based on the adjustment of inputs in order to comply with the rules of origin. To obtain explicit fixed cost ratio, however, we do not assume such variable costs of RTA utilization and may overestimate the FCR.

$$\pi_i^M(l,k) = \Phi(l,k)[T(l)]^{-\upsilon(l)}\zeta_i(l) - f_i(l),$$

$$\pi_i^R(l,k) = \Phi(l,k)[\mu_i(l)T(l)]^{-\upsilon(l)}\zeta_i(l) - f_i(l) - f_i^R(l),$$

where

$$\Phi(l,k) = [\varphi(k)]^{\upsilon(l)-1},$$

$$\zeta_i(l) = \left(\frac{\upsilon(l)-1}{w_i}\right)^{\upsilon(l)-1}\left(\frac{1}{\tau_i(l)\upsilon(l)}\right)^{\upsilon(l)}\left(p(l)\right)^{\upsilon(l)-1}\beta(l)Pc.$$

Thus, export profits are found to be increasing in $\varphi(k)$. Further, we obtain the following relation:

$$\pi_i^R(l,k) - \pi_i^M(l,k) = \Phi(l,k)[T(l)]^{-\upsilon(l)}\zeta_i(l)\left[\left(\frac{1}{\mu_i(l)}\right)^{\upsilon(l)} - 1\right] - f_i^R(l).$$

This implies that RTA is more beneficial than MFN for the more productive producers because the tariff rate is lower for RTA than for MFN.

Firms determine whether they export or not, and which tariff scheme to use if they export. Thus, the optimization of exporters on the export decision is given by

$$\max\{0, \pi_i^M(l,k), \pi_i^R(l,k)\}.$$

We have three productivity thresholds. The first and second ones define the ranges of producers that gain positive profits by exporting under MFN ($\pi_i^M(l,k) \geq 0$) and RTA ($\pi_i^R(l,k) \geq 0$), respectively. These thresholds are obtained with the equality as

$$\bar{\varphi}_i^M(l) = \left(\frac{f_i(l)}{\zeta_i(l)}[T(l)]^{\upsilon(l)}\right)^{\frac{1}{\upsilon(l)-1}},$$

$$\bar{\varphi}_i^R(l) = \left(\frac{f_i(l) + f_i^R(l)}{\zeta_i(l)}[\mu_i(l)T(l)]^{\upsilon(l)}\right)^{\frac{1}{\upsilon(l)-1}}.$$

Given that firms decide to export, they prefer RTA to MFN if $\pi_i^R(l,k) > \pi_i^M(l,k)$. Thus, on the choice of tariff scheme, we have the third threshold, as follows:

$$\bar{\varphi}_i^{R>M}(l) = \left(\frac{f_i^R(l)}{\zeta_i(l)}\left([\mu_i(l)T(l)]^{-\upsilon(l)} - [T(l)]^{-\upsilon(l)}\right)^{-1}\right)^{\frac{1}{\upsilon(l)-1}},$$

indicating that firms prefer RTA to MFN if $\bar{\varphi}_i^{R>M}(l) < \varphi(k)$. A product is exported under multiple tariff schemes when $\bar{\varphi}_i^{R}(l) > \bar{\varphi}_i^{M}(l)$, which corresponds to the heterogeneous regime discussed in Demidova and Krishna (2008). Namely, in this regime, some exporters use the RTA scheme while some do the MFN scheme.

We measure additional fixed cost for RTA utilization. Specifically, we quantify the *fixed cost ratio* (*FCR*), which is defined as

$$FCR_i(l) \equiv \frac{f_i^R(l)}{f_i(l)}.$$

In the following sections, we try to provide the way to calculate the FCR. Using the FCR, we can rewrite the condition for the heterogeneous regime, namely $\bar{\varphi}_i^{R}(l) > \bar{\varphi}_i^{M}(l)$, by

$$FCR_i(l) > \left[\frac{1}{\mu_i(l)}\right]^{\upsilon(l)} - 1. \tag{1}$$

When additional RTA fixed costs are large or RTA tariff rates are not low enough, less productive exporters hesitate to use RTA schemes. As a result, less productive exporters use the MFN scheme while more productive exporters choose RTA schemes when the condition (1) holds. In contrast, all exporters gain larger profits by using the RTA scheme rather than the MFN scheme when the condition (1) does not hold. Namely, product l is only exported under the RTA scheme. We call this case the homogeneous regime.

3.3. Measurement of FCR

Using above theoretical setup, we propose two approaches to quantify the FCR with observable information. We call the first one the *tariff-ratio approach*. In this approach, we directly use the condition (1), which defines products that are imported to the home country both under RTA and MFN schemes. In general, RTA rates are gradually reduced after RTAs' entry into force. If, in the early stage of an RTA, the RTA rate is not significantly lower than the MFN rate and $\mu_i(l)$ is not significantly low for a product, the condition (1) holds and the product is supposed to be traded under both RTA and MFN schemes. This is the typical case of the heterogeneous regime. However, if the RTA rate is substantially reduced afterwards and $\mu_i(l)$ is substantially lowered by the late stage of an RTA, the right hand side (RHS) of the condition (1) rises and the product would be traded only under RTA scheme, that is the homogeneous regime. Thus, we can expect that the left hand side (LHS) of equation (1), i.e., FCR, lies in a range from the value of the RHS when trade regime is heterogeneous to that when the regime is homogeneous. Using this relationship between trade regime change and FCR, we infer the FCR.

This approach can be illustrated in Figure 1. RTA tariff rates are reduced from years t−1 to t, then tariff ratios decline. Suppose that a concerned product l is imported under the heterogeneous regime in year $t-1$ and the homogeneous regime in year t. Let $RHS_i(l)$ be the RHS of the condition (1) for product l imported from country i. That is, $RHS_i(l) \equiv [\mu_i(l)]^{-\nu(l)} - 1$. Noting that the tariff ratio, $\mu_i(l)$, can change during the sample year and that we need to distinguish imports under the two regimes, we denote $RHS_i(l)$ under the heterogeneous and homogeneous regimes in year τ as $RHS_{i\tau}^{HT}(l)$ and $RHS_{i\tau}^{HM}(l)$, respectively. Define the maximum of $RHS_{i\tau}^{HT}(l)$ and the minimum of $RHS_{i\tau}^{HM}(l)$ during the sample years by

$$\overline{RHS}_i^{HT}(l) \equiv \max\{RHS_{i\tau}^{HT}(l) | \tau \in T\},$$

$$\underline{RHS}_i^{HM}(l) \equiv \min\{RHS_{i\tau}^{HM}(l) | \tau \in T\},$$

where T is the set of sample years. Theoretically, the following condition must hold:

$$\overline{RHS}_i^{HT}(l) \leq \underline{RHS}_i^{HM}(l). \tag{2}$$

Then, we can express the range of the FCR as follows:

$$FCR_i(l) \in \left[\overline{RHS}_i^{HT}(l), \underline{RHS}_i^{HM}(l)\right].$$

Later, for aggregation purpose, we will compute the middle value of this range, $RHS_i^*(l)$, as

$$RHS_i^*(l) \equiv \frac{\overline{RHS}_i^{HT}(l) + \underline{RHS}_i^{HM}(l)}{2}. \tag{3}$$

=== Figure 1 ===

Our second approach is called the *import-ratio approach*. Assuming that productivity follows the Pareto distribution, $FCR_i(l)$ is related to the ratio of MFN imports to RTA imports under the heterogeneous regime in the following manner:[9]

$$FCR_i(l) = \left([\mu_i(l)]^{-\upsilon(l)} - 1\right)\left([\mu_i(l)]^{1-\upsilon(l)} \frac{Q_i^M(l)}{Q_i^R(l)} + 1\right)^{\frac{\upsilon(l)-1}{\alpha-\upsilon(l)+1}}. \tag{4}$$

$Q_i^M(l)$ and $Q_i^R(l)$ are imports of product l from country i under MFN and RTA schemes, respectively, and are defined as

$$Q_i^M(l) \equiv \int_{\bar{\varphi}_i^M(l)}^{\bar{\varphi}_i^{R>M}(l)} p_i^M(l,k) c_i^M(l,k) G(\varphi),$$

$$Q_i^R(l) \equiv \int_{\bar{\varphi}_i^{R>M}(l)}^{\infty} p_i^R(l,k) c_i^R(l,k) G(\varphi),$$

where

$$c_i^M(l,k) \equiv c_i(l,k)\big|_{p_i(l,k)=p_i^M(l,k)}, \qquad c_i^R(l,k) \equiv c_i(l,k)\big|_{p_i(l,k)=p_i^R(l,k)}.$$

Equation (4) implies that, in the heterogeneous regime, the ratio of MFN imports to RTA imports should be large when RTA rates are not significantly low relative to MFN rates, or the tariff ratio is not significantly low, given the FCR. This equation provides a way to compute the FCR directly.

Both approaches have advantages and disadvantages. The key advantage of the tariff-ratio approach is that it requires relatively less information. We need the shape parameter of productivity distribution to implement the import-ratio approach, while we do not need such information for the tariff-ration approach. Note that both approaches require the import and tariff data according to tariff schemes in addition to the demand elasticity parameter. Another key advantage of the tariff-ratio approach is that it is applicable to any types of productivity distribution, whereas (4) in the import-ratio approach is derived only under the assumption of Pareto distribution. On the other hand, the advantage of the import-ratio approach is that it gives a *point* estimate of FCR. The tariff-ratio approach can only provide an implied range of FCR unless the RHS of equation (1) takes the same value between the homogeneous and heterogeneous regimes. The import-ratio approach has another advantage in its feasibility. That is, it is feasible as long as we observe heterogeneous regime in one sample year, whereas the tariff-ratio approach can be implemented only if both heterogeneous and homogeneous regimes

[9] Derivation of equation (4) is given in Appendix A. The assumption of the Pareto distribution is necessary for the import-ratio approach, not for the tariff-ratio approach.

emerge during the sample period because this approach relies on the regime switch.

4. Empirical Analysis

In this section, we report our estimates of the FCR for Japan's imports. As in Section 2, we examine Japan's RTAs with six countries including Switzerland, Chile, Indonesia, India, Mexico, and Peru, during the period of 2012 to 2016. We show first the estimates based on the tariff-ratio approach and then those based on the import-ratio approach. Some robustness checks are also provided.

4.1. Tariff-ratio Approach

As demonstrated in the previous section, the tariff-ratio approach requires the import and tariff data according to tariff schemes and the elasticity of substitution. The former two are obtained from the same source as in Section 2. We use the HS three-digit level elasticity for Japan obtained from Broda et al. (2006). By using the import data, we first identify the trade regime in each country-product-year pair. We drop the pairs in which no imports or only imports under MFN schemes are observed. Then, by using the tariff data and the elasticity, we compute the RHS of equation (1) for each product, year, and country and infer the FCR. We restrict sample pairs only to those in which RTA tariff rates are lower than MFN rates.

Before reporting our results of the tariff-ratio approach, we check how applicable our approach is in our sample observations. Table 2 reports the number of products according to export countries and trade regimes. Types (i)-(iii) include products that are imported under both heterogeneous and homogeneous regimes during our sample period. These three types are further distinguished according to the magnitude relationship between the maximum value of RHS in heterogeneous regime (Max. Hetero) and the minimum value in homogeneous regime (Min. Homo). In types (iv) and (v), we can observe only either homogeneous or heterogeneous regime during the sample period and hence cannot apply our tariff-ratio approach. Type (iii) violates condition (2). In short, we can apply the approach only into cases (i) and (ii). While there are a relatively small number of the pairs in case (i), case (ii) has a relatively large number.

=== Table 2 ===

Restricting to cases (i) and (ii), we infer the FCR. While the RHS of equation (1) in case (ii) is expected to be exactly equal to the FCR, we can identify only its range in case (i). For the latter case, to show some aggregated statistics, we simply compute the middle value between the maximum value in heterogeneous regime and the minimum value in homogeneous regime as presented by equation (3). Table 3 shows various statistics on our estimates, including the minimum, maximum, and mean values and the 25th, 50th (median), 75th percentiles. Among all observations, the mean and median of the middle value are 0.15 and 0.13, respectively. This implies that additional fixed costs for RTA utilization are one-seventh of fixed costs for exporting. In terms of the median, Chile shows the relatively low FCR (0.09) while Peru has the relatively high FCR (0.16).

=== Table 3 ===

To check a robustness of the above magnitude, we extend our sample. Specifically, following the way of aggregation in Ulloa and Wagner (2013) and Hayakawa et al. (2016), we also try to infer the FCR for cases (iii)-(v). In case (iii), we again simply compute the middle value following equation (3), though this case violates condition (2). We compute the minimum value in homogeneous regime for case (iv) and the maximum value in heterogeneous regime for case (v). This strategy implies that we estimate the possible maximum and minimum of FCR for case (iv) and (v), respectively. The statistics according to observation types are provided in Table 4. In terms of mean and median, cases (i) and (ii), which are ideal cases in our approach, show a bit larger value than the other cases. However, the difference is small. In all cases, we see approximately 0.14 of FCR, which means that additional fixed costs for RTA utilization are one-seventh of fixed costs for exporting.

=== Table 4 ===

4.2. Import-ratio Approach

In this subsection, we report the estimates based on the import-ratio approach. In this approach, we need the shape parameter of the productivity distribution in each country, which is obtained from Spearot (2016). The shape parameter is available at the industry level defined in the Global Trade Analysis Project (GTAP). By using the converter between GTAP industry classification and HS constructed by Aguiar (2016), we map this parameter to our HS-base dataset. In the relationship between the demand elasticity and the shape parameter, there is one key assumption in the theory, which is $\alpha - \nu + 1 > 0$. At an HS nine-digit level, this relationship does not hold in more than half of our observations (see Table C1 in Appendix C). Therefore, we modify these two parameters. Specifically, we first restrict country-product (HS nine-digit) pairs only to those in which the above relationship holds. Then, we take the average of each parameter by country and the Section of HS tariff classification and apply that to all corresponding country-product pairs.

By using these "modified" parameters, we compute the RHS of equation (4), which is equal to the FCR. As mentioned in the previous section, the import-ratio approach is valid only for the case of heterogeneous regime. Therefore, we restrict country-product observations only to those in the latest year when a trade regime is heterogeneous. The various statistics for the RHS of equation (2), i.e., the FCR, are shown in Table 5. Since some observations show extremely large values, the mean becomes very large. The median takes relatively reasonable values. In total, it is 0.25, which implies that additional fixed costs for RTA utilization are one-fourth of fixed costs for exporting. This value is larger than the median based on the tariff-ratio approach, though it is not necessarily appropriate to compare those two statistics since the latter approach shows only a range of FCR. However, the value in the import-ratio approach is larger than the median even in case (ii), which presents a point estimate of FCR in the tariff-ratio approach. On the other hand, like the case of the tariff-ratio approach, Chile shows the relatively low FCR (0.14) while Peru has the relatively high FCR (0.34).

=== Table 5 ===

Our estimates are smaller than those in the previous study. As mentioned in section 1, Cherkashin et al. (2015) structurally estimated some costs in the GSP utilization for exporting apparel products to the EU from Bangladesh. Their estimates on fixed costs for exporting and GSP utilization are US$6,404 and US$4,240, respectively. Thus, their estimates on the FCR become 0.66. There are several possible reasons to explain this difference in the magnitude of FCR. First, the target for estimation is different in terms of country and industry. In particular, Cherkashin et al. (2015) focus on apparel industry, of which RoOs are likely to be specific process rule (SP). As shown in the next section, FCR in the case of SP tends to be high. Second, our estimates do not include those for products in which imports under only the MFN scheme are observed. In other words, we focus on products in either/both heterogeneous and homogeneous regimes. In the products with imports under only the MFN scheme, additional fixed costs for RTA utilization (i.e., FCR) will be so high that we cannot observe any imports under RTA schemes. These differences will result in the difference in the magnitude of the FCR.

We conduct some robustness checks. Specifically, we try various parameter values in the computation of the RHS of equation (4). First, in contrast to previous examination in which we used the modified values of the two parameters, we use the raw values though observations that do not meet that $\alpha - \nu + 1 > 0$ are dropped. Second, instead of the demand elasticity obtained from Broda et al. (2006), we use that estimated in Kee et al. (2008). Third, we also change the data source for the shape parameter. Specifically, we estimate it for Indonesia by employing the method in Mayer and Ottaviano (2007).[10] To do that, we use two kinds of plant-level total factor productivity (TFP); TFP based on the method in Ackerberg et al. (2015) (called ACF) and TFP based on the simple fixed effect estimation (called FE). We compute the RHS of equation (4) using various combination of these parameters.

The results are shown in Table 6. We show various statistics for FCR only in Indonesia. For a comparison purpose, we again report the result for Indonesia in Table 4. Due to the violation of the necessary condition on the relationship between the demand elasticity and the shape parameter, the number of observations becomes much smaller in these robustness checks. We can see some differences in the estimates of FCR, depending on which parameters to use in the computation. In terms of the median, the value in Table 4 is 0.06 to 0.11 higher than the values in the robustness checks. Nevertheless, we can still see that fixed costs for exporting are much higher than those for RTA utilization.

=== Table 6 ===

5. Additional Analyses

This section conducts two kinds of analyses by using our estimates of the FCR. Specifically, we examine the determinants of FCR to uncover the source of its difference across countries and products. Then we conduct the simulation analysis on how the reduction of the FCR changes RTA utilization.

5.1. Determinants of FCR

In this subsection, we examine the determinants of the FCR in Table 5. Specifically, we estimate the following equation:

$$\ln FCR_{il} = \mathbf{X}_{il}\boldsymbol{\alpha} + \mathbf{Y}_{l}\boldsymbol{\beta} + \mathbf{Z}_{i}\boldsymbol{\gamma} + \epsilon_{il}.$$

$\mathbf{X}_{il}$ includes country-product specific variables. $\mathbf{Y}_{l}$ and $\mathbf{Z}_{i}$ are vectors of product-specific and country-specific variables, respectively. The country-product specific variables include dummy variables indicating a type of RoOs. Using the information on RoOs in

[10] For more details, see Appendix B.

the legal text of RTAs, we roughly classify into either change-in-tariff classification (CTC), regional value content rule (RVC), SP, or wholly-obtained rule (WO). In some cases, CTC and RVC are combined through "and (&)" or "or (/)."[11] For example, "CTC&RVC" requires to meet both CTC and RVC. The product-specific variable is the number of HS six-digit codes inputted for the production of product p (Number of Inputs).[12] The country-specific variables include the general fixed costs for exporting. Specifically, those are the cost and time at the border in export country c, of which the data are obtained from the Doing Business Database in the World Bank. We use those data for 2012.[13]

Our hypotheses are as follows. First, FCR may be different according to a type of RoOs through the difference in fixed costs for RTA utilization. For example, those fixed costs will be relatively low in WO because it requires exporters to certify only all-or-nothing in production. Indeed, Hayakawa et al. (2016) found in RTA imports in Thailand that WO has relatively low fixed costs for RTA utilization. On the other hand, those costs might be costly in SP because exporters have to certify their production of specific processes or chemical reaction. Second, the coefficient for Number of Inputs is expected to be positive because exporters have to certify the origin of all inputs and thus the costs to do that become higher if the number of inputs is larger. Third, due to the rise of fixed costs for exporting which is the denominator of FCR, the cost and time at border will be negatively related to FCR.

The estimation results by ordinary least squares are reported in Table 7. In column (I), we introduce all the above variables. The results show the high and low FCRs in SP and WO, respectively. However, it is strange that CTC has the higher FCR than CTC&RVC. The coefficient for Number of Inputs is positively significant, implying that the FCR becomes higher in the products required to input a larger number of parts and components. Two country-specific variables on the general fixed costs for exporting, that is the cost and time at border in export countries, have negative coefficients though the coefficient for the cost is insignificant. In column (II), we introduce export country fixed

[11] Originally, there are various types of RoOs. We aggregate into CTC, change-in-chapter, change-in-heading, and change-in-subheading rules. For example, change-in-chapter rule requires exported products to have a different two-digit HS code from inputs imported from non-RTA member countries. RVC is a rule that requires to add a certain share of value in the RTA member countries. SP requires to conduct a specific process or chemical reaction in those countries.
[12] We construct this variable using National Input-output (IO) Table in Japan for 2011 in addition to the converter between HS codes and IO classification. These are drawn from the website of Ministry of Internal Affairs and Communications in Japan.
[13] The year of FCR differs by countries and products because in Section 4.2, we compute the FCR at a country-product level in the latest year when a trade regime is heterogeneous. In this analysis, we consistently use the data on border cost and time in 2012.

effects, instead of country specific variables. The results in CTC&RVC and WO turn out to be insignificant. In sum, the FCR is higher in the products produced with a larger number of inputs or in the products with SP of RoOs.

=== Table 7 ===

5.2. Simulation

In this subsection, we conduct two simulation analyses. Specifically, we examine the effect of a change in FCR/tariffs on the rate of utilization of an RTA scheme. To do this, we define the RTA utilization rate $U_i(l)$ by

$$U_i(l) \equiv \frac{Q_i^R(l)}{Q_i^M(l) + Q_i^R(l)} = \frac{1}{Q_i^M(l)/Q_i^R(l) + 1}. \tag{5}$$

We can rearrange equation (4) as

$$\frac{Q_i^R(l)}{Q_i^M(l)} = \frac{\left[\left(\frac{1}{\mu_i(l)}\right)^{v(l)} - 1\right]^{\frac{\alpha - v(l)+1}{v(l)-1}} \left(\frac{1}{\mu_i(l)}\right)^{v(l)-1}}{[FCR_i(l)]^{\frac{\alpha - v(l)+1}{v(l)-1}} - \left[\left(\frac{1}{\mu_i(l)}\right)^{v(l)} - 1\right]^{\frac{\alpha - v(l)+1}{v(l)-1}}}. \tag{6}$$

These two equations enable us to compute the RTA utilization rate with the FCR, the tariff ratio, and exogenous parameters.

The first simulation is to quantify the effect of a 10% reduction of FCR. Our procedure for this simulation is as follows. Let $U_{i0}(l)$ be the original RTA utilization rate. First, we reduce our import-ratio approach-estimates of FCR in each country-pair-product by 10%.[14] Second, substituting the reduced FCR for equation (6), we obtain a new ratio of $Q_i^M(l)/Q_i^R(l)$, which we denote $\hat{Q}_i^M(l)/\hat{Q}_i^R(l)$. Third, introducing the new ratio, $\hat{Q}_i^M(l)/\hat{Q}_i^R(l)$, into equation (5), we compute the RTA utilization rates

$$\hat{U}_i(l) = \frac{1}{\hat{Q}_i^M(l)/\hat{Q}_i^R(l) + 1}.$$

Fourth, we obtain the new RTA utilization rate, $U_{i1}(l)$, by $U_{i1}(l) = \min\{1, \hat{U}_i(l)\}$ because when $\hat{U}_i(l)$ is greater than one, equation (1) does not hold under the reduced FCR and the regime switches from heterogeneous to homogeneous one. Finally, we take a difference between the original and new RTA utilization rates. That is, we compute $U_{i1}(l) - U_{i0}(l)$.

[14] Our use of the import-ratio approach-estimates implies that country-product pairs in this simulation analysis are restricted to those in which a heterogeneous regime is observed in our sample period.

The results are shown in Table 8. In total, on average, a 10% reduction of FCR raises RTA utilization rates by 3.6 percentage points. This average magnitude is not so different from the median value (3.2 percentage points). In some observations, the RTA utilization rate becomes 100% after the reduction of FCR. In short, the reduction of additional fixed costs for RTA utilization contributes to raising RTA utilization rates. As found in Section 5.1, such reduction is possible by, for example, revising RoOs to CTC/RVC. We observe little difference in the magnitude across export countries, though the maximum value is relatively small in Chile.

=== Table 8 ===

Next, we examine how much RTA utilization rates increase when a phase-in period is completed, compared with their level in 2016. With the assumption that the FCR is constant from 2016 to the final year of the phase-in period, equation (4) can be rewritten as follows:

$$\overline{FCR}_i(l) = \left(\left[\mu_{i,t}(l)\right]^{-\nu(l)} - 1\right)\left(\left[\mu_{i,t}(l)\right]^{1-\nu(l)} \frac{Q_{i,t}^M(l)}{Q_{i,t}^R(l)} + 1\right)^{\frac{\nu(l)-1}{\alpha-\nu(l)+1}},$$

where the lower right subscript t represents the year ($t = 2016, final$) and $final$ indicates the final year of the phase-in period. $\overline{FCR}_i(l)$ is the FCR which is assumed to be constant. Equalizing the right hand side of above relation when $t = 2016$ and $t = final$ and rearranging, the ratio of MFN imports to RTA imports in the final year is given as:

$$\frac{Q_{i,final}^M(l)}{Q_{i,final}^R(l)} = \frac{\left[\left(\mu_{i,2016}(l)\right)^{1-\nu(l)} \frac{Q_{i,2016}^M(l)}{Q_{i,2016}^R(l)} + 1\right]\left[\frac{\left(\mu_{i,2016}(l)\right)^{-\nu(l)}-1}{\left(\mu_{i,final}(l)\right)^{-\nu(l)}-1}\right]^{\frac{\alpha-\nu(l)+1}{\nu(l)-1}} - 1}{\left[\mu_{i,final}(l)\right]^{1-\nu(l)}}. \qquad (7)$$

Note that the use of equation (4) means that we again focus on the pairs in which a heterogeneous regime is observed in our sample period. Based on this equation, we can compute the ratio in the final year. Importantly, in this computation, we do not need the estimates of the FCR. We just assume that FCR does not change over time. Applying the ratio in the final year into equation (5), we will have RTA utilization rates in the final year.

The practical procedure is similar to the first simulation. First, we restrict observations only to those in which RTA tariff rates are further reduced after 2016.[15]

[15] No observations for Mexico are available in this case.

Second, by introducing RTA tariff rates in 2016 and the final year into equation (7), we compute a new ratio of imports under MFN to those under RTA. Third, applying the new ratio into equation (5), we compute the RTA utilization rate in the final year. Fourth, similar to the first simulation, we replace the new RTA utilization rate to the value one if it exceeds the value one. Last, we take a difference between RTA utilization rates in 2016 and the final year. The expected change of RTA utilization rates are shown in Table 9. Since RTAs with India and Peru are relatively new and RTA tariff rates are further reduced after 2016, the average change is larger in those two countries.[16] The average changes in India and Peru are 17 and 21 percentage points, respectively. We can also see that, for example, a 10% reduction of FCR in Peru is equivalent to the reduction of RTA tariff rates by 0.7 percentage points.[17] In sum, the further reduction of RTA tariff rates results in raising RTA utilization rates.

=== Table 9 ===

6. Concluding Remarks

This paper proposed methods to quantify the ratio of fixed costs for RTA utilization to those for exporting. We call this ratio the FCR in this study. Using the data of Japan's imports from some RTA partners, we found that RTA utilization in exporting requires 13-25% of additional fixed effects. We also empirically showed that the FCR is higher in the products produced with a larger number of inputs. It is also found that SP in RoOs raises the FCR more greatly than other types of RoOs. By using these estimates of the FCR, we conducted various simulation analyses. We showed that a decrease of the FCR by 10% raises the RTA utilization rates by 3.6 percentage points on average.

It is important to compute FCR for many countries. As mentioned in the introductory section, our method is technically easy and less data-demanding, compared with that in the previous studies. Therefore, we expect that our method is applied to the case of other countries. The availability of such estimates of FCR in many countries will enable us to uncover what kinds of elements affect the FCR. In particular, we can examine not only export country characteristics but also import country characteristics and country

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[16] Table C3 in Appendix C reports the gap in RTA tariff rates between 2016 and the final year.

[17] In Peru, on average, a 10% reduction of FCR and the introduction of RTA tariff rates in the final year raises RTA utilization 3.94 and 21.49 percentage points, respectively. Table C3 shows that on average, RTA tariff rates are further reduced by 3.98 percentage points in Peru. As a result, a 10% reduction of FCR becomes equivalent to the reduction of RTA tariff rates by 0.7 (= 3.94 * 3.98 / 21.49) percentage points

Table C3 in Appendix C reports the gap in RTA tariff rates between 2016 and the final year.

pair characteristics. Such analyses contribute to uncovering how to reduce fixed costs for RTA utilization. The reduction of those fixed costs will result in enhancing firms' RTA utilization.

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Table 1. Total Imports, Duty-free Imports, and RTA Imports by Exporters and Years

	CHE	CHL	IDN	IND	MEX	PER
(A) Total Imports (Bil. JPY)						
2012	664	754	2,562	576	360	241
2013	746	798	2,833	701	425	228
2014	779	858	2,608	724	470	165
2015	884	681	2,287	557	594	144
2016	833	614	1,975	523	635	162
(B) Duty-free Import Share (%)						
2012	94	78	85	77	71	94
2013	93	77	83	75	70	92
2014	93	75	81	73	70	89
2015	93	71	78	67	75	89
2016	93	69	76	71	77	89
(C) Total RTA Imports (Bil. JPY)						
2012	34	148	250	106	70	10
2013	43	160	325	143	90	12
2014	48	190	355	162	114	13
2015	53	172	372	159	119	14
2016	51	172	361	139	120	14
(D) RTA Share (%) = (C)/(A)						
2012	5	20	10	18	19	4
2013	6	20	11	20	21	5
2014	6	22	14	22	24	8
2015	6	25	16	29	20	9
2016	6	28	18	27	19	9
(E) Number of Eligible Tariff-line						
2012	638	135	1,132	1,079	469	242
2013	621	124	1,151	1,114	473	257
2014	623	110	1,159	1,132	478	252
2015	590	120	1,132	1,174	497	277
2016	598	115	1,131	1,130	512	254
(F) RTA Share (%) in Eligible Tariff-line						
2012	76	91	89	79	74	82
2013	73	91	89	80	79	82
2014	76	90	89	81	90	86
2015	74	90	88	80	90	84
2016	77	92	89	79	90	75

Sources: Ministry of Finance and TAO

Notes: The share of duty-free imports is imports of products with zero MFN rates divided by total imports. “Eligible” means that (i) both RTA and MFN rates are ad-valorem rates and RTA rates are lower than MFN rates or (ii) MFN rates are specific rates and RTA rates ad-valorem rates.

Table 2. Number of Products by Observation Types and Export Countries

		CHE	CHL	IDN	IND	MEX	PER
	Pairs with both heterogeneous and homogenous regimes						
(i)	Max. Hetero < Min. Homo	2	8	10	14		10
(ii)	Max. Hetero = Min. Homo	137	22	331	277	66	70
(iii)	Max. Hetero > Min. Homo	5	13	19	30		9
(iv)	Pairs with only a homogeneous regime						
		179	51	409	344	77	132
(v)	Pairs with only a heterogeneous regime						
		222	24	447	431	113	84
	Total	323	94	769	665	143	221

Source: Authors' computation

Notes: This table reports the number of products according to export countries and trade regimes. Types (i)-(iii) include products that are imported under both heterogeneous and homogeneous regimes during our sample period. These three types are further distinguished according to the magnitude relationship between the maximum value of RHS in heterogeneous regime (Max. Hetero) and the minimum value in homogeneous regime (Min. Homo).

Table 3. Statistics for FCR Based on Tariff-ratio Approach

Exporter	N	Min	Max	Mean	p25	p50	p75
CHE	139	0.03	0.48	0.14	0.08	0.10	0.18
CHL	30	0.05	0.32	0.12	0.07	0.09	0.13
IDN	341	0.04	0.68	0.15	0.09	0.13	0.18
IND	291	0.03	0.47	0.15	0.08	0.13	0.20
MEX	66	0.04	1.08	0.19	0.07	0.13	0.23
PER	80	0.04	0.29	0.16	0.07	0.16	0.27
Total	947	0.03	1.08	0.15	0.08	0.13	0.20

Source: Authors' computation

Note: This table reports various statistics for the middle value between "Hetero" and "Homo" in Table 2.

Table 4. Statistics for FCR by Observation Types

		N	Min	Max	Mean	p25	p50	p75
	Pairs with both heterogeneous and homogenous regimes							
(i)	Max. Hetero < Min. Homo	44	0.03	0.68	0.16	0.08	0.13	0.20
(ii)	Max. Hetero = Min. Homo	903	0.03	1.08	0.15	0.08	0.13	0.20
(iii)	Max. Hetero > Min. Homo	76	0.03	0.59	0.19	0.09	0.16	0.23
(iv)	Pairs with only a homogeneous regime							
		1,192	0.01	1.08	0.16	0.09	0.14	0.20
(v)	Pairs with only a heterogeneous regime							
		1,321	0.02	0.80	0.15	0.08	0.13	0.23
	Total	3,536	0.01	1.08	0.15	0.08	0.13	0.21

Notes: Types (i)-(iii) include products that are imported under both heterogeneous and homogeneous regimes during our sample period. These three types are further distinguished according to the magnitude relationship between the maximum value of RHS in heterogeneous regime (Max. Hetero) and the minimum value in homogeneous regime (Min. Homo). In cases (i)-(iii), we compute the middle value (i.e., (3)). We compute the minimum value in homogeneous regime for case (iv) and the maximum value in heterogeneous regime for case (v).

Table 5. Statistics for FCR Based on Import-ratio Approach

Exporter	N	Min	Max	Mean	p25	p50	p75
CHE	366	0.05	37,688	126	0.11	0.23	0.84
CHL	67	0.03	57	2	0.09	0.14	0.28
IDN	807	0.02	14,040	42	0.12	0.21	0.49
IND	752	0.02	1,823	7	0.13	0.29	0.70
MEX	179	0.03	140 mil.	780,518	0.13	0.25	0.80
PER	173	0.03	527	7	0.17	0.34	0.75
Total	2,344	0.02	140 mil.	59,641	0.12	0.25	0.64

Source: Authors' computation

Table 6. Robustness Checks for Indonesia

Elasticity	Shape	N	p25	p50	p75
Modified	Modified	807	0.12	0.21	0.49
Broda et al.	Spearot	142	0.07	0.09	0.17
Kee et al.	Spearot	184	0.06	0.09	0.15
Broda et al.	ACF	243	0.08	0.13	0.60
Kee et al.	ACF	175	0.06	0.10	0.18
Broda et al.	FE	289	0.08	0.14	0.65
Kee et al.	FE	195	0.06	0.10	0.16

Source: Authors' computation

Notes: "Broda et al." and "Kee et al." are demand elasticities obtained from Broda et al. (2006) and Kee et al. (2008), respectively. "Spearot" is the shape parameter obtained from Spearot (2016). "ACF" and "FE" are the shape parameters estimated by using the TFPs based on the method in Ackerberg et al. (2015) and on the simple fixed effect estimation, respectively. The more details are available in Appendix B.

Table 7. Determinants of FCR with Product and Country Characteristics

	(I)		(II)	
	Coef.	S.E.	Coef.	S.E.
Country-product characteristics				
RoO Dummy (Base: CTC)				
CTC&RVC	-0.409**	[0.178]	-0.015	[0.249]
CTC/RVC	-0.946***	[0.120]	-0.892***	[0.120]
SP	0.810***	[0.105]	1.315***	[0.183]
WO	-0.352**	[0.163]	0.151	[0.227]
Product characteristics				
Number of Inputs	0.544***	[0.103]	0.540***	[0.110]
Country characteristics				
Cost at border	-0.246	[0.166]		
Time	-1.049***	[0.169]		
Number of observations	2,323		2,323	
R-squared	0.0615		0.0714	

Notes: The dependent variable is a log of FCRs computed in Table 4. ***, **, and * represent significance at the 1%, 5%, and 10% statistical levels, respectively. Parentheses contain the heteroscedasticity-consistent standard error (S.E.). We estimate using the OLS method. In model (II), we introduce country fixed effects.

Table 8. Statistics for Impacts of 10% Reduction of FCR on RTA Utilization Rates (Percentage points)

Exporter	N	Min	Max	Mean	p25	p50	p75
CHE	366	0.00	15.81	3.63	1.15	2.99	4.69
CHL	67	0.01	9.01	3.68	0.73	3.08	6.60
IDN	807	0.02	14.55	3.28	1.12	2.90	4.38
IND	752	0.01	15.63	3.83	1.98	3.42	4.59
MEX	179	0.00	15.87	3.70	1.02	3.10	5.80
PER	173	0.01	14.89	3.94	2.32	3.61	4.93
Total	2,344	0.00	15.87	3.61	1.45	3.17	4.59

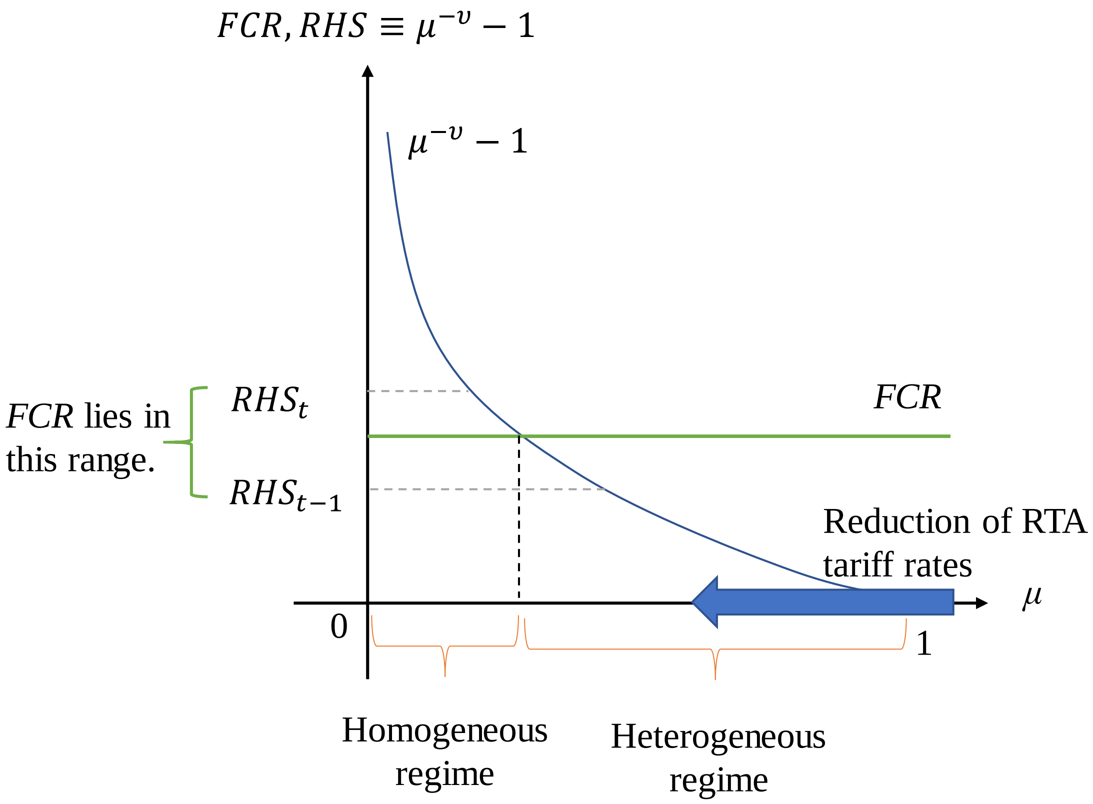
Source: Authors' computation

Table 9. Statistics for the Change of RTA Utilization Rates from 2016 to the Final Year (Percentage points)

Exporter	N	Min	Max	Mean	p25	p50	p75
CHE	11	0.00	25.90	9.41	0.69	4.72	16.56
CHL	14	0.03	38.94	6.25	1.44	4.49	6.29
IDN	11	0.47	4.83	2.42	0.76	2.16	3.67
IND	54	0.17	45.70	17.49	4.18	16.75	30.53
PER	12	0.25	47.00	21.49	8.39	19.79	34.06

Source: Authors' computation

Figure 1. Tariff-ratio Approach



Source: Authors' compilation

Appendix A. Derivation of Equation (4)

We assume that $\varphi(k)$ follows the Pareto distribution. Its cumulative distribution function is given by

$$G(\varphi) = 1 - \varphi^{-\alpha} \qquad v(l) < \alpha,$$

and ranges in $[1, \infty)$. In the heterogeneous regime, imports under respective schemes are written as

$$Q_i^M(l) \equiv \int_{\overline{\varphi}_i^M(l)}^{\overline{\varphi}_i^{R>M}(l)} p_i^M(l,k) c_i^M(l,k) G(\varphi)$$

$$= \frac{1}{\alpha - v(l) + 1} \left(\zeta_i(l) \left[\frac{1}{T(l)} \right]^{v(l)} \right)^{\frac{\alpha - v(l)+1}{v(l)-1}} \left\{ \left[\frac{1}{f_i(l)} \right]^{\frac{\alpha - v(l)+1}{v(l)-1}} \right.$$

$$- \left(\frac{1}{f_i^R(l)} \left[\left(\frac{1}{\mu_i(l)} \right)^{v(l)} \right.\right.$$

$$\left.\left.\left. - 1 \right] \right)^{\frac{\alpha - v(l)+1}{v(l)-1}} \right\} \left(\frac{1}{T(l)\tau_i(l) w_i} \frac{v(l)-1}{v(l)} \right)^{v(l)-1} \alpha [p(l)]^{v(l)-1} \beta(l) Pc,$$

$$Q_i^R(l) \equiv \int_{\overline{\varphi}_i^{R>M}(l)}^{\infty} p_i^R(l,k) c_i^R(l,k) G(\varphi)$$

$$= \frac{1}{\alpha - v(l) + 1} \left(\frac{\zeta_i(l)}{f_i^R(l)} \left[\frac{1}{T(l)} \right]^{v(l)} \left[\left(\frac{1}{\mu_i(l)} \right)^{v(l)} \right.\right.$$

$$\left.\left. - 1 \right] \right)^{\frac{\alpha - v(l)+1}{v(l)-1}} \left(\frac{1}{\mu_i(l) T(l) \tau_i(l) w_i} \frac{v(l)-1}{v(l)} \right)^{v(l)-1} \alpha [p(l)]^{v(l)-1} \beta(l) Pc.$$

Thus,

$$\frac{Q_i^R(l)}{Q_i^M(l)} = \frac{\left[\left(\frac{1}{\mu_i(l)} \right)^{v(l)} - 1 \right]^{\frac{\alpha - v(l)+1}{v(l)-1}} \left(\frac{1}{\mu_i(l)} \right)^{v(l)-1}}{[FCR_i(l)]^{\frac{\alpha - v(l)+1}{v(l)-1}} - \left[\left(\frac{1}{\mu_i(l)} \right)^{v(l)} - 1 \right]^{\frac{\alpha - v(l)+1}{v(l)-1}}}.$$

This is equation (5) in Section 6. Solving this equation for $FCR_i(l)$, we obtain equation (4).

Appendix B. Estimating the Pareto Shape Parameter with Indonesian Plant-level Data

In this appendix, we explain how we estimate the Pareto share parameter with Indonesian plant-level data.

B1. Data

We use Indonesia plant-level panel data from 2000 to 2012. This dataset originates from annual surveys by Indonesia's Statistical Agency (Badan Pusat Statistik, BPS), which covers manufacturing plants with 20 or more workers. It contains production and cost information at the plant level, including the total numbers of production and non-production workers, amount of capital stocks, total value of production, value-added, costs of material inputs and labor. There are some plants that have extremely large or small values of output or input. We exclude those plants whose value of production, material inputs and the number of employees lie in the top or bottom 1% in each industry. We also prepare the output and input deflator. The output deflator is constructed using the wholesale price index produced by BPS. We construct the input deflator by aggregating the output deflator using the Indonesia input-output table to compute input share weights.

B2. Production Function Estimation

We obtain the total factor productivity (TFP) by estimating the gross production function. For production function estimation, we need the gross output, intermediate input, number of employees, and capital stock. As for gross output and intermediate input, we use the values of output and material input deflated by the industry-level output or input deflator. Capital stock is constructed with the value of tangible asset and the value of investment and is estimated by the perpetual inventory method. For our production function estimation, we use the Ackerberg et al. (2015) methodology. This method takes into account both the issue of the endogeneity of the capital stock raised by Olley and Pakes (1996) and the potential co-linearity in the first stage of the Levinsohn and Petrin (2003) estimator. We use Stata module "acfest" developed by Manjon and Manez (2016). Production function is estimated by two digit-level industry.

B3. Estimating Pareto Shape Parameter

Next, we estimate the Pareto shape parameter using estimated TFP, following Mayer and Ottaviano (2007). Let X and X_m denote TFP and its mode, respectively. Then, the cumulative distribution of TFP can be expressed as follows:

$$F(X) = 1 - \left({X_m}/{X}\right)^{\alpha}, \tag{B1}$$

where *k* is the Pareto shape parameter. Tanking a log, (B1) can be rewritten as

$$\ln\big(1 - F(\mathrm{X})\big) = \alpha \ln(X_m) - \alpha \ln(X). \tag{B2}$$

Since *X* and *F*(X) are available, by regressing ln (1-*F*(*X*)) on ln *X* as in equation (B3), we obtain the estimates of the Pareto parameter.

$$\ln\big(1 - F(X)\big) = \gamma_0 + \gamma_1 \ln(X) + \varepsilon, \tag{B3}$$

where $\gamma_1 = -\alpha$ and ε is error term.

Appendix C. Other Tables

Table C1. Validity of Theoretical Condition

Shape − Sigma + 1	Broda et al.	Kee et al.	Modified
Negative	114,675	47,245	1,345
Positive	92,925	160,355	206,255
Total	207,600	207,600	207,600

Notes: Numbers indicate the number of country--product (HS nine-digit)-year pairs in our sample. "Broda et al." and "Kee et al." are original parameters of demand elasticity. In "Modified," we first restrict country-product pairs only to those in which the shape parameter is greater than the demand elasticity (Broda et al.) minus one. Then, we take the average of a shape parameter and a demand elasticity by country and the Section of HS tariff classification and apply that to all corresponding country-product pairs.

Table C2. Basic Statistics for Table 6

Variable	Obs	Mean	Std. Dev.	Min	Max
FCR	2,323	-0.9327	1.8576	-3.6998	18.7548
Number of Inputs	2,323	7.3160	0.3514	6.1591	8.0650
CTC&RVC	2,323	0.0783	0.2688	0	1
CTC/RVC	2,323	0.1713	0.3769	0	1
SP	2,323	0.1718	0.3773	0	1
WO	2,323	0.0306	0.1722	0	1
Cost	2,323	5.7373	0.2934	5.3033	6.1312
Time	2,323	2.6621	0.2799	2.0794	2.8391

Source: Authors' computation

Table C3. Gap in RTA Tariff Rates between 2016 and the Final Year (Percentage points)

Exporter	N	Min	Max	Mean	p25	p50	p75
CHE	11	1.10	8.50	2.97	1.40	2.70	3.70
CHL	14	0.30	6.30	1.19	0.30	0.50	1.40
IDN	11	0.10	8.40	2.62	0.40	1.70	5.30
IND	54	0.30	11.90	4.04	2.30	3.60	5.50
PER	12	2.30	6.80	3.98	2.55	3.95	4.80
Total	102	0.10	11.90	3.37	1.40	2.90	4.80

Source: Ministry of Finance

References in Appendices

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