RIETI Discussion Paper Series 19-E-054

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RIETI Discussion Paper Series 19-E-054

July 2019

Costs of Utilizing Regional Trade Agreements

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Abstract

This paper proposes a method of quantifying the additional fixed cost to exporters of taking advantage of regional trade agreements (RTAs). Such additional fixed costs can be measured by the ratio of fixed costs resulting from preference utilization to those associated with non-preferential export activities, or "fixed cost ratio (FCR)." Our method is built on a model of international trade where heterogeneous exporters decide what tariff schemes to use. By applying our method to Japan's imports from RTA partner countries, we obtain the median estimate for FCR of 0.04-0.08, implying that RTA utilization imposes fixed cost increases of 4-8%. Furthermore, we demonstrate that the reduction of the FCR by half raises the RTA utilization rate by 22 percentage points. We also compute the change in procurement costs resulting from compliance with RTA rules of origin. Our estimate of the change is two percent of per-unit production cost. Then, we simulate the complete elimination of these additional procurement costs, which had the impact of a 20 percentage point rise in RTA utilization rate.

Keywords: Regional trade agreement; Preference utilization; Cost estimation; Japan

JEL classification: F15; F53

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[§] This study is conducted as a part of the Project "A Study of Free Trade Agreements" undertaken at the Research Institute of Economy, Trade and Industry (RIETI). We would like to thank Richard Baldwin, Hiroyuki Kasahara, Kozo Kiyota, Roberto Patuelli, Joel Rodrigue, Hisamitsu Saito, Takaaki Takahashi, Vicard Vincent, and seminar participants at CEPII, Kyoto University, Gakushuin University, Kobe University, Kushiro Public University of Economics, Japan Society for International Economics 2017, MWIEG meeting 2018, APTS 2018, 58th ERSA 2018, ETSG 2018, 9th international conference on Economics of Global Interactions in Bari (Italy), Policy Modelling Conference 2018 in Nagasaki University, and RIETI. Hayakawa acknowledges financial support from the JSPS under KAKENHI Grant Number JP17H02530. Yoshimi acknowledges financial support from the JSPS under KAKENHI Grant Number JP16H03638. All remaining errors are ours.

1. Introduction

Using preferential tariff schemes, firms can enjoy tariff rates lower than general tariff rates, such as most favored nation (MFN) rates. To claim preferential tariff rates, they must comply with rules of origin (RoOs) and obtain certificates of origin (CoOs). RoOs are a device used to prevent the roundabout export from unqualified countries under preferential status. The compliance of RoOs may require exporters to change their procurement sources. For example, to comply with RoOs, some exporters may be forced to switch from intermediate inputs sourced from unqualified origins to local inputs and thereby suffer from the increase in procurement costs. This type of cost is positively associated with production value. To obtain CoOs, exporters must submit various documents, such as a list of inputs, a production flow chart, production instructions, invoices for each input, and contract documents. Exporters are required to provide these documents for each transaction regardless of the value of exports. Therefore, this burden becomes a substantial fixed cost to utilize preferential tariff schemes. Firms where gains from low preferential tariff rates overcome these two costs, claim preference schemes in exporting. Indeed, these costs will affect the behavior of exporting firms. For example, recent proposals by Donald Trump's administration for the revamp of the North American Free Trade Agreement's (NAFTA) revamp include a plan to tighten RoOs. According to the North American Economic Alliance, there is a concern that the proposal of tightening RoOs in automotive sectors in NAFTA will discourage manufacturers from utilizing the NAFTA and induce them to pay MFN rates.[1]

This study aims to quantify fixed costs to utilizing preferential tariff schemes.[2] Some studies measure the tariff-equivalent rates of total costs for preference utilization without differentiating the two costs above. Applying the threshold regression approach to the utilization rate of Cotonou preference, for example, Francois et al. (2006) found that the tariff-equivalent costs of using the preference ranged between 4% and 4.5%. Further, some studies have estimated the absolute values of fixed costs for regional trade agreement (RTA) utilization. Using the data on RTA utilization for exports from Chile to the United States (US), Ulloa and Wagner-Brizzi (2013) found that the 75th percentile was around US$3,000

[1] See the report by John G. Murphy, entitled "Offshoring American Jobs? The Risk Posed by Tighter Rules of Origin in NAFTA," which is available at https://www.naeconomicalliance.com/offshoring-american-jobs-the-risk-posed-by-tighter-rules-of-origin-in-nafta/

[2] Firms have to pay the fees for issuing CoOs to the authority. The fees vary across countries. For example, they are around US$30 when exporting one product from Japan. The fixed costs that we estimate in this paper include direct and indirect costs to prepare the documents mentioned before. Firms may need to request their business partners to send some documents on transactions. The import prices in terms of home currency may be updated for every transaction because of the significant change in exchange rates. The firms have to handle all the procedures. To this end, they may set up some division and assign some staff. Our fixed costs include these communication costs and labor expenses incurred in preparing necessary documents. In particular, these indirect costs have to be borne in the third-party as well as the self-certification system.

in the year the RTA came into force (around US$200 for the median). By employing firm-level data on the generalized system of preferences (GSP) utilization for exporting apparel products to the European Union (EU) from Bangladesh, Cherkashin et al. (2015) estimated structurally the fixed costs at US$4,240. Hayakawa et al. (2016) applied detailed customs data in Thailand to the modified version of Ulloa and Wagner-Brizzi's (2013) method and found that the median costs were approximately US$2,000 for exports from China, US$300 for exports from Australia, and US$1,000 for exports from Japan. In short, these studies found various levels of fixed costs for preference utilization, depending on countries, tariff schemes, and industries.

Against this backdrop, we propose an alternative method to quantify the fixed costs associated with the use of RTA schemes. Specifically, our method enables us to compute the ratio of fixed costs for preference utilization to those associated with exports in general. We call this ratio the "fixed cost ratio (FCR)," indicating additional fixed costs required to export under a preference scheme compared with the MFN scheme. Our method relies on the model of tariff scheme choice developed by Demidova and Krishna (2008), which incorporates the exporter's tariff scheme choice into the heterogeneous firm model of Melitz (2003). In Demidova and Krishna's (2008) model, when exporters use an RTA scheme, they incur additional procurement costs, which we call "procurement adjustment cost (PAC)" to comply with RoOs, and fixed costs to obtain CoOs. Thus, it is theoretically demonstrated that more productive exporters choose a preference scheme while less productive exporters choose an MFN scheme. In this separation, the FCR plays a crucial role: the lower the FCR, the higher the share of trade values under RTA schemes. This relationship is summarized as one key equation.

Our method to compute the FCR is primarily to solve the above key equation. The resulting solution expresses the FCR as a function of the PAC and the (country-product-level) trade and tariff data by tariff schemes (i.e., MFN and RTA schemes). The trade data by tariff schemes are publicly available in some developed countries, such as in the US, EU, and Japan. We can also obtain detailed tariff data from the database managed by international organizations (e.g., the World Integrated Trade Solution in the World Bank or the Tariff Analysis Online in the WTO). As a result, the remaining unknown variable is the PAC. Therefore, we first compute the PAC. To this end, we assume that the FCR is time-invariant. Combining this assumption and the key equation, we can derive an additional equation that describes the relationship between the PAC and the trade values and tariffs by tariff schemes. The data on the latter two are available as mentioned above. Therefore, for each country-product pair, we can solve this equation for the PAC. Then, applying the estimates of the PAC to the key equation, we can solve for the FCR in each country-product pair.

We apply this method to Japan's imports from several RTA partner countries during 2012–2016. Our findings can be summarized as follows. We first find that the magnitude of the PAC is 2% in the median, meaning that the compliance of RoOs requires exporters to incur an additional cost, which is comparable to two percentage points of per-unit production cost. Unfortunately, the number of pairs where the PAC computation is feasible is small in our sample. This is because our method requires the data on the two years with different RTA tariff rates, but Japan had nearly completed its tariff reduction/elimination before our sample period. Hence, when solving the key equation for the FCR, we use the same value of the PAC (e.g., 25, 50, or 75 percentiles of our estimates for the PAC among all pairs) common to all the pairs, rather than using it in a corresponding pair. As a result, when applying the above median value of the PAC (i.e., 2%) to all country-product pairs, we see that the median of the FCR is 0.08, indicating that RTA utilization in exporting requires an additional 8% of fixed costs.

Using these estimates, we conduct additional analyses. For example, we simulate how much the RTA utilization rate, which is defined as imports under the RTA scheme over total imports, rises if the FCR decreases by half. This analysis shows that the utilization rates rise by 22 percentage points, on the median. We also simulate the impacts of the elimination of the PAC and show the rise of RTA utilization rates by 20 percentage point in the median. Namely, we found that the reduction of the FCR by half has a similar absolute effect on the RTA utilization rates to the complete elimination of the PAC. We also examine the empirical validity of our assumption that the FCR is time-invariant, which is key to computing the PAC. For this, we first theoretically demonstrate that, under some conditions, if the FCR is time-invariant, the ratio of imports under an MFN scheme to those under RTA schemes should not change over time. Then, we empirically show that the null-hypothesis that such a ratio does not change over time cannot be rejected. In sum, we find indirect support for the time-invariability of the FCR.

This paper makes at least three contributions to the literature. One strand of literature includes studies that quantify fixed costs incurred for preference utilization, listed above. A clear advantage of our method is the ease of computing the FCR, compared with Cherkashin et al. (2015). We simply solve the key equation for the FCR, as briefly mentioned above. In addition, our method does not require detailed data such as firm/transaction-level trade data by tariff schemes, unlike Cherkashin et al. (2015) and Hayakawa et al. (2016). The necessary data for our approach includes the country-product-level data on trade values and tariff rates by tariff schemes in addition to the elasticity of substitution and the shape parameter of the Pareto distribution in firms' productivity.[3] Therefore, our method can be applied to many countries from the viewpoint of data requirement.[4] This advantage is

[3] Some literatures employ trade data differentiated by tariff schemes. For example, some studies analyze what determines the use of preference schemes (e.g., Cadot et al., 2006; Carrere and de Melo, 2006; Francois et al., 2006; Manchin, 2006; Hakobyan, 2015). They find that preference margins (i.e., MFN rates minus preferential rates) and the restrictiveness of RoOs play a significant role. Another strand of literature examines the benefits to exporters arising from preference utilization (Cadot et al., 2005; Olarreaga and Ozden, 2005; Ozden and Sharma, 2006; Cirera, 2014). Specifically, these studies quantify how much export prices rise with use of preference schemes.

[4] Fixed costs associated with exports have been quantified in several studies (e.g., Das et al., 2007;

important to conduct a cross-country comparison in the future.

Second, to our best knowledge, this paper is the first to provide estimates of the PAC, which is the cost proportional to export volume. Although several studies quantify fixed costs for preference utilization, no studies have estimated the PAC. However, it is essential to differentiate the PAC from the fixed cost for RTA utilization because those two costs are qualitatively different, as mentioned in the beginning of this section. For example, Cherkashin et al. (2015) incorporate the PAC for GSP utilization in exporting woven apparel products. However, they merely set its magnitude at a level roughly in line with the specifics of the market they examine. Specifically, as RoOs involve using domestic cloth, which is about 20% more expensive than imported cloth and as roughly 75% of the cost is the cloth, they assume a 15% cost increase from meeting RoOs. Furthermore, the method of measuring fixed costs for RTA utilization in Ulloa and Wagner-Brizzi (2013) and Hayakawa et al. (2016) is feasible only when assuming no costs for procurement adjustment. In this paper, we present the first estimate of the PAC.

Last, our simulation analysis is related to several studies that quantify 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).[5] A critical difference between these studies and ours is that we take into account the existence of some costs for RTA utilization.[6] Due to their existence, not all exporters use RTA tariff rates even after RTAs come into force. Indeed, as shown in Section 3, the share of imports under RTA schemes in Japan's total imports from RTA partners is below 100%. Therefore, we believe that it is essential to consider the presence of those costs for RTA utilization when evaluating the performance of RTAs. Furthermore, as we differentiate the two costs for RTA utilization (i.e., the PAC and the FCR), we can simulate the impacts of changing these costs separately. Such simulation analyses have never been conducted in the literature. A separate investigation of the two costs is critical because policy measures to reduce these two costs are different. The PAC will be lowered by setting business-friendly types of RoOs in RTAs while the introduction

Morales et al., 2019; Albornoz et al., 2016). In these studies, the extent of the relationship between the sunk costs and the fixed costs associated with exports is most focused on. For example, using plant-level data in Colombia, Das et al. (2007) find that the sunk components are about US$400,000 and that the annual fixed costs are almost zero. Morales et al. (2019) use firm-level export data in Chile and find that the relationship is similar to that in Das et al. (2007). However, using firm-level export data in Argentine, Albornoz et al. (2016) finds the opposite relationship, namely, that fixed costs associated with exports are higher than the sunk costs. In addition, Kropf and Sauré (2014) compute fixed costs per export shipment using Swiss export data.

[5] There is also a growing number of studies 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 costs associated with RTA utilization, as we do.

[6] Petri et al. (2011) take into account some costs for RTA utilization in their analysis on the Trans-Pacific Partnership agreement.

of the concise and transparent procedures in certifying the origin of goods will decrease the fixed costs for RTA utilization. We examine how much the reduction/elimination of each type of costs for RTA utilization contributes to raising RTA utilization rates.

The rest of this paper is organized as follows. Section 2 presents the theoretical setup for our methods to quantify the costs for RTA utilization. Section 3 provides an overview of RTA utilization in Japan to show that not all exporters choose RTA schemes even when exporting to RTA partner countries. Section 4 provides our estimates of the two costs in Japan's RTA imports. Section 5 presents some additional examinations conducted, including simulation analyses for reducing these costs. Finally, Section 6 concludes the paper.

2. Theoretical Setup

We propose an application of the model developed by Demidova and Krishna (2008) to quantify the FCR.[7] Their model includes two types of tariff schemes: MFN and RTA. Exporters choose one of these to maximize their export profits. In line with the findings presented in Section 3, the model shows that some exporters do not choose the RTA scheme even while exporting to RTA partner countries. To make the model structure consistent with our data, we assume the presence of multiple products. A continuum of monopolistically competitive firms engages in the production of each product.

2.1. Representative Household and Producers

We assume there are J countries, including the home country, in the world economy. Our analysis focuses on imports and domestic consumption in the home country. The representative household is assumed to consume L types of products. The utility function of the representative household is given by

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

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

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

where $\upsilon(l)$ represents the demand elasticity of each product. Each producer is indexed by k. $\Omega_i(l)$ is the set of firms in country i that supply product l. Using the above aggregates,

[7] Similar application is conducted by Ulloa and Wagner-Brizzi (2013). One remarkable difference with our model is that Ulloa and Wagner-Brizzi ignore the cost for procurement adjustment and fixed costs for exporting. If we do so, our estimate of the FCR shows the level of fixed costs for RTA utilization only. However, the previous studies found that the fixed costs for exporting are non-negligible (see footnote 4). Therefore, we assume the existence of both fixed costs for exporting and RTA utilization.

the optimal consumption is derived in the following manner:

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

Price indices are defined as follows:

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

Producers employ the domestic labor force, produce the output, and sell it in the domestic and foreign markets. We assume that the production technology of each producer k, that produces product l in country i, follows the simple linear function for the labor force given by

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

where $\varphi(k)$ represents firm-specific productivity and $n_i(l,k)$ is the labor input. Firms draw their productivity, $\varphi(k)$, from a distribution, $G_l(\varphi)$. Profit maximization leads to the following free on-board price:

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

where w_i is the wage rate in country i.

2.2. Choice of Tariff Schemes

The decisions on exports and tariff schemes are made by producers. For simplicity, we assume that there are no fixed costs of domestic supply without loss of generality. Further, we assume that destination markets are segmented, and that each producer makes decisions for each destination market separately. This setting allows us to analyze trade in each pair of countries independent of other country pairs. In addition, each exporter is assumed to be so small that we can ignore the effect of his/her behavior on macroeconomic variables such as the price index in destination markets. To examine the FCR and the PAC, we focus on the pair of the exporting and importing countries that have an RTA. In the trade flow between those two countries, exporting firms can choose either an MFN scheme (M) or an RTA scheme (R).[8] In either case, they need to pay fixed costs for exports, denoted by $f_i(l)$.

[8] We typically call the general tariff scheme "MFN," despite the fact that some exporting countries are non-WTO members. All our sample countries are WTO members, which means MFN rates are available for all sample country pairs. Moreover, 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, or multilateral resistance terms, in the home country but does not affect our methods of computing the FCR. We will discuss this issue later in this section.

Furthermore, when exporting under RTA schemes, they also need to incur *additional* fixed costs, such as document preparation costs, which are denoted by $f_i^R(l)$.[9] These two types of fixed costs are assumed to be exporting country-product specific and to be paid in units of labor in exporters' country. Producers do not face a choice of tariff schemes when they sell to their home country.

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

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

where τ_i is the iceberg 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 the "tariff ratio," defined as

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

where $T_i^R(l)$ is the (one plus) per-unit RTA tariff rate ($T(l) > T_i^R(l) > 1$). $\theta_i(l)$ is exactly what we call the PAC in this paper and represents the cost for adjusting procurement sources to comply with RoOs ($\theta_i(l) \geq 1$). RTA tariff rates are assumed to be exporting country (i.e., country pair)-product specific. We exclude the case where all exporters always choose the RTA scheme by assuming that:

$$0 < \theta_i(l)\mu_i(l) < 1. \tag{1}$$

As a result, export profits under respective tariff schemes can be derived as follows:

$$\pi_i^M(l,k) = [\varphi(k)]^{\upsilon(l)-1}[T(l)]^{-\upsilon(l)}\zeta_i(l) - w_i f_i(l),$$

$$\pi_i^R(l,k) = [\varphi(k)]^{\upsilon(l)-1}[\theta_i(l)\mu_i(l)T(l)]^{-\upsilon(l)}\zeta_i(l) - w_i f_i(l) - w_i f_i^R(l),$$

where

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

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

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

implying that RTA is more beneficial than MFN for the more productive producers. This is

[9] Following Helpman et al. (2004) and Helpman et al. (2008), we assume that exporters pay fixed costs for exports to each destination and ignore the case where they deal with export processes for multiple destinations simultaneously and save on the total fixed cost. In other words, the economies of scale are not considered for $f_i(l)$.

a consequence driven from the assumption presented by (1), which reveals that overall variable costs are smaller under RTA than MFN (i.e. $\theta_i(l)T_i^R(l) < T(l)$). More productive firms export more; thus, the total amount of variable costs under the respective tariff schemes becomes larger for more productive exporters than for less productive exporters since variable costs are assumed to be multiplicative. In other words, more productive exporters can save a larger amount of variable costs by utilizing RTA. Considering that fixed costs are larger for RTA than MFN, productive exporters prefer utilizing RTA to MFN as they can save a larger amount of variable costs and gain larger profits, which cover fixed costs for RTA utilization.

Firms determine whether they will export or not, and which tariff scheme they will use for exports. The optimization by exporters of their 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 define the range of producers that earn 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

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

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

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 given below:

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

indicating that firms prefer RTA to MFN if $\varphi(k) > \bar{\varphi}_i^{R>M}(l)$. 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 others go for the MFN scheme.

We measure additional fixed costs for RTA utilization, which we call the FCR and are defined as

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

Using the FCR, we can rewrite the condition for the heterogeneous regime, $\bar{\varphi}_i^R(l) > \bar{\varphi}_i^M(l)$, as

$$FCR_i(l) > \left[\frac{1}{\theta_i(l)\mu_i(l)}\right]^{v(l)} - 1. \tag{2}$$

When additional fixed costs for RTA utilization are large enough, or RTA tariff rates are not low enough, the less productive exporters hesitate to use RTA schemes. These exporters then use the MFN scheme while more productive exporters choose RTA schemes when condition (2) holds. In contrast, all exporters earn larger profits through the RTA rather than the MFN scheme when condition (2) is violated. In this case, product l is only exported under the RTA scheme. We call this case the (RTA-) homogeneous regime.

2.3. Computation of the FCR

Based on the theoretical setup above, we propose a method to quantify the FCR. Assume that productivity $\varphi(k)$ follows the Pareto distribution whose cumulative distribution function is given by

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

with $\varphi \in [1, \infty)$. Focusing on the heterogeneous regime, we can derive the following equation on the relation between $FCR_i(l)$ and the ratio of MFN imports to RTA imports (called "import ratio"):[10]

$$FCR_i(l) = \left([\theta_i(l)\mu_i(l)]^{-v(l)} - 1\right)\left([\theta_i(l)\mu_i(l)]^{1-v(l)}\frac{Q_i^M(l)}{Q_i^R(l)} + 1\right)^{\frac{v(l)-1}{\alpha(l)-v(l)+1}}. \tag{3}$$

$\alpha(l)$ is the shape parameter of the Pareto distribution and is assumed to vary across products. $Q_i^M(l)$ 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

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

Equation (3) is the key equation in this paper and captures the theoretical relation of the FCR with other variables, including the PAC, tariff ratio, import ratio, and a few

[10] Derivation of equation (3) is given in Appendix A. By assuming the Pareto distribution, the import ratio can be explicitly solved for the FCR.

parameters. Suppose that RTA tariff rates are zero. The shape parameter of the Pareto distribution (α) and the demand elasticity (υ) are set to 3.09 and 2.25, respectively.[11] Figure 1 depicts how the FCR is related to the import ratio. To focus on the relation between the FCR and import ratio, we set $\theta_i(l) = 1$ in the figure. We draw two cases where MFN rates are 5% and 20%. The figure shows that the import ratio should be positively related with the FCR. Namely, when we observe the higher import ratio, the FCR should be higher. Another interesting finding is that at a given import ratio, MFN rates are positively related to the FCR. Taking the import ratio as given, the FCR should be lower when MFN rates are lower because the smaller benefit from RTA utilization associated with lower MFN rates (i.e., smaller preference margin) have to be compensated for by the lower fixed costs for RTA utilization so that the import ratio becomes the same.

=== Figure 1 ===

Furthermore, Figure 2 presents the relation between the FCR and the import ratio with alternative values of the PAC. Specifically, the figure demonstrates cases with $\theta_i(l) = 1$ and $\theta_i(l) = 1.15$. The latter level is the one assumed by Cherkashin et al. (2015), as introduced in Section 1. The MFN rate is fixed to 20% ($T(l) = 1.20$) for both cases so that we can examine how ignoring the PAC changes the estimates of the FCR. For other parameters, we employed the same values as in Figure 1. The figure shows that the solid line (with $\theta_i(l) = 1$) is always located over the dotted line (with $\theta_i(l) = 1.15$), indicating the FCR is overvalued if we ignore the presence of the PAC as implied by equation (3). For instance, if the import ratio is 1, simulated FCR is 0.88 for the case with $\theta_i(l) = 1$ and 0.16 for the case with $\theta_i(l) = 1.15$. Therefore, the overvaluation is not negligible. In addition, the overvaluation becomes larger when the import ratio is higher. This illustration suggests the importance of joint consideration of the PAC and fixed costs of RTA utilization.

=== Figure 2 ===

As demonstrated above, once we have the information on all variables and parameters on the right-hand side (RHS) of equation (3), we can infer the FCR. As introduced in the next section, we have the data on the tariff ratio and the import ratio. Also, the elasticity of substitution ($\upsilon(l)$) and the shape parameter ($\alpha(l)$) are drawn from the estimates obtained in the existing study, as introduced in the next section. As a result, the unknown variable in the RHS is only the PAC, $\theta_i(l)$. To infer this cost as well as the FCR, we introduce a time-dimension into our discussion though our theoretical setup is static and ignores any dynamic aspects in firms' tariff scheme choice. Specifically, we impose one important

[11] These values are obtained from the weighted average in Crozet and Koenig (2010). Details are given in the next section.

assumption: that the FCR is time-invariant.[12] This assumption is not so strong because we allow proportional changes of fixed costs for exporting and RTA utilization. For instance, the assumption is assured if these fixed costs are mitigated at a similar speed to firms' experience on exporting and RTA utilization. In addition, we take the PAC as time-invariant because RoOs do not change over time, at least in our empirical sample. Indeed, as can be found in the current renegotiation of RoOs in NAFTA, it is rather difficult to change RoOs after RTAs' entry into force. Moreover, the elasticity of substitution ($v(l)$) and the shape parameter ($\alpha(l)$) are time-invariant as our sample period is so short that these parameters can be stable. On the other hand, the tariff ratio ($\mu_i(l)$) and the import ratio ($Q_i^M(l)/Q_i^R(l)$) change year on year.

If t refers to the year, equation (3) can be rewritten as

$$FCR_i(l) = \left([\theta_i(l)\mu_{it}(l)]^{-v(l)} - 1\right)\left([\theta_i(l)\mu_{it}(l)]^{1-v(l)}\frac{Q_{it}^M(l)}{Q_{it}^R(l)} + 1\right)^{\frac{v(l)-1}{\alpha(l)-v(l)+1}}. \tag{4}$$

Combining equation (4) for alternative years ($t = t', t^*$) to eliminate $FCR_i(l)$, we can obtain the following relation:

$$\begin{aligned}
&\left([\theta_i(l)\mu_{it'}(l)]^{-v(l)} - 1\right)\left([\theta_i(l)\mu_{it'}(l)]^{1-v(l)}\frac{Q_{it'}^M(l)}{Q_{it'}^R(l)} + 1\right)^{\frac{v(l)-1}{\alpha(l)-v(l)+1}} \\
&\qquad = \left([\theta_i(l)\mu_{it^*}(l)]^{-v(l)} - 1\right)\left([\theta_i(l)\mu_{it^*}(l)]^{1-v(l)}\frac{Q_{it^*}^M(l)}{Q_{it^*}^R(l)} + 1\right)^{\frac{v(l)-1}{\alpha(l)-v(l)+1}}.
\end{aligned} \tag{5}$$

Equation (5) proposes a way to calculate the PAC for each country-product pair. Note that the left- and right-hand sides of this equation are decreasing functions of $\theta_i(l)$. Figure 3 illustrates both sides of equation (5) taking $\theta_i(l)$ in the horizontal axis. In the figure, for LHS ($t = t'$) and RHS ($t = t^*$), MFN tariff rates are set to 20% and 10%, respectively. An RTA tariff rate is set at 0% for both cases. With respect to the ratio of imports under respective tariff schemes, we set for LHS (RHS) so that the RTA utilization rate becomes 90% (20%). The shape parameter of the Pareto distribution and the demand elasticity are set at 3.09 and 2.25, respectively. In this numerical example, since the intercept of blue solid and red dotted lines is unique, the solution of $\theta_i(l)$ is uniquely determined. Obviously, the intercept of these lines is unique as long as slopes of these lines are negative and differ from each other. In other words, the solution is uniquely determined if partial derivatives of left and right hand sides of equation (5) with respect to $\theta_i(l)$ differ from each other (remember both sides are monotonically decreasing in $\theta_i(l)$, and these partial derivatives are always negative). After obtaining the value of the PAC with equation (5), we can calculate the value of the FCR based on equation (4).[13]

[12] We further examine this assumption in Section 5.1.

[13] It is noteworthy that our estimates of the PAC and the FCR, which are implied by equations (3) and

=== Figure 3 ===

Last, we discuss the empirical feasibility of the above method. The primary restriction to its feasibility is that, to obtain the solution of the PAC in equation (5), we need the data for at least two years with different tariff ratios ($\mu_{it'}(l)$ and $\mu_{it^*}(l)$) and different import ratios ($Q^M_{it'}(l)/Q^R_{it'}(l)$ and $Q^M_{it^*}(l)/Q^R_{it^*}(l)$). This is because the equality of the equation holds only when either both tariff ratios and import ratios are the same across those two years, or both of these two variables are different. The former case is rarely observed in the data; thus, we need two years with different tariff ratios and import ratios. Furthermore, whether the solution is determined in a reasonable range depends on tariff ratios, import ratios, and other parameter values. Specifically, the solution of the PAC is reasonable in the case when inequalities (1) and (2) in addition to $\theta_i(l) \geq 1$ are met. However, in many cases, either of these conditions is violated. For instance, we observe a year in which the tariff ratio is higher, and the import ratio is lower than another year. Such cases are empirically observed but theoretically unnatural because, all other things being equal, the import ratio should be higher (because of lower RTA imports compared to MFN imports) when the tariff ratio is higher. In this case, we may obtain an unnatural value for the PAC, which violates any of the above three conditions. In the event that we pick up cases that are consistent with those three conditions, the number of the pairs where the PAC is successfully computed may not necessarily be large. Indeed, our case is not so, as shown in the following sections. Therefore, after obtaining the estimates of the PAC for some pairs, we use their summary statistics (e.g., median) common to all pairs in the computation of the FCR rather than compute the FCR using the PAC for each pair.

3. Overview of RTA Utilization in Japan's Imports

Before applying our method to Japan's imports, we briefly review the utilization of RTAs in these imports. The Japanese government announced its RTA strategy in October 2002.[14] It says that RTAs offer instruments for strengthening partnerships in areas not covered by the World Trade Organization (WTO) and for achieving liberalization beyond levels attainable under the WTO. The RTA with Singapore, which was the first RTA for Japan, came into force the next month (November 2002). Following this, Japan finalized RTAs with many countries. As of February 2018, 15 RTAs have become effective in Japan.

(5), are not affected by the fact that the theoretical setup is based on a partial equilibrium model. For equation (3), although the term $Q^M_i(l)/Q^R_i(l)$ is affected by the wage, we directly compute this term using the trade data by tariff schemes. Therefore, how the wage is determined does not affect our estimates. The same applies to multilateral resistance terms. Regarding the static characteristic of our model, it may cause some biases if exporters dynamically determine tariff schemes to use. This could be a future issue to explore.

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

They include RTAs with Singapore (2002), Mexico (2005), Malaysia (2006), Chile (2007), Thailand (2007), Indonesia (2008), Brunei (2008), the Association of Southeast Asian Nations (ASEAN) (2008), the Philippines (2008), Switzerland (2009), Vietnam (2009), India (2011), Peru (2012), Australia (2015), and Mongolia (2016).

In this study, we focus on Japan's imports from six RTA partner countries—Switzerland (CHE), Chile (CHL), Indonesia (IDN), India (IND), Mexico (MEX), and Peru (PER) for the following three reasons. First, we exclude the six ASEAN countries that have multiple RTAs with Japan; Singapore, Malaysia, Thailand, Brunei, the Philippines, and Vietnam. Japan concluded with these six countries, two RTAs including bilateral RTAs and ASEAN-Japan Comprehensive Economic Partnership Agreement (AJCEP).[15] We focus on imports from partner countries with only one RTA to avoid mixing firms' decisions on MFN and a single RTA, and their decisions on MFN and multiple RTA schemes. Indeed, our framework, presented in Section 2, does not consider the case where two RTA schemes coexist. Second, for the same reason, we exclude three least developed countries (LDCs) in ASEAN. Those countries can utilize not only the AJCEP but also the GSP for LDCs when exporting to Japan. Third, our approach of quantifying the PAC requires us to employ data from multiple years; hence, we exclude RTAs of Australia and Mongolia.

In the following section, we provide a brief overview of RTA utilization in Japan's imports in 2016, which is the final year of our data sample. To this end, we use the information on MFN rates, RTA rates, imports under RTA schemes, and imports under all tariff schemes. The data sources for these variables are as follows: The data on MFN rates and RTA rates are taken from Tariff Analysis Online in the WTO. The tariff line-level data on imports under RTA schemes and on total imports are taken from the Trade Statistics of Japan's Ministry of Finance. Data on the former type of imports are available only from 2012 onwards. Imports under the MFN scheme are computed as total imports minus imports under the RTA scheme. The tariff-line is defined at a Harmonized System (HS) nine-digit level in Japan and originally includes approximately 9,500 codes. These data cover all commodity imports in Japan. However, Japan's tariff line codes change over time, even within the same HS version (HS 2012) in our case. Therefore, we use the tariff-line codes panelized throughout 2012-2016, which includes 9,236 codes.[16] Last, we aggregate our import data according to Japanese fiscal years (April to March) because Japan's RTA tariff rates change on April 1.

Table 1 reports Japan's imports from six RTA partner countries. Row (A) shows total imports and row (B) reports the share of imports of products with zero MFN rates (duty-

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[15] Since Indonesia was not a member of AJCEP during our sample period despite being an ASEAN member country, we include the RTA with Indonesia in our analysis.

[16] To construct the panel code, we use the concordance available in the Japan Tariff Association; http://www.kanzei.or.jp/tariff/im_statnewold.htm. A typical pattern of the change is that multiple codes are integrated into a single code. For example, codes A and B are integrated into code C. If codes A and B have different MFN rates, we drop all codes A, B, and C because we need a unique level of MFN rates for each tariff line code for the empirical analysis. The concordance table is available in Appendix B.

free imports) in total imports. These two rows show that all countries have high shares of duty-free exports, which are typically above 70%. In particular, the duty-free import shares from Switzerland and Peru are approximately 90%. Row (C) reports imports under RTA schemes; their shares in total imports are calculated as row (C) over row (A), shown in row (D). The share of RTA imports in total imports is around 20%. It is about 10% in the case of imports from countries with approximately 90% of duty-free import shares. That is, most of the imports from RTA partners either are duty-free in terms of MFN rates or come under RTAs.

=== Table 1 ===

Row (E) reports the number of tariff line-products eligible for RTA schemes; the share of imports under RTA out of total imports in those eligible products is shown in row (F). "Eligible" in this paper refers to either case in the following: (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 are ad-valorem rates. We exclude the case where both the RTA and MFN rates are specific rates because of the difficulty in identifying eligibility.[17] Owing to differences in the year of entry across RTAs, the number of eligible products is different across countries. It is more than 1,000 in the cases of Indonesia and India while it is just in a few hundred for Chile and Peru. The RTA import share in these eligible products is around 80%. Keck and Lendle (2012, Table 4) report the share of RTA imports, which are comparable to this figure to some extent, for some developed countries (Australia, Canada, EU, and the US). In terms of levels, the share of RTA imports for RTA eligible products in Japan is similar to those shares in other developed countries.

Next, we take a closer look at the share of RTA imports in 2016. Figure 4 shows the distribution of product-level shares of RTA imports in total imports. Here, we restrict exporting country-product pairs to those that have positive imports and are eligible for RTA schemes. The product is defined at Japan's (panelized) tariff-line level, that is the HS nine-digit-level. The figure shows that all imports are traded under RTA schemes in a significant number of products. For example, the category of the 100% share has the highest frequency for Chile, Indonesia, and Peru. However, there are still some products with RTA utilization rates of less than 50%. In particular, the 0% share category has the highest frequency for Switzerland and Mexico. Thus, there are still many firms that use MFN rather than RTA schemes when exporting RTA eligible products to Japan.

=== Figure 4 ===

[17] The legal status on preference eligibility is available in the legal text of RTAs but is defined under the HS 2002 version. Since we are examining imports based on the HS 2012 version, we rely on the comparison between the actual levels of the MFN and RTA tariff rates, to identify preference eligibility.

4. Empirical Analysis

In this section, we report our estimates of the PAC and the FCR for Japan's imports from the six partner countries—Switzerland, Chile, Indonesia, India, Mexico, and Peru. After computing the PAC, we solve for the FCR. We also conduct some sensitivity analyses.

4.1. A Solution of the PAC

In this subsection, we compute the PAC using equation (5). To this end, we employ the import and tariff data from 2012 to 2016, the sources of which are the same as in Section 3. As demonstrated in Section 2, our method is valid under the heterogeneous regime. Before the computation, we check how many observations are feasible for our approach. Table 2 shows the number of (panelized) tariff lines with any positive imports from each country in 2016 as an example. The data on imports are obtained from the same source as in Section 3. We focus on the lines eligible for RTAs, i.e., those with lower RTA tariff rates than MFN rates. The data on tariffs are obtained from the same source as in Section 3. As shown in row "Number of eligible lines with any imports," this focus drops to approximately 60% of observations. This magnitude is natural not only because there are several lines where tariffs are not reduced by RTAs (the lines in the exclusion list) but also because 42% of the lines already have zero MFN rates in Japan. We further classify the remaining observations according to the trade regime. "MFN-homogeneous regime" ("RTA-homogeneous regime") refers to the regime where imports only under the MFN (RTA) scheme are observed. "Heterogeneous regime" is the one where we can observe imports under both the MFN and RTA schemes. As shown in the table, the number of observations is further reduced if we focus on the lines under the heterogeneous regime. Similar findings can be obtained in the other years (i.e., 2012-2015).

=== Table 2 ===

Our method requires further restriction. First, we obtain the data on the elasticity of substitution and the shape parameter of the productivity distribution from Crozet and Koenig (2010), who estimated both the demand elasticity and shape parameters using data on manufacturing firms in France.[18] Table 3 reports the number of observations where these

[18] We map the estimates by Crozet and Koenig (2010) to the four-digit ISIC revision 3 and then to the HS-base dataset. One may consider using the elasticity estimated in Broda et al. (2017) or Kee et al. (2008) and the shape parameter in Spearot (2016). Using these sources, we can obtain the elasticity for Japan and the shape parameters in our sample exporting countries. However, for the relationship between the demand elasticity and the shape parameter, a key theoretical assumption must be made; $\alpha - \nu + 1 > 0$. This is discussed in Akgul et al. (2015). Indeed, following the estimates in Broda et al. (2017), Kee et al. (2008), and Spearot (2016), this theoretical relationship does not necessarily hold. On the other hand, Crozet and Koenig (2010) provide the elasticity and shape parameters estimated under this theoretical

two parameters are available, and we can observe heterogeneous regime in at least one year during our sample period of 2012–2016. The number decreases in some countries because the estimates in Crozet and Koenig (2010) are available only in some manufacturing industries. Second, we need at least two years with the different tariff and import ratios. Therefore, we focus on the lines where RTA tariff rates change during our sample period because MFN rates do not change for all products in Japan during our sample period. This focus forces us to drop the lines where tariff reduction/elimination is already completed before our sample period. As shown in Table 3, this drop dramatically reduces the number of observations. At this stage, our approach is not feasible for the import observations from Chile and Mexico.[19]

=== Table 3 ===

Using these restricted observations, we compute the PAC based on equation (5). In equation (5), we need two years with the different RTA tariff rates and import ratio for each country-product pair. If more than two years are available, we compute PACs for all possible combinations of two of the available years. Then, we check the validity of the above-mentioned three theoretical conditions: inequalities (1) and (2) in addition to $\theta_i(l) \geq 1$. In this process, to check the validity of inequality (2), we also compute the FCR by applying the estimates of the PAC in each pair to equation (4).[20] Although we assume that the FCR is time-invariant, it may decline with time if there are stronger learning effects in RTA utilization than in general exporting. To minimize such effects, we choose our estimates based on the combination of the first and second year of each country-product pair where the three conditions hold. As a result, as shown in row "+ Three theoretical restrictions" in

restriction. Therefore, we choose the estimates made by Crozet and Koenig (2010) although they do not include agricultural, food manufacturing, and some other industries. One may be concerned that the use of the estimates for France is not necessarily appropriate for some of our sample countries. In Section 4.2, we use the estimates for Indonesia in the computation of the FCR for Indonesia.

[19] In general, there are several types of tariff reduction/elimination in RTAs. For example, "immediate elimination" refers to eliminating tariffs just after the effectuation, and "gradual reduction" (or long phase) means to reduce tariffs for some years gradually. The tariff reduction may start some years after the RTA's introduction ("late start"). Our method can be applied only to the cases other than "immediate elimination." However, developed countries like Japan tend to set immediate elimination for most of the products in their RTAs. The gradual reduction or the late start are given to only a limited number of products, which tend to be placed in the sensitive or highly-sensitive list in RTAs. In this sense, the number of country-product pairs where the computation of the PAC is feasible becomes small when using the data in developed countries. In developing countries, on the other hand, the gradual reduction is a typical type of trade liberalization. In Thailand, for example, the gradual reduction is set to 43% of all tariff lines for ASEAN-Japan comprehensive economic partnership agreement. Thus, we will be able to improve the empirical feasibility greatly if we use the data in developing countries. However, to our knowledge, no data for RTA utilization are publicly available in developing countries.

[20] These estimates of the FCR computed by using the PAC in the corresponding pair is provided in Table C1 in Appendix C. Among all observations (47), the mean and median are 0.191 and 0.082, respectively.

Table 3, some observations do not meet at least one of these conditions in all combinations and are dropped. Finally, we succeed in computing the theoretically-consistent value of the PAC for 9 products for Switzerland, 23 products for Indonesia, 13 products for India, and 2 products for Peru.[21]

Table 4 reports descriptive statistics on our estimates of the PAC, including the number of observations, the standard deviation (S.D.), and the mean, median, and the 25 and 75 percentiles. In total, the mean and median are 1.027 and 1.021, respectively. This implies that the compliance of RoOs requires firms to accept the 2-3% rise in procurement costs. This magnitude is much lower than the magnitude assumed in Cherkashin et al. (2015). As mentioned in Section 1, Cherkashin et al. (2015) examine GSP utilization for exporting apparel products from Bangladesh to the EU in 2004. They assumed that the PAC is 15%.[22] Even the maximum in our estimates shows a 12% rise. Another noteworthy finding is that although the number of observations differs greatly across countries, Indonesia and Peru have relatively high costs, compared with Switzerland and India. These differences will be based on various factors including the difference in products. In particular, the availability of supporting industries (that of intermediate goods, for instance) is one of the crucial factors. Although the number of observations is small, no studies have ever estimated the PAC in the compliance of RoOs.

=== Table 4 ===

4.2. A Solution of the FCR

Next, we compute the FCR by introducing the PAC and the other necessary information into the RHS of equation (4). As mentioned in Section 3, since there are a limited number of pairs where our method can be applied, we use the summary statistics of the PAC common to all pairs. Specifically, we use the median value of the PAC obtained above, i.e., 1.021, against all observations. Fortunately, the standard deviation of the PAC looks small, as found in Table 4. We eliminate the observations that do not satisfy inequalities (1)

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[21] Due to these restrictions, the summary statistics on our estimates of the PAC and FCR may suffer from some biases. For example, our use of two years under the heterogeneous regime implies that we exclude the observations where the heterogeneous regime appears only in one year during our sample period. Either MFN-homogeneous regime or RTA-homogeneous regime may be realized in the other years. The former (the latter) regime is likely to appear in the observations with the higher (lower) PAC or/and FCR. Thus, since the summary statistics on our estimates can be both underestimated and overestimated, the direction of the biases is not clear.

[22] Cherkashin et al. (2015) focus on the exports of men's/boys' cotton trousers (HS 620342) from Bangladesh to the EU under the GSP scheme. RoOs for this case require firms in Bangladesh to manufacture the trousers from fabrics. However, unlike the firms in our sample countries, Bangladesh apparel exporters have difficulties in procuring the material in their country since it is technically hard for Bangladesh textile manufactures to produce good quality fabrics. This difficulty would be one of the reasons for the higher PAC.

and (2).[23] Then, among all the county-product pairs, we restrict our samples to the observations that appear in the first year in each country-product pair. The upper panel in Table 6 reports various descriptive statistics on our estimates of the FCR. We drop the top 1% of observations as outliers. In total, the mean and median values are 0.077 and 0.051, respectively. These statistics indicate that RTA utilization requires around 8% and 5% additional fixed costs in terms of the mean and median.

=== Table 5 ===

As sensitivity analyses, we also compute the FCR by using the 25 and 75 percentiles of the PAC, which are respectively 1.008 and 1.034. The results are shown in the middle and lower panels. The number of the pairs where we succeed in computing the theoretically-consistent value of the FCR is found to be smaller when we use the larger value of the PAC because inequality (2) is more likely to be violated. The median and mean values of the FCR slightly change, compared with the case where we use the median value of the PAC. In particular, as Figure 2 demonstrated that the larger PAC results in the lower FCR, we observe such a relationship in the summary statistics in Table 5. The median values of the FCR are 0.082 in the case of the 25 percentiles and 0.037 in the case of the 75 percentiles. In sum, RTA utilization requires 4-8% additional fixed costs in terms of the median.

There are two more noteworthy points. First, our estimates of the FCR are larger than those by Cherkashin et al. (2015), which is 0.016.[24] We believe that our estimates are more accurate because ours are obtained by using the PAC computed by the actual data, which is much smaller than the PAC set in Cherkashin et al. (2015). Indeed, one source for the smaller estimate of the FCR in Cherkashin et al. (2015) lies in this difference in the PAC because the larger PAC results in the lower FCR as demonstrated in Figure 2. Second, in terms of the median, Chile and Mexico have relatively low and high FCRs, respectively. Although not only the higher fixed costs for RTA utilization but also the lower fixed costs for exporting result in the higher FCR, this difference across countries may indicate that Chile and Mexico have relatively low and high fixed costs for RTA utilization, respectively.

We also conduct another sensitivity analysis. So far, we have used the estimates of the elasticity of substitution and the shape parameter provided by Crozet and Koenig (2010), which are based on manufacturing firms in France. This application might be reasonable for Switzerland, but may yield some bias in our estimates for other countries, especially developing countries. To test this possibility, we estimate the elasticity of substitution and the shape parameter for Indonesia by employing the Manufacturing Surveys by Indonesia's

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[23] We delete 10 observations that do not satisfy the inequality (1) and 75 observations are dropped due to the violation of (2).

[24] Cherkashin et al. (2015) consider three types of fixed costs including those for foreign market entry, production, and the documentation for RoO compliance. These are estimated to be US$251,250, US$6,404, and US$4,240, respectively. Thus, we compute 4,240/ (251,250 + 6,404) as the FCR.

Statistical Agency.[25] We combine the methods by Crozet and Koenig (2010) and Mayer and Ottaviano (2007) to obtain the estimates of these parameters. Then, using these parameters specific to Indonesia and the median of the PAC (i.e., 1.021), we compute the FCR only for Indonesia.

The results for Indonesia are shown in Table 6. While there is some missing in the estimates by Crozet and Koenig (2010) even within the manufacturing industries, we can estimate the elasticity and the shape parameter for all manufacturing industries. Therefore, as shown in column "All" of "Our estimates," the number of observations slightly increases compared with the case in Table 6. We also report the statistics of the FCR by restricting to the products where we can compute the FCR by using both our estimates and the estimates by Crozet and Koenig (2010), which are provided in "Common" in "Our estimates" and "Common" in "CK," respectively. Since the differences between these two columns is trivial (except for the maximum value), the use of the estimates by Crozet and Koenig (2010) may not produce serious biases in the estimates of the FCR at least in terms of the median.

=== Table 6 ===

5. Other Analyses

This section conducts two kinds of analyses by using our estimates on FCRs. First, we examine the validity of our assumption that the FCR is time-invariant, which is key in our computation of the PAC. Second, we conduct some simulation analyses by using our estimates of the FCR.

5.1. Time-variability of the FCR

We examine our assumption that the FCR is time-invariant. To this end, we take an indirect approach. As mentioned in Section 2, it is reasonable to take the PAC as time-invariant because RoOs do not change over time in most RTAs. The shape parameter and the elasticity of substitution are usually supposed to be constant over time at least during a short period. Suppose the heterogenous regime-pairs where tariff ratio does not change over time. In this case, equation (4) suggests that if the FCR is time-invariant, the import ratio should be time-invariant, too. By using this relation, we investigate the time-variability of the import ratio to check that of the FCR. If the import ratio does not change over time in the heterogenous regime-pairs with constant tariff ratios, we will be able to consider FCRs as time-invariant.

Specifically, our test procedures and results are as follows. We first restrict observations only to those that (i) are eligible to RTAs, (ii) are categorized into the

[25] Our estimates and methods to obtain these parameters are provided in Appendix D.

heterogeneous regime, and (iii) the estimates in Crozet and Koenig (2010) are available. Second, we take a one-year difference in the import ratio and further restrict to the observations where a one-year difference of the tariff ratio is zero (i.e., tariff ratio does not change). Last, we test the hypothesis that a one-year difference in the import ratio equals zero. The results are shown in Table 7. We conduct the tests for each exporting country in addition to the one for all countries. The mean and standard errors on the one-year difference of the import ratio are presented in the table. It shows that the null-hypothesis on equality to the value of zero is not rejected at a conventional significance level in all cases. Thus, among the above-mentioned observations, the import ratio is proved to be not time-variant.

=== Table 7 ===

We also regress the one-year difference of the import ratio on various fixed effects (FE) and then compute the F-value for the null-hypothesis that all coefficients are zero. Specifically, we estimate the following equation;

$$R(l)_{it} - R(l)_{it-1} = \lambda_l + \lambda_i + \lambda_t + \varepsilon_{lit}.$$

where $R(l)_{it} \equiv Q_{it}^M(l)/Q_{it}^R(l)$. λ_l, λ_i, and λ_t are product, country, and year fixed effects, respectively. ε_{lit} is an error term. This equation is estimated by OLS. The results are shown in Column (I) in Table 8. Country-product FE and year FE are included in column (II). In column (III), we include most detailed FE, i.e., country-product FE, product-year FE, and country-year FE. Since singleton observations are dropped, the number of observations is different across columns. However, all cases show that the null-hypothesis is not rejected, indicating that the import ratio does not change over time. In sum, we obtain indirect evidence that the FCR is time-invariant. One crucial reason for this time-invariant nature might be our use of a ratio between two fixed costs. Although both fixed costs for exporting and RTA utilization may decline through firms' experience, their ratio does not significantly change over time. As a result, our assumption of time-invariability of the FCR might be not so strong.

=== Table 8 ===

5.2. Simulation

This subsection conducts two kinds of simulation analyses using the estimates of the FCR in Table 5. First, we examine the effect of a change in the FCR on RTA utilization. For instance, the FCR can be reduced by introducing more concise and transparent procedures to certify origin. To investigate such an effect, we define the RTA utilization rate $U_i(l)$ by

$$U_i(l) \equiv \frac{Q_i^R(l)}{Q_i^M(l) + Q_i^R(l)} = \frac{1}{Q_i^M(l)/Q_i^R(l) + 1}. \tag{6}$$

The relationship between $Q_i^M(l)/Q_i^R(l)$ in the denominator of (6) and the FCR can be obtained by rearranging (3):

$$\frac{Q_i^M(l)}{Q_i^R(l)} = \frac{[FCR_i(l)]^{\frac{\alpha(l)-v(l)+1}{v(l)-1}} - \left[\left(\frac{1}{\theta_i(l)\mu_i(l)}\right)^{v(l)} - 1\right]^{\frac{\alpha(l)-v(l)+1}{v(l)-1}}}{\left[\left(\frac{1}{\theta_i(l)\mu_i(l)}\right)^{v(l)} - 1\right]^{\frac{\alpha(l)-v(l)+1}{v(l)-1}} \left(\frac{1}{\theta_i(l)\mu_i(l)}\right)^{v(l)-1}}. \tag{7}$$

These two equations allow us to compute the RTA utilization rate by using the FCR, the tariff ratio, the PAC, and exogenous parameters.

We simulate the impacts of reducing the FCR by half on the RTA utilization rate. To this end, we simply introduce the half value of the FCR obtained in Table 5 and the median value of the PAC into equation (7) and then compute the hypothetical RTA utilization rate by using equation (6). Finally, we take the difference between original and hypothetical utilization rates. If the hypothetical rate exceeds the value of one, we replace with 100%. The results are shown in the upper panel in Table 9. The table indicates a reduction of fixed costs for RTA utilization relative to those for exporting (i.e., FCR) by half raises RTA utilization rates from 66% by 28 percentage points, on average. In terms of the median, RTA utilization rates rise from 74% by 22 percentage points. These magnitudes are economically large, indicating that the decrease in fixed costs for RTA utilization contributes to a significant rise in the RTA utilization rate. We also observe some differences in the impact across export countries. The impact of the reduction of the FCR on the utilization rate varies depending on various elements which appear on the right-hand side of equation (7). Our simulation analysis indicates that the impact is relatively large in Peru, and small in Chile and Indonesia.

=== Table 9 ===

Second, we examine how much the RTA utilization rate rises if the PAC is completely eliminated. In other words, we examine the change of RTA utilization rates when the PAC is reduced from the median value to the value of one. Such elimination might be technically possible by revising RoOs to the business-friendly types, though it requires rigorous renegotiation among RTA member countries. In this simulation, we simply introduce the estimates of the FCR obtained in Table 5 and the one-valued PAC into equation (7) and then compute the hypothetical RTA utilization rate using equation (6). Finally, we take the difference between the original rate and the hypothetical rate. If the hypothetical rate exceeds the value one, we replace with 100%. The results are reported in the middle panel in Table 9. In total, the RTA utilization rates rise by 27 percentage points in terms of the mean and by 20 percentage points in terms of the median. The magnitude of these results looks similar to that in the effect of reducing the FCR by half, as shown above. In other words, reducing the FCR by half has a similar absolute effect on the RTA utilization rates to the complete elimination of the PAC.

6. Concluding Remarks

This study proposed methods to quantify the additional fixed costs for RTA utilization in addition to the procurement adjustment cost. By applying our method to Japan's imports from RTA partner countries, in the median estimate, we found that RTA utilization in exporting requires 4-8% of additional fixed costs. We also found that exporters incur additional cost for procurement adjustment, which is comparable to two percentage points of per-unit production cost. Our simulation analysis using these estimates shows that a reduction of fixed costs for RTA utilization relative to those for exporting by half raises the utilization rates by 22 percentage points. Moreover, the 20 percentage-point rise can be found through the complete elimination of the PAC. Thus, these two scenarios yield similar magnitude of impacts on RTA utilization rates. On the one hand, reducing the PAC requires revising the RoOs, i.e., a renegotiation among RTA member countries. Furthermore, complete elimination of the PAC may result in the roundabout export from RTA non-member countries. On the other hand, the reduction of fixed costs for RTA utilization is possible by own country's effort. Therefore, our simulation results may suggest that the reduction of fixed costs for RTA utilization is more effective in enhancing RTA utilization than the reduction of the PAC.

Several issues for future research remain. First, it is invaluable to apply our methods to imports in developing countries. One limitation of this study is the small number of observations where we can compute the PAC and the FCR simultaneously. This is mainly because Japan already liberalizes many products (42% of all tariff lines) on an MFN basis and tends to immediately eliminate tariff rates in most of the remaining products in RTAs. We may improve this limitation when examining imports in developing countries because they keep positive rates of MFN tariffs in a larger number of products and are likely to gradually reduce tariff rates over time in the RTAs. Second, it is important to explore the determinants of the PAC and the FCR by estimating those costs for various importing country-exporting country pairs. Changing the level of such determinants would become a critical policy measure to reduce the PAC and the FCR, and thus to enhance firms' RTA utilization.

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Table 1. Total Imports, Duty-free Imports, and RTA Imports by Exporters in 2016

	CHE	CHL	IDN	IND	MEX	PER
(A) Total Imports (Bil. JPY)	787	611	1,957	517	634	161
(B) Duty-free Import Share (%)	93	69	76	71	77	89
(C) Total RTA Imports (Bil. JPY)	48	170	347	134	119	13
(D) RTA Share (%) = (C)/(A)	6	28	18	26	19	8
(E) Number of Eligible Tariff-line	3,006	3,010	3,012	3,108	2,950	3,124
(F) RTA Share (%) in Eligible Lines	77	92	88	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 are ad-valorem rates.

Table 2. Number of Tariff-lines by Observation Types and Export Countries in 2016

	CHE	CHL	IDN	IND	MEX	PER
Number of lines with any imports						
	1,866	294	2,444	2,488	1,530	386
Number of eligible lines with any imports						
	598	115	1,130	1,130	512	254
Number of eligible lines: MFN-homogeneous regime						
	256	26	168	261	326	73
Number of eligible lines: RTA-homogeneous regime						
	134	57	431	353	84	95
Number of eligible lines: Heterogeneous regime						
	208	32	531	516	102	86

Source: Authors' computation using the data from the Ministry of Finance and TAO.

Notes: "MFN-homogeneous regime" ("RTA-homogeneous regime") refers to the regime where imports only under the MFN (RTA) scheme are observed. "Heterogeneous regime" is the one where we can observe imports under both the MFN and RTA schemes.

Table 3. Number of Tariff-lines with the Theoretically-consistent PAC: by Export Countries: 2012-2016

	CHE	CHL	IDN	IND	MEX	PER
Heterogeneous regime in at least one year						
	300	10	517	463	98	59
Heterogeneous regime in multiple years with different RTA rates						
	17	0	36	28	0	3
+ Three theoretical restrictions						
	9	0	23	13	0	2

Source: Authors' computation using the data from the Ministry of Finance, TAO, and Crozet and Koenig (2010).

Note: "Three theoretical restrictions" include inequalities (1) and (2) in addition to $\theta_i(l) \geq 1$.

Table 4. Statistics for the PAC

Exporter	N	S.D.	Mean	p25	Median	p75
CHE	9	0.010	1.020	1.012	1.019	1.024
IDN	23	0.022	1.032	1.014	1.026	1.041
IND	13	0.032	1.022	1.005	1.008	1.028
PER	2	0.033	1.028	1.005	1.028	1.052
Total	47	0.024	1.027	1.008	1.021	1.034

Source: Authors' computation using the data from the Ministry of Finance, TAO, and Crozet and Koenig (2010).

Notes: "N" and "S.D." indicate the number of observations and standard deviation, respectively. "px" means x-percentile. The PAC in this table is computed by solving equation (5).

Table 5. Statistics for the FCR

	N	S.D.	Mean	p25	Median	p75
PAC = 1.021 (Median)						
CHE	299	0.111	0.116	0.053	0.084	0.135
CHL	10	0.064	0.078	0.041	0.046	0.101
IDN	513	0.107	0.105	0.051	0.073	0.109
IND	461	0.090	0.108	0.057	0.083	0.127
MEX	94	0.266	0.254	0.056	0.114	0.403
PER	59	0.077	0.118	0.048	0.090	0.163
Total	1,436	0.124	0.118	0.054	0.081	0.131
PAC = 1.008 (p25)						
CHE	299	0.111	0.116	0.053	0.084	0.135
CHL	10	0.064	0.078	0.041	0.046	0.101
IDN	513	0.107	0.105	0.051	0.073	0.109
IND	460	0.090	0.108	0.057	0.083	0.127
MEX	94	0.274	0.258	0.056	0.114	0.403
PER	59	0.077	0.118	0.048	0.090	0.163
Total	1,435	0.126	0.119	0.054	0.082	0.131
PAC = 1.034 (p75)						
CHE	182	0.054	0.048	0.013	0.031	0.059
CHL	6	0.008	0.019	0.016	0.016	0.019
IDN	372	0.073	0.056	0.016	0.033	0.060
IND	326	0.064	0.061	0.018	0.046	0.076
MEX	61	0.129	0.141	0.034	0.112	0.227
PER	41	0.062	0.092	0.031	0.111	0.133
Total	988	0.074	0.063	0.017	0.037	0.078

Source: Authors' computation using the data from the Ministry of Finance, TAO, and Crozet and Koenig (2010).

Notes: "N" and "S.D." indicate the number of observations and standard deviation, respectively. "px" means x-percentile. The FCR is computed by introducing into equation (4), the 25, 50, and 75 percentiles of the PAC obtained in Table 4.

Table 6. Statistics for the FCR for Indonesia: Use of Different Parameters

	Our estimates		CK
	All	Common	Common
N	775	503	503
S.D.	0.232	0.174	0.085
Min	0.002	0.002	0.002
Max	3.237	3.237	0.766
Mean	0.129	0.081	0.071
p25	0.035	0.028	0.028
p50	0.076	0.053	0.048
p75	0.155	0.084	0.078

Source: Authors' computation using the data from the Ministry of Finance, TAO, Crozet and Koenig (2010), and the Manufacturing Surveys by Indonesia's Statistical Agency.

Notes: This table reports various statistics for the FCR for Indonesia. In column "Our estimates," we use our estimates of the elasticity of substitution and the shape parameter. All the results using our estimates are shown in column "All." We also report the statistics of the FCR by restricting to the products where we can compute the FCR by using both our estimates and the estimates by Crozet and Koenig (2010), which are provided in "Common" in "Our estimates" and "Common" in "CK," respectively. "N" and "S.D." indicate the number of observations and standard deviation, respectively. "px" means x-percentile.

Table 7. *t*-tests: Time-invariability of Import Ratios

	Mean	S.E.	*t* -value	# of Obs.
CHE	0.291	0.391	0.745	332
CHL	0.858	5.776	0.149	10
IDN	0.111	0.192	0.581	579
IND	0.222	0.244	0.910	500
MEX	-0.817	1.282	-0.637	64
PER	0.314	0.370	0.850	59
All	0.160	0.151	1.061	1,544

Notes: This table reports the results of *t*-tests on the inequality of the one-year difference of import ratios to the value of zero. The observations are restricted only to those that are eligible to RTAs, are categorized into the heterogeneous regime, the estimates in Crozet and Koenig (2010) are available, and a one-year difference of the tariff ratio is zero.

Table 8. *F*-tests: Time-invariability of Import Ratios

	(I)	(II)	(III)
F -value	0.487	0.408	0.543
Country FE	X		
Product FE	X		
Year FE	X	X	
Country-product FE		X	X
Product-year FE			X
Country-year FE			X
Number of observations	1,470	1,413	657

Note: This table reports the *F*-value for the null-hypothesis on that all coefficients are zero when regressing the one-year difference of the import ratio on various fixed effects (FE).

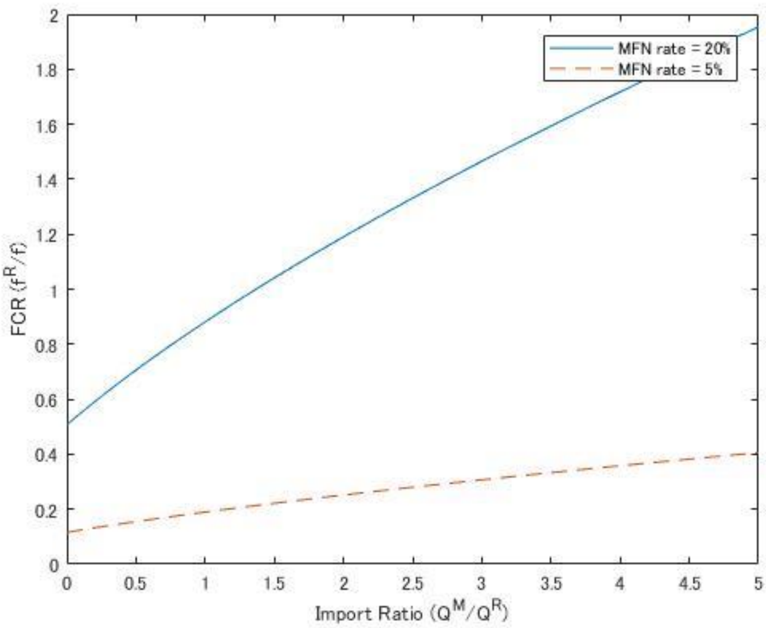
Table 9. Impacts on RTA Utilization Rates (Percentage Points)

		N	S.D.	Mean	p25	Median	p75
Reduction of FCR by half							
	CHE	291	23	31	11	28	50
	CHL	10	23	19	0.1	11	31
	IDN	504	22	20	2	12	32
	IND	454	24	31	10	27	50
	MEX	90	24	32	11	27	49
	PER	58	26	41	19	42	61
	Total	1,407	24	28	6	22	45
Eliminating the PAC							
	CHE	291	26	35	12	30	56
	CHL	10	23	20	0.1	11	31
	IDN	504	22	20	2	12	31
	IND	454	23	30	10	25	46
	MEX	90	25	29	8	21	46
	PER	58	23	35	16	33	48
	Total	1,407	24	27	7	20	44

Source: Authors' computation using the data from the Ministry of Finance, TAO, and Crozet and Koenig (2010).

Notes: "N" and "S.D." indicate the number of observations and standard deviation, respectively. "px" means x-percentile. In the computation of the impacts, we employ the FCR obtained in Table 5 by using the median value of the PAC.

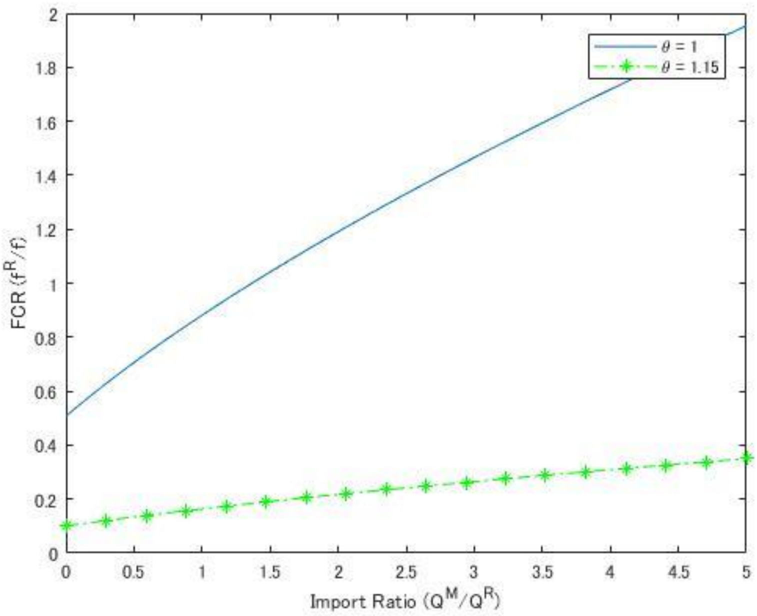
Figure 1. FCR and Import Ratio: Different MFN Rates



Source: Authors' compilation using equation (4).

Notes: RTA tariff rates are assumed to be zero. The PAC is set to the value one. The shape parameter of the Pareto distribution and the demand elasticity are set to 3.09 and 2.25, respectively.

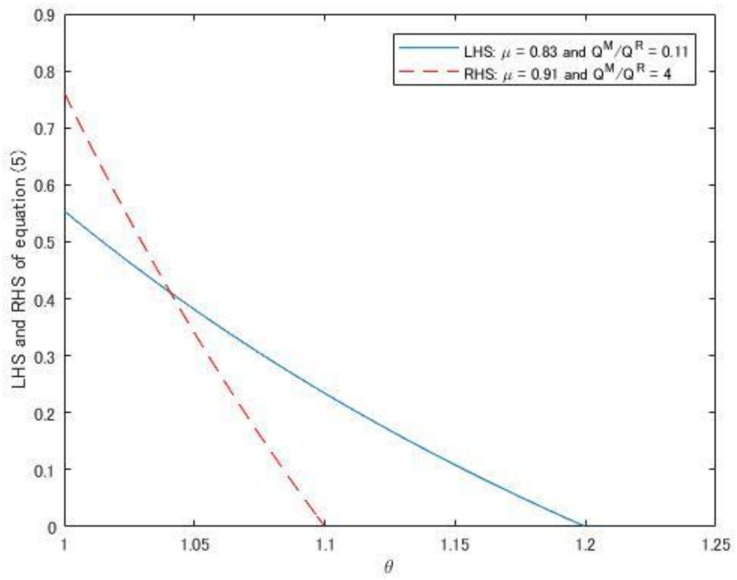
Figure 2. FCR and Import Ratio: Different PACs



Source: Authors' compilation using equation (4).

Notes: MFN and RTA tariff rates are set to 20% and 0%, respectively. The shape parameter of the Pareto distribution and the demand elasticity are set to 3.09 and 2.25, respectively.

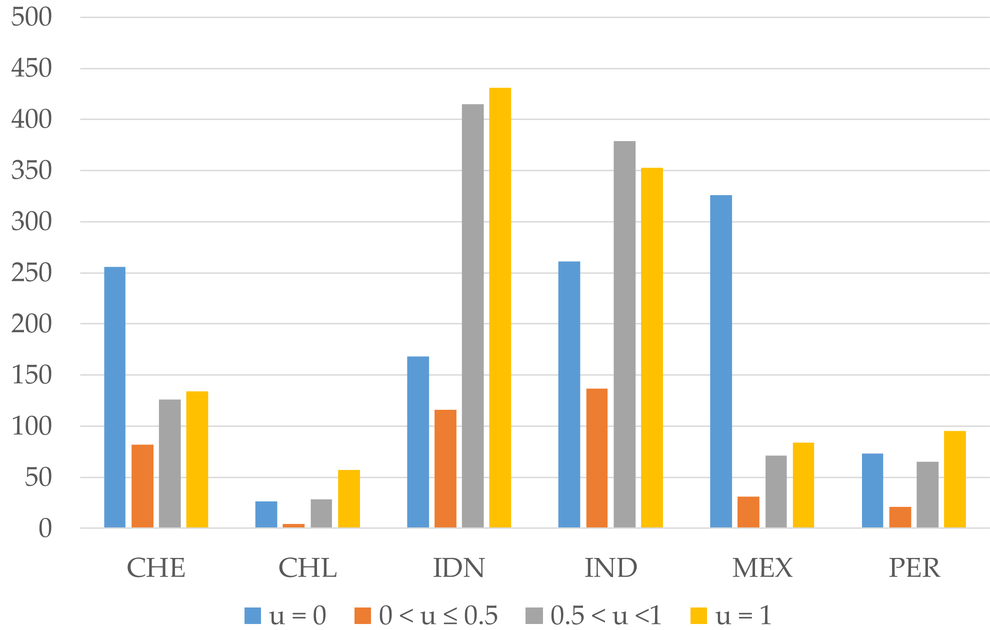
Figure 3. Numerical Example of the Estimation of the PAC



Source: Authors' compilation using equation (5).

Notes: For LHS and RHS, RTA tariff rates are set to 20% and 10%, respectively. MFN tariff rate is set to 0% for both cases. With respect to the ratio of imports under respective tariff schemes, we set for LHS (RHS) so that the RTA utilization rate becomes 90% (20%), respectively. The shape parameter of the Pareto distribution and the demand elasticity are set to 3.09 and 2.25, respectively.

Figure 4. Number of Products according to RTA Utilization Rates (u) by countries



Source: Authors' compilation

Notes: "u" is the share of imports under RTA schemes out of total imports. We restrict observations only to those with positive imports and eligible for RTA schemes.

Online Appendix to "Costs of Utilizing Regional Trade Agreements"

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A. Derivation of Equation (3)

In a heterogeneous regime, imports under the respective schemes are written as

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

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

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

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

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

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

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

Thus,

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

Solving this equation for $FCR_i(l)$, we obtain equation (3).

B. Panelized Tariff-line Codes

In Table B1, we report the concordance between the original HS code (Original) and the code panelized throughout 2012-2016 (Common).

Table B1. Concordance Table of HS Tariff-line Codes

Original	Common	Original	Common	Original	Common	Original	Common
10619012	10619010	30572192	30572190	160529011	160529010	250620090	250620000
10619019	10619010	30572199	30572190	160529019	160529010	252800010	252800000
10619030	10619090	30579191	30579190	170310091	170310090	252800090	252800000
10619041	10619090	30579192	30579190	170310099	170310090	260200011	260200010
10619042	10619090	30579199	30579190	170390091	170390090	260200012	260200010
10619044	10619090	30749120	30749190	170390099	170390090	271112010	271112000
10619045	10619090	30819210	30819200	190220111	190220110	271112020	271112000
10619046	10619090	30819290	30819200	190220119	190220110	283090010	283090000
10619047	10619090	30830310	30830300	190220191	190220190	283090020	283090000
10619049	10619090	30830320	30830300	190220199	190220190	283090090	283090000
10639010	10639000	30830390	30830300	190220211	190220210	283329910	283329900
10639090	10639000	30890110	30890100	190220219	190220210	283329990	283329900
20840091	20840090	30890190	30890100	190220221	190220220	284420010	284420000
20840099	20840090	30890212	30890219	190220229	190220220	284420090	284420000
21092010	21092000	30890292	30890299	190230110	190230100	284450010	284450000
21092090	21092000	50800250	50800200	190230190	190230100	284450090	284450000
30389231	30389299	50800290	50800200	190230210	190230200	290290100	290290000
30487040	30487010	120110010	120110000	190230290	190230200	290290200	290290000
30487050	30487010	120110090	120110000	220710191	220710190	290339051	290339029
30487060	30487010	150210011	150210010	220710199	220710190	290339052	290339029
30487090	30487010	150210019	150210010	230110010	230110000	290339053	290339029
30489230	30489290	150290011	150290010	230110090	230110000	290339054	290339029
30572191	30572190	150290019	150290010	250620010	250620000	290379910	290379900

Table B1. Concordance Table of HS Tariff-line Codes (Conti.)

Original	Common	Original	Common	Original	Common	Original	Common
290379990	290379900	380899090	380899000	621120110	621120100	850610019	850610010
290389091	290389090	382478110	382478000	621120190	621120100	850819010	850819000
290389099	290389090	382478120	382478000	621149110	621149100	850819090	850819000
290919091	290919090	382478130	382478000	621149190	621149100	852990120	852990190
290919099	290919090	382478140	382478000	621710025	621710019	854020010	854020000
292249010	292249000	382478900	382478000	630510100	630510000	854020090	854020000
292249090	292249000	382490991	382490999	630510200	630510000	901813010	901813000
293339100	293339110	391239010	391239000	670300100	670300000	901813090	901813000
293339210	293339110	391239090	391239000	670300200	670300000	901814010	901814000
293790011	293790000	391290010	391290000	711029100	711029000	901814090	901814000
293790019	293790000	391290090	391290000	711029200	711029000	901819091	901819090
293790020	293790000	392490010	392490000	711039100	711039000	901819098	901819090
293790090	293790000	392490090	392490000	711039200	711039000	901831010	901831000
300190030	300190090	441294120	441294190	711049100	711049000	901831020	901831000
300390010	300390000	441890231	441890222	711049200	711049000	901832010	901832000
300390020	300390000	441890232	441890222	720826011	720826010	901832020	901832000
300630100	300630000	441890233	441890222	720826019	720826010	903089092	903089099
300630200	300630000	481190100	481190000	720827011	720827010	903149010	903149000
310290010	310290000	481190900	481190000	720827019	720827010	903149090	903149000
310290090	310290000	481820100	481820000	720916011	720916010	903180012	903180019
320415020	320415000	481820200	481820000	720916019	720916010	910119010	910119000
320415090	320415000	500200212	500200215	720917011	720917010	910119090	910119000
330590010	330590000	500200213	500200215	720917019	720917010	920999010	920999000
330590090	330590000	500200222	500200225	722530910	722530900	920999020	920999000
350300091	350300090	500200223	500200225	722530990	722530900	920999030	920999000
350300099	350300090	510529010	510529000	722540910	722540900	920999090	920999000
370120011	370120010	510529090	510529000	722540990	722540900	940130020	940130090
370120019	370120010	510540010	510540000	722790021	722790020	940130030	940130090
370210010	370210000	510540090	510540000	722790029	722790020	940180011	940180010
370210090	370210000	520511021	520511023	732690040	732690090	940180012	940180010
370242010	370242000	520511022	520511023	740319031	740319030	940180091	940180090
370242090	370242000	520541021	520541020	740319039	740319030	940180099	940180090
370243091	370243000	520541029	520541020	741999010	741999000	940389010	940389000
370243099	370243000	590220011	590220010	741999090	741999000	940389090	940389000
370244091	370244000	590220012	590220010	820291010	820291000	940550010	940550000
370244099	370244000	610620011	610620014	820291020	820291000	940550090	940550000
370254011	370254010	610620012	610620014	820291090	820291000	940560010	940560050
370254019	370254010	610620013	610620018	820770020	820770090	940560020	940560050
370255011	370255000	610620019	610620018	820790020	820790090	940560030	940560050
370255012	370255000	610690011	610690010	821220100	821220000	950300321	950300329
370255019	370255000	610690012	610690010	821220200	821220000	950300322	950300329
370255020	370255000	610690013	610690030	842489010	842489000	960190200	960190900
370255090	370255000	610690019	610690030	842489090	842489000	960190300	960190900
380891092	380891099	621111010	621111000	847170040	847170090		
380899010	380899000	621111090	621111000	850610011	850610010		

Source: Authors' compilation

C. Simultaneous Computation of FCR and PAC

Table C1. Statistics for FCRs Based on the PAC in the Corresponding Country-product Pair

Exporter	N	S.D.	Mean	Median	Min	Max
CHE	9	0.148	0.148	0.068	0.030	0.480
IDN	23	0.630	0.279	0.108	0.003	3.098
IND	13	0.053	0.086	0.074	0.021	0.202
PER	2	0.018	0.059	0.059	0.046	0.072
Total	47	0.450	0.191	0.082	0.003	3.098

Source: Authors' computation

Notes: "N" and "S.D." indicate the number of observations and standard deviation, respectively.

D. Estimates of Parameters for Indonesia

In this appendix, we explain our way of estimating the Pareto shape parameter and the elasticity of substitution with Indonesian plant-level data.

D1. 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 all 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, the total value of production, value-added, and 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 lies 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.

D2. Production Function Estimation

We obtain the total factor productivity (TFP) by estimating the gross production function. To do so, 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. The capital stock is constructed with the value of the tangible asset and the value of the investment and is estimated by the perpetual inventory method. For our production function estimation, we use the Wooldridge (2009) modification of the Levinson and Petrin 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 pointed out by Ackerberg et al. (2015). The production function is estimated by two digit-level industry.

D3. Estimating Pareto Shape Parameter and Elasticity of Substitution

We estimate the Pareto shape parameter and the elasticity of substitution using estimated TFP. Following Crozet and Koenig (2010), we assume that the utility function is CES type and productivity A follows a Pareto distribution. The cumulative production of plants with higher productivity than plant i's productivity, X_i can be expressed as a function of its productivity A_i;

$$X_i = A_i^{-(\alpha - v + 1)}. \tag{D1}$$

α and v are the shape parameter and the elasticity of substitution, respectively. By estimating the log-version of equation (D1) by two-digit level industry, we can obtain the estimates of $\alpha - v + 1$ for each industry as in equation (D2).

$$\ln X_i = \eta_0 + \eta_1 \ln(A_i) + \epsilon_i, \tag{D2}$$

where $\eta_1 = -(\alpha - v + 1)$ and ϵ is error term.

Next, we estimate the parameter of the Pareto distribution, α by following Mayer and Ottaviano (2007). Let A_m denote the mode value of TFP. Then, the cumulative distribution of TFP can be expressed as follows:

$$F(A_i) = 1 - \left({A_m}/{A_i}\right)^{\alpha}, \tag{D3}$$

Tanking a log, we can rewrite (D3) as

$$\ln\big(1 - F(A_i)\big) = \alpha \ln(A_m) - \alpha \ln(A_i). \tag{D4}$$

Since A_i and $F(A_i)$ are available, by regressing $\ln(1 - F(A_i))$ on $\ln A_i$ by two-digit industry as in equation (D5), we obtain the estimates of the Pareto parameter.

$$\ln\big(1 - F(A_i)\big) = \gamma_0 + \gamma_1 \ln(A_i) + \varepsilon_i, \tag{D5}$$

where $\gamma_1 = -\alpha$ and ε is an error term. The corresponding R-squares is known to be close to one. We estimate (D2) and (D5) by ordinary least square (OLS) for each year and industry and take the average by industry. As presented in Table D1, we confirmed R-squares for both of (D2) and (D5) are close to one.

Table D1. Mean Values of Estimated Parameters and the R-squares

	α-υ+1	R2	α	R2
15 Food and beverages	1.868	0.869	3.002	0.959
16 Tobacco	1.614	0.878	2.234	0.901
17 Textiles	1.423	0.684	2.276	0.934
18 Wearing apparel	1.484	0.772	2.206	0.914
19 Tanning and dressing of leather	2.555	0.814	2.802	0.920
20 Products of wood and cork	1.342	0.728	2.264	0.925
21 Paper and paper products	2.109	0.770	2.575	0.952
22 Publishing, printing	2.087	0.832	2.365	0.954
23 Coke, refined petroleum products	2.224	0.782	2.939	0.911
24 Chemicals and chemical products	1.257	0.834	1.982	0.933
25 Rubber and plastics products	1.582	0.784	2.441	0.940
26 Other non-metallic mineral products	1.222	0.826	2.644	0.977
27 Basic metals	1.723	0.817	2.242	0.968
28 Fabricated metal products	1.611	0.816	2.103	0.954
29 Machinery and equipment n.e.c.	1.557	0.850	2.175	0.942
31 Electrical machinery and apparatus n.e.c.	1.673	0.813	2.079	0.943
32 Communication equipment and apparatu	1.378	0.820	1.698	0.905
33 Medical, precision and optical instrumen	1.557	0.749	2.448	0.864
34 Motor vehicles	1.258	0.759	2.170	0.944
35 Other transport equipment	1.445	0.780	1.965	0.937
36 Furniture; manufacturing n.e.c.	2.018	0.875	2.731	0.942

Notes: Parameters are estimated for each year and industry by OLS. The mean value of estimated coefficients and R-squares by industry are presented in this table.

References in Appendices

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