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Keywords: Duty drawbacks; Trade creation effect; Regional trade agreement
JEL Classification: F15; F53

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1. Introduction

The existence of other preference regimes plays a key role in the trade creation effect of regional trade agreements (RTAs). Most studies have assumed that firms use the most favored nation (MFN) tariffs before the conclusion of RTAs. When the entry of RTAs induces firms to switch from MFN to RTA tariffs, they increase their exports because of the reduction in tariff rates. Based on this preconception, we expected the RTAs to exert a positive effect on trade. However, this may not be true. Firms might use other preference regimes before the RTAs enter into force. One example of such a regime is the duty drawback regime for raw materials imported for producing export products. The importers switching from the duty drawback to the RTA regime may not witness an increase in their imports if they were enjoying duty-free imports even before the entry of RTAs into force. However, the studies

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on RTAs have paid little attention to this possibility. Given this, it is important to re-consider the trade creation effect of RTAs in the presence of other preference regimes.

This study aims to examine how users of other preference regimes change their trade when they switch to an RTA regime. We mainly focus on the duty drawback regime in addition to other similar regimes, in terms of requirements and benefits. While both the duty drawback and RTA regimes may not require the importers of materials to pay tariffs, there are three crucial differences between the two regimes. First, the materials imported using the RTA regime can be used to produce goods for the domestic market, while those imported using the drawback regime cannot be used for domestic production. Second, the administrative work is conducted by the material importers when claiming the drawback regime, while it is conducted by the material exporters when claiming the RTA regime. Thus, the player who bears the administrative costs is different between the two regimes. Finally, the use of the RTA regime may increase the import prices of the materials because it requires compliance with the rules of origin (RoO). These differences affect the choice of tariff regimes, and thereby lead to a change in firms' trade.

In this context, we theoretically examine firms' choice of tariff regimes by employing the international trade model with firm heterogeneity in terms of productivity. We suppose that before the RTA enters into force, the firms can import materials either under the MFN or duty drawback regime. We show that firms with a relatively high productivity choose to use the drawback regime, while the rest select the MFN regime. After the conclusion of an RTA, the drawback users with a relatively low productivity switch to the RTA regime to import the materials. Although the use of the RTA regime leads to an increase in the import prices of the materials, this switch is profitable because it does not require the importers to pay for the fixed costs. This switch can exert a negative or positive effect on the imports. The rise in material costs, that is, import prices, leads to a decline in the import quantity and hurts imports. However, the positive effect comes from the use of duty-free materials to produce goods for the domestic market. Since the duty drawback regime does not allow firms to use the materials to produce for the domestic market, the firms switching to the RTA regime expand the output for the domestic market, and thereby increase the material imports. In sum, the magnitude relationship between these positive and negative effects plays a crucial role in determining whether RTAs result in increasing imports in the presence of other preference regimes.

Next, we empirically investigate the (net) effect of regime-switching on imports by employing detailed firm-level trade data in Thailand, for the period between 2007 and 2011. Unlike the firm-level trade data used in the other studies, our data include information on the tariff regime in importing. This approach allows a direct examination of how firms switching from the drawback to the RTA regime in importing change their imports from RTA partner countries. In our analysis, we incorporate some similar regimes into the drawback regime (e.g., preference regimes for bonded warehouses, free zones, or

investment promotion). Subsequently, we classify firms according to their major import regime (i.e., the regime with the largest imports). It must be noted that the imports under the drawback regime accounted for approximately 30% of the total imports in Thailand in 2011. Thus, the drawback users occupy a non-negligible fraction of the national imports. The simple regression analyses show that the import growth between 2007 and 2011 was 20–30% higher in firms switching from the duty drawback to the RTA regime than that of the non-switching firms—firms that used the drawback regime in both 2007 and 2011.

We further examine the causal effect of this switch on imports. According to the main regimes in the two years, there are various types of firms that are not randomly chosen. Thus, the results of the simple regression analyses suffer from selection bias. However, owing to the existence of many types and thereby many selection mechanisms, it is difficult to address all the sources of endogeneity using the instrumental variable method. We use the propensity score matching (PSM) method. We restrict study firms to those in which the main regimes were duty drawback regimes in 2007, and either duty drawback or RTA regimes in 2011. Subsequently, by applying the PSM to these two kinds of firms, we correct the selection mechanism separating the two firms. We estimate the propensity of switching by using observable variables, including firms' total exports, tariffs, or foreign ownership. We choose the one-to-one nearest neighbor matching method as the matching algorithm. In the statistical test, we use standard errors based on the innovation of Abadie and Imbens (2016).

Our findings can be summarized as follows. The results of the estimation on the propensity to switch to RTA regimes reveals that, among the drawback regime users, in terms of exports, the smaller-sized firms exhibit a higher likelihood to switch. Suppose that, in terms of trade values, the firm size is positively related to productivity. In that case, this result is consistent with our theoretical result that the drawback users with a relatively low productivity switch to the RTA regime in importing. We also conducted the matching analyses. The matched firms are well-balanced. The results show robust evidence that firms switching to the RTA regime increase their import of materials. However, we did not find an evidence that the switching firms increase exports. These results imply that the switching firms increase the import of materials owing to an increase in their outputs for the domestic market. We also show that switching firms have a higher share of domestic sales in the total sales than that of the non-switching firms. Another remarkable result is that a larger increase in imports can be found in firms that switched from the MFN to the RTA regime.

Our findings have substantial implications for the literature on the trade creation effect of RTAs. We consider four types of importers according to their productivity and tariff regimes, before and after the RTA's effectuation—importers with a high range of productivity use the drawback regime, those with medium-high productivity switch from the drawback to the RTA regime, those with medium-low productivity switch from the MFN to the RTA regime, and those in the low ranges continue using the MFN regime.

Importers with a high or low productivity range do not change their imports because they do not change their tariff regimes. Thus, those with a medium range of productivity play a vital role in the trade creation effect of RTAs. Although a switch to the RTA regime does not yield additional tariff advantages, importers with a medium-high productivity range increase their imports owing to an increase in production for the domestic market.[1] The importers with a medium-low range also increase their imports simply because of the reduced tariff rates that accompany the switch from the MFN to the RTA rate.

In sum, the size of the trade creation effect of RTAs is determined by the magnitude of the increase in the import of firms switching from the drawback or the MFN regime to the RTA regime. It should be noted that these two types of firms have a medium range of productivity, not a high range, and hence the absolute magnitude of their imports may not occupy a significant fraction in the national imports. In our study sample, the imports by such switching firms account for 23% of the total imports in the post-RTA year of 2011. Therefore, the increase in (national) imports by RTAs is not large. Many gravity studies have found small or *seemingly implausible results* in the RTA dummy variable (Baier & Bergstrand, 2007). For example, Cipollina and Salvatici (2010) conducted meta-analyses on RTA coefficients and showed that 312, out of 1827, estimates are even negative. Other meta-analyses (e.g., Kohl, 2014; Afesorgbor, 2017) also showed similar results. Our results would add to the evidence on such a small magnitude of the trade creation effect of RTAs. In other words, the trade creation effect becomes small if many productive firms keep using the drawback regime.

Our study is not the first to examine other preference regimes, especially the duty drawback regime. The existing studies on the subject are Hamada (1974), Panagariya (1992), Sargent and Matthews (2001), Cadot, de Melo, and Olarreaga (2003), Ianchovichina (2004, 2007), Egger and Egger (2005), Mah (2007), Cruz and Bussolo (2015), and Brandt and Morrow (2017). The first two are early theoretical studies on the duty drawback regime. Hamada (1974) showed that an increase in foreign investments in duty-free zones does not necessarily increase national income. Panagariya (1992) showed that increases in input tariffs with a duty drawback are more likely to be welfare-improving. Most empirical studies focus on the processing trade perhaps because of data availability (e.g., in the European Union or China). For example, Egger and Egger (2005) examined the determinants of processing trade using the country pair-product-level data in Europe. A similar analysis can be found for China in Brandt and Morrow (2017). Using industry-province data, they examined the role of input tariffs in the choice between ordinary and processing trades.

[1] If we consider a cumulation rule of RoO and firms' export of their outputs to partner countries of RTAs, only the inputs imported using the RTA tariffs can be accumulated as "within-RTA inputs." Subsequently, firms that switch to the RTA regime can comply with RoO and enjoy lower output tariffs. In this case, the switching firms may increase their exports of outputs. Our theoretical model takes into account this effect.

Our study differs from these studies in terms of the following points. In regard to theoretical analysis, the basic structure of our model is similar to that of Brandt and Morrow (2017). The choice between the drawback and MFN regimes, in our model, corresponds to the choice between the processing and ordinary trades in their model. Brandt and Morrow (2017) investigate the effects of input tariff reduction when some firms choose the processing regime, while others choose ordinary trade. In our theoretical model, we add another regime, that is, an RTA regime, whose utilization also reduces input tariffs. As mentioned above, there are some important trade-offs between the drawback and RTA regimes. Owing to the compliance of RoO, the input prices under the RTA regime are higher than those under the drawback regime. However, importers also bear some fixed costs to utilize the duty drawback regime. As a result, our theoretical model presents more fruitful results in relation to the choice of tariff regimes and the trade impacts of input tariff reduction.

In regard to the empirical analysis, our estimation of the propensity of regime-switching contributes to uncovering the determinants of other preference regimes, similar to the studies above. However, we differentiate between the three regimes—MFN, RTA, and other preference regimes. Furthermore, we estimate such propensity at a firm (-country-product) level rather than at an aggregated level (e.g., an industry- or product-level). As a result, for example, we demonstrate that small-sized importers tend to switch from the duty drawback to the RTA regime; to the best of our knowledge, this aspect has never been revealed in the literature.[2] Our study does not end with *determinants*. We further investigate the *impacts* of regime-switching on trade at the firm level. Hayakawa (2015) and Hayakawa et al. (2019a) analyze the firm-level effects of utilizing RTA regimes on import prices or some performance indicators (e.g., employment). However, these studies do not shed light on other preference regimes.[3]

The remainder of this paper is organized as follows. The next section discusses other preference regimes. Section 3 theoretically examines the choice of firms' tariff regimes and the effect of RTAs on trade. After explaining our empirical framework in Section 4, we present our empirical results in Section 5. Section 6 concludes this study.

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[2] Namely, the choice of tariff regimes in importing is not random, indicating the important implication of our findings for the existing studies in this literature. For example, Cruz and Bussolo (2015) conducted the difference-in-differences (DID) analyses on the impacts of input tariffs on export performance by comparing importers under the ordinary trade regime (i.e., MFN or RTA regime) with those under the DD regime. However, those two types of importers are not exogenously assigned. Thus, based on their DID analyses, the estimates still suffer from the sample-selection bias.

[3] Several studies examine the determinants of the utilization of RTAs or generalized system for preferences. The example includes Francois, Hoekman, and Manchin (2006), Manchin (2006), Bureau, Chakir, and Gallezot (2007), Hakobyan (2015), Hayakawa, Kim, and Yoshimi (2017), and Hayakawa, Urata, and Yoshimi (2019b). By using country pair-product-level trade data, these studies found the significant contribution of various elements such as preference margin (i.e., MFN tariff rates minus RTA tariff rates), rules of origin, or transaction sizes. The theoretical studies in this context include Demidova and Krishna (2008) and Cherkashin et al. (2015).

2. Other Preference Regimes

This section discusses various preference regimes. Although the variety and benefits of those regimes differ by country, this section explains the regimes adopted in Thailand, as an example. Specifically, we consider five regimes—bonded warehouses, free zones, investment promotion, duty drawbacks for raw materials imported for the production of export products, and duty drawbacks for re-exportation. While benefits under the first three are realized immediately at the time of importation, those under the latter two regimes essentially represent the refund of the duty already paid, which is collected when the exportation or re-exportation is achieved[4]. The benefits offered under these five regimes, which may also vary among regimes, are different from those under RTAs, at least in the following five aspects.

The first aspect focuses on beneficiaries. RTA regimes can be chosen irrespective of the use purpose of the imported goods. These goods can be used to produce goods for the domestic market or export market or distributed to firms or customers. However, beneficiaries under the bonded warehouses, free zones, and duty drawback regimes are required to import goods only for their production and export activities. Concerning the imports under investment promotion, beneficiaries depend on the imported goods. Concerning the imports of machinery, domestic market and export-oriented manufacturers can benefit from the investment promotion regime, while only export-oriented manufacturers benefit from this regime during the importation of raw materials.

The second aspect is the eligibility of goods. The goods eligible for RTA regimes are listed in the legal text of RTAs. Specifically, subject to negotiations among RTA members, eligible goods can be raw materials, machinery, or final products. Conversely, eligible goods mainly include raw materials, under the other privilege regimes. All the other regimes grant eligibility to goods used to produce finished products. Machinery imported for the production process can be eligible only under free zones and investment promotion regimes. The duty drawback for re-exportation applies to any good—raw materials, machinery, or final products–provided that such goods do not undergo any transformation from the time of importing to that of exporting.

Third, the depth of tariff reduction differs by regime. Under the RTA regimes, while tariffs for a large portion of traded goods are eliminated, some goods keep positive rates because of their sensitivity to the economy. Most of the other privilege regimes allow a

[4] Nevertheless, imports are recorded as those under the duty drawback regimes. Indeed, before importing, firms must submit the declaration form on the use of duty drawback regimes and pay the amount equivalent to import duties to the customs. This procedure implies that firms cannot enjoy the refund of import duties when importing under the MFN regime even if all of the imported inputs are used for the production of export goods. In addition, to get the refund, exportation must be completed within a year from the importation.

deeper tariff reduction. Tariffs for all raw materials imported under free zones, investment promotion, and bonded warehouse regimes are virtually exempted. Concerning machinery, based on the decision of the Board of Investment of Thailand, the imports under free zones are tariff-free, while those under the investment promotion regime may be either tariff-free or subject to a 50% tariff reduction. The duty drawback regime allows a full refund if raw materials are imported to produce goods for the export market; it also allows a refund equal to nine-tenths or the excess of one thousand Thai Baht of the duty already paid, whichever is higher if goods are imported for re-exportation.

The fourth aspect is that the originating status of goods has different impacts on eligibility. Goods are qualified under RTA regimes if they are *substantially* produced in RTA member countries and meet the relevant originating criteria specified in the RoO. However, this status does not pose an issue for importation under other privilege regimes. Goods qualified for these regimes may be produced in and exported from anywhere in the world.

Finally, except for the RTA regime, importers are required to submit an evidence of compliance to the authority in charge. The proof of compliance includes the production formula, the necessity claim that explains why imports are preferred to locally produced goods, and other relevant documents. This inevitably results in higher compliance costs. However, importers are not required to produce this evidence in order to claim preferential benefits under the RTA regime; this is because all RTAs concluded by Thailand adopt third-party approval in the certification of goods' origin. As an evidence, they are only required to submit a certificate of origin issued by a competent authority in the exporting country. Consequently, the burden and cost of proving the eligibility under the RTA regime are imposed mainly on exporters.[5]

Many countries introduce similar regimes. In particular, there is high popularity of the duty drawback regime for raw materials imported to produce goods for the export market. For example, the WTO (2003) introduced this regime in Argentina, Brazil, Chile, the Dominican Republic, Egypt, Guatemala, India, Indonesia, Kenya, Malawi, Malaysia, Nigeria, South Africa, Slovakia, Turkey, and Uganda. The JETRO website also highlights the presence of a similar preference in South Korea, Cambodia, Sri Lanka, Taiwan, Vietnam, Australia, Canada, the United States, Colombia, Peru, European Union, Iran, and Ethiopia.[6] In short, these preference regimes are adopted across the globe, and not just in specific regions/countries. Therefore, it is important to consider their existence when considering the effect of RTAs on trade.

[5] Furthermore, on top of tariff reduction, certain regimes grant additional duty privileges to firms. The exemption of excise tax exists for goods imported under bonded warehouse and duty drawback for raw materials imported to produce goods for the export market. The free zones allow the imported goods to be free of the tariff, excise tax, and value-added tax.

[6] https://www.jetro.go.jp/world/search/compare.html

3. Theoretical Analysis

This section builds a theoretical model with firm heterogeneity to examine firms' choices of tariff regimes in importing input materials and their decisions to export final products. The difference in productivity plays a crucial role in determining how firms react to the formation of RTAs. Each firm chooses one regime in procuring each input, from the following three regimes: (1) the MFN regime in which MFN tariffs are applied to inputs, (2) the DD regime in which a firm uses the duty-drawback (DD) system, and (3) the RTA regime in which a firm imports inputs from RTA partner countries by using the RTA tariffs that are lower than the MFN tariffs. Firms choosing the MFN and RTA regimes can sell their products in the domestic market and export them if exporting generates positive profits. We suppose that firms choosing the DD regime in procuring inputs export their products and do not sell them in the domestic market.[7]

3.1. Setup of the Model

There are two countries where final products are consumed—a home country (country h) and a foreign country (country x). There are other countries that supply inputs used for final products. Consumers in each country have the same preferences, and they consume a homogenous good and S products whose goods are differentiated in each product category. The utility function in country j $(= h, x)$ is given by:

$$U_j = c_{j0}^{\beta_0} \prod_{s=1}^{S} C_{js}^{\beta_s}, \tag{1}$$

where $\beta_0 + \sum_{s=1}^{S} \beta_s = 1$ and c_{j0} is the consumption of the homogenous good. C_{js} is the total consumption of a differentiated product s in country j, which is given by

$$C_{js} = \left[\int_{i \in I_{js}} c_{js}(i)^{\frac{\sigma_s - 1}{\sigma_s}} di \right]^{\frac{\sigma_s}{\sigma_s - 1}}, \tag{2}$$

[7] In our study data, the share of inputs imported under the DD regime accounted for 75% in the firms that used the DD regime before the entry of RTA. This share increased to 98% after the RTA formations. This evidence indicates that firms choosing the DD regime do not use multiple tariff regimes depending on the sales destination of their outputs. Specifically, although it is legally possible, DD-regime users are less likely to sell their outputs to both the foreign and domestic markets by using both the DD regime and the MFN/RTA regime. They export the majority of their outputs to foreign countries. This fact supports our assumption. Furthermore, if those firms also sell their products to the domestic market, firms switching from the DD regime to the RTA regime in input procurements would not increase the domestic sales; this would contradict the empirical result (see footnote 26). Other than that, the main results would remain unchanged.

where $c_{js}(i)$ is the consumption of variety i, and I_{js} is the set of available varieties in the country j of product s. $\sigma_s \in (1, +\infty)$ is the elasticity of the substitution between any two pairs of varieties within the product group s.

By maximizing the consumers' utility, subject to their budget constraints, the demand for a variety i of product s in country j is given by

$$c_{js}(i) = \frac{p_{js}(i)^{-\sigma_s}}{P_{js}^{1-\sigma_s}} \beta_s E_j, \tag{3}$$

where $p_{js}(i)$ is the consumer price of the variety i that the producing firm charges, and P_{js} is the consumer price index for product s in country j.

The homogenous good is produced only with labor, and we assume that one unit of output requires one unit of labor. It is produced in both countries h and x and freely traded without any trade costs between the countries. By choosing the homogenous good as a numeraire and setting the price of the good equal to one, the wage rates become $w_x = w_h = 1$.

Each variety i of product s is produced only by a single firm in the home country using labor and intermediate inputs. The firm that produces a variety i is called a firm i. A variety i of product s is produced with a standard Cobb–Douglas function, which is given by

$$y_s(i) = \varphi_s(i) l_s(i)^{1-\alpha} M_s(i)^{\alpha}, \tag{4}$$

where $\varphi_s(i)$ is the productivity parameter, $l_s(i)$ is the labor input, $M_s(i)$ is a CES composite of intermediate inputs, and $\alpha \in (0,1)$ is the output elasticity of $M_s(i)$. It is defined as

$$M_s(i) = \left[\int_{k \in K_s(i)} m_{ks}(i)^{\frac{\nu_s - 1}{\nu_s}} \, dk \right]^{\frac{\nu_s}{\nu_s - 1}}, \tag{5}$$

where $m_{ks}(i)$ is an input used to produce a variety i of product s, and $\nu_s \in (1, +\infty)$ is the elasticity of substitution between inputs. $K_s(i)$ is the set of available inputs used to produce each variety i of product s. Each firm purchases these inputs from suppliers located in foreign countries, including the country x. Thus, $M_s(i)$ corresponds to the total import of inputs.[8]

We assume that each firm produces a single variety, taking the prices of inputs as given. By solving the cost-minimization problem of each firm, the demand for each input k per unit of the final good output is given by

$$m_{ks}(i) = \gamma \left(\frac{Z_s(i)^{\nu_s - (1-\alpha)}}{\varphi_s(i)} \right) z_{ks}(i)^{-\nu_s}, \tag{6}$$

[8] The model does not include domestic inputs because their inclusion complicates the model without changing the main results.

where $z_{ks}(i)$ is the price of each input that firm i faces, $Z_s(i)$ is the price index of inputs used to produce the variety i, and $\gamma \equiv \{\alpha/(1-\alpha)\}^{1-\alpha}$ is a positive parameter. The price index of the inputs is calculated as

$$Z_s(i) = \left[\int_{k\in K_s} z_{ks}(i)^{1-\nu_s} \, dk\right]^{\frac{1}{1-\nu_s}}. \tag{7}$$

The unit cost to produce each variety of product s in country j becomes $\Gamma Z_s(i)^{\alpha}/\varphi_s(i)$, where $\Gamma \equiv \gamma(1+\gamma^{1/(\alpha-1)})$ is the positive parameter. By substituting (6) and (7) into (5), the total import of inputs becomes

$$M_s(i) = \frac{\gamma}{\varphi_s(i) Z_s(i)^{1-\alpha}}, \tag{8}$$

which is decreasing in the price index of imported inputs.

A final-good firm producing a variety i of product s maximizes the profit and sets the free-on-board price, $\tilde{p}_s(i)$, which is given by

$$\tilde{p}_s(i) = \left(\frac{\sigma_s}{\sigma_s - 1}\right)\Gamma \frac{Z_s(i)^{\alpha}}{\varphi_s(i)}. \tag{9}$$

Thus, a firm with a higher productivity charges a lower price. The price also decreases with a decline in the price index of inputs. The equilibrium consumer price is given by $p_{js}(i) = T_{js}\tilde{p}_s(i)$, where the parameter $T_{js} \geq 1$ is one plus the ad-valorem tariff rate imposed by country j on imports of product s. If the variety is sold in the domestic market ($j = h$), we set $T_{hs} = 1$.

3.2. The Input Costs under Each Regime

When analyzing a firm's choice of a tariff regime in procuring inputs, it is sufficient to focus on one product among the product sectors. Hence, we omit the subscript s in the following analysis. The price of input k, $z_k(i)$, and the price index of inputs, $Z(i)$, depend on the regime chosen by firm i. Let $\tilde{z}_k$ be the fundamental price of the imported input k, which should reflect the technology of producing input k and other locational factors (such as wages and transport costs) of the foreign country where the supplier of k operates. When importing an input, each firm chooses one regime from the three regimes.

The tariff-inclusive price of an input imported from a foreign country is as follows. First, if firm i chooses the MFN regime, the input price will be given by $z_k^{MFN}(i) = \tau_k^{MFN}\tilde{z}_k$, where $\tau_k^{MFN} \geq 1$ is one plus the MFN tariff rate on input k imposed by the home country. Second, if firm i chooses the DD regime, then it will be free from input tariffs. In this case, we have $z_k^{DD}(i) = \tilde{z}_k$. Third, if there is an RTA between the foreign and home countries, and a firm in the home country imports k with the RTA tariff, we have

$$z_k^{RTA}(i) = \tau_k^{RTA}\theta_k\tilde{z}_k, \tag{10}$$

where $\tau_k^{RTA} \in [1, \tau_k^{MFN})$ is the one plus the preferential tariff rate of an RTA imposed on k imported from an RTA partner country. In addition, $\theta_k \geq 1$ is the cost of adjusting the procurement sources of input produced to meet the RoO for k. The adjustment cost is incurred by the producers of inputs and it is passed through to input prices.

To make formations of RTAs meaningful, we restrict our attention to the case where $z_k^{MFN}(i) > z_k^{RTA}(i)$ holds for the inputs imported from partner countries. This inequality requires that $1 > \mu_k\theta_k$ holds, where $\mu_k \equiv \tau_k^{RTA}/\tau_k^{MFN}$ $(\mu_k \in (0,1))$ is the tariff ratio that captures how RTAs reduce the input tariff on input k. This assumption excludes the case in which firms never choose the RTA regime.

3.3. Pre-RTA Regime Choices

We consider each firm's export decisions before the formation of an RTA and the choice between the MFN and DD regimes for input procurements. Since firms choosing the DD regime do not sell their products domestically, the DD regime is chosen only if the firms export their varieties to country x. If a firm uses the DD regime for at least one imported input, it must incur f_D as the fixed cost of getting the duty drawbacks for the imported inputs from the domestic government. As explained in Section 2, the fixed cost reflects the cost of submitting the evidence of compliance to the government. Since $z_k^{DD}(i)$ is the lowest price for each input k among the three regimes, and the fixed cost of getting drawbacks does not depend on the number of inputs imported by the DD system, it is optimal for firms to import all inputs using the DD regime (whenever they use the regime).[9] This also implies that the use of the MFN regime in importing k implies that a firm also imports all other inputs with MFN tariffs.

In this study, the firms importing all inputs under the MFN and DD regimes are referred to as the "MFN-type firm" and "DD-type firm," respectively. Henceforth, superscripts M and D are attached to variables for the MFN-type and DD-type firms, respectively. Accordingly, the price index of inputs for the MFN-type firm and that for the DD-type firm are denoted by Z^M and Z^D, respectively.

An MFN-type firm's profit from exporting to country x becomes

$$\pi_x^M(i) = \left[\left(\frac{\sigma}{\sigma-1}\right)\Gamma\frac{T_x(Z^M)^\alpha}{\varphi(i)P_x}\right]^{1-\sigma}\frac{\beta E_x}{\sigma} - f_x, \tag{11}$$

where f_x is the fixed cost of the exports. By setting $A = \sigma^{-\sigma}(\sigma-1)^{\sigma-1}\Gamma^{1-\sigma}$ and $B_j = [T_j(Z^M)^\alpha]^{1-\sigma}P_j{}^{\sigma-1}\beta E_j$, the export profit can be rewritten as

$$\pi_x^M(i) = AB_x\varphi(i)^{\sigma-1} - f_x. \tag{12}$$

[9] Even if the fixed cost is incurred per input, a firm imports all inputs by the DD regime (if the firm uses it). This is because we can confirm that the degree of the profit-gain by using the DD system increases with a rise in the number of inputs imported by the DD regime.

In this profit function, B_j captures the baseline profitability of selling a variety in the country j. B_j is increasing in the market size of country j, which is represented by βE_j, and in the consumer price index, P_j. It is decreasing in the input costs under the MFN regime, Z^M, and in the tariff on the final product, T_x. Firm i exports its product if and only if $\pi_x^M(i) \geq 0$ holds. By solving $\pi_x^M(i) = 0$ with respect to $\varphi(i)$, the cutoff level of productivity is calculated as $\underline{\varphi_x^M} \equiv [f_x/AB_x]^{1/(\sigma-1)}$. The MFN-type firms $\varphi(i) \geq \underline{\varphi_x^M}$ export their varieties. The MFN tariffs are also applied to inputs used for domestic sales. The profit in the domestic market is given by:

$$\pi_h^M(i) = AB_h\varphi(i)^{\sigma-1}. \tag{13}$$

To simplify our analysis, we assume no fixed cost of domestic production, which implies that firms producing the final goods always serve the domestic market. The total profit of the MFN-type firm is given by $\Pi^M(i) = \max[\pi_x^M(i), 0] + \pi_h^M(i)$.

A DD-type firm earns profits only from exports. Its profit from exporting to country x becomes

$$\begin{aligned}\pi_x^D(i) &= \left[\left(\frac{\sigma}{\sigma-1}\right)\Gamma\frac{T_x(Z^D)^{\alpha}}{\varphi(i)P_x}\right]^{1-\sigma}\frac{\beta E_x}{\sigma} - (f_x + f_D) \\ &= AB_x\left[\frac{\varphi(i)}{(\rho^D)^{\alpha}}\right]^{\sigma-1} - (f_x + f_D),\end{aligned} \tag{14}$$

where $\rho^D \equiv Z^D/Z^M$ represents the input-cost ratio that captures the degree of the reduction in the input costs for the DD-type firm relative to those for the MFN-type firm. To the extent that the tariffs on imported inputs are positive, at least for some inputs, $\rho^D < 1$ holds. ρ^D decreases with an increase in the MFN rates of the input tariffs. A DD-type firm exports its product if and only if $\pi_x^D(i) \geq 0$ holds, and the cutoff level of the productivity becomes $\underline{\varphi_x^D} \equiv (\rho^D)^{\alpha}[(f_x + f_D)/AB_x]^{1/(\sigma-1)}$. Since the DD-type firms with $\varphi(i) \geq \underline{\varphi_x^D}$ only export their varieties and do not sell those varieties in the domestic market, a DD-type firm's profit becomes $\Pi^D(i) = \max[\pi_x^D(i), 0]$.

A firm's export decision and the choice of regime for procuring inputs depend on the firm's productivity. Figure 1 depicts the net profits of a firm in each market as a function of its productivity index, $\varphi(i)^{\sigma-1}$. The slope of $\pi_x^D(i)$ is steeper than that of $\pi_x^M(i)$ because the DD-type firms are free from input tariffs, though they must incur additional fixed costs. The profit in the domestic market is always positive, but the export profit of an MFN-type firm and the profit of a DD-type firm are positive only for firms with a high productivity.

=== Figure 1 ===

By comparing $\Pi^D(i)$ and $\Pi^M(i)$, given that both $\pi_x^M(i)$ and $\pi_x^D(i)$ are positive, we have

$$\Pi^D(i) - \Pi^M(i) = H^{DM}A\varphi(i)^{\sigma-1} - f_D, \tag{15}$$

where $H^{DM} \equiv B_x\{(\rho^D)^{\alpha(1-\sigma)} - 1\} - B_h$. Since $\rho^D < 1$ and $\sigma > 1$, $(\rho^D)^{\alpha(1-\sigma)} > 1$ holds. We focus on the case where $B_h/B_x < (\rho^D)^{\alpha(1-\sigma)} - 1$ is satisfied such that $H^{DM} > 0$ holds. This ensures that firms with high productivity choose to be DD-type firms rather than MFN-type firms. Specifically, the cutoff level of the productivity, above which an exporting firm prefers to be a DD-type firm, becomes $\tilde{\varphi}_x^{D>M} \equiv [f_D/(H^{DM}A)]^{1/(\sigma-1)}$.

To consider several switching scenarios after the formation of an RTA, we restrict our attention to the case where some exporters choose to be MFN-type firms in the pre-RTA situation. Specifically, we focus on the case where $\Pi^D(i) < \Pi^M(i)$ holds at $\varphi(i) = \underline{\varphi}_x^M$.[10] We have the following proposition:

Proposition 1. *Suppose that the home country does not form any RTA with supplier countries. If* $\tilde{\varphi}_x^{D>M} > \underline{\varphi}_x^M$ *holds, then firms with* $\varphi(i) \geq \tilde{\varphi}_x^{D>M}$ *will import all inputs by the DD regime and export their outputs, firms with* $\varphi(i) \in [\underline{\varphi}_x^M, \tilde{\varphi}_x^{D>M})$ *will import all inputs by the MFN regime and sell their outputs in both the home and foreign countries, and firms with* $\varphi(i) < \underline{\varphi}_x^M$ *will import all the inputs under the MFN regime and sell their outputs in the home country.*

Figure 2 depicts the total profits in the two regimes and shows how firms with different productivities choose different regimes for input procurements.[11] We can confirm that firms with a high productivity can cover the fixed cost of using the DD regime and choose that regime for all inputs.

=== Figure 2 ===

3.4. Post-RTA Regime Choices

Let us investigate how the formation of RTAs with supplier countries influences firms' decisions to export and their choices of a regime in procuring inputs. If the partner countries of RTAs include country x, the tariff on the final good may also decrease from T_x to T'_x. We denote $\lambda_x \equiv T'_x/T_x$ ($\in (0,1]$) as the tariff ratio capturing how an RTA reduces output tariffs. In other words, $1/\lambda_x$ (> 1) is the preference margin of the output tariff. We suppose that a final-good firm can comply with RoO for the output tariff, and $\lambda_x < 1$ holds only if

[10] This requires that $B_h/B_x > (\rho^D)^{\alpha(1-\sigma)} - 1 - f_D/f_x$ is satisfied. If $B_h/B_x \leq (\rho^D)^{\alpha(1-\sigma)} - 1 - f_D/f_x$ holds, the profit of the DD-type firm will always dominate the profit of the MFN-type firm and all the exporters will use the duty-drawback system whenever firms export their products.

[11] The different choices of regimes require $(\rho^D)^{\alpha(1-\sigma)} - 1 - f_D/f_x < B_h/B_x < (\rho^D)^{\alpha(1-\sigma)} - 1$.

it imports input using the RTA scheme. If country x is not included as an RTA partner or a firm uses the MFN regime or the DD regime for input procurements, $\lambda_x = 1$ holds.[12]

If a firm chooses the RTA regime in importing k from a partner country of RTAs, then the RTA tariff rate on the input will be applied. As $z_k^{MFN}(i) > z_k^{RTA}(i)$ holds and no fixed cost is incurred under the MFN and RTA regimes, a firm will always prefer the RTA to the MFN regime whenever the RTA tariff is available. When an imported input is not produced in partner countries of RTAs, a firm cannot choose the RTA regime for that input; this scenario leads to the application of the MFN tariff rate. In this study, a firm that imports at least one input produced by the RTA regime is referred to as the RTA-type firm. The superscript R is attached to variables for the RTA-type firms, and the price index of inputs is denoted by Z^R. It must be noted that Z^R consists of the prices of inputs imported with RTA tariffs and those imported with the MFN tariffs. The inclusion of the latter can be attributed to a firm's dependence on the MFN regime when importing from non-RTA countries.[13] We have $Z^M > Z^R > Z^D$ and the input costs in the RTA regime are somewhere between the input costs under the DD and MFN regimes.

An RTA-type firm's profit from exporting to country i becomes

$$\pi_x^R(i) = AB_x \left[\frac{\varphi(i)}{\lambda_x(\rho^R)^\alpha}\right]^{\sigma-1} - f_x, \tag{16}$$

where $\rho^R \equiv Z^R/Z^M$ is the input-cost ratio of the RTA-type firm relative to that of the MFN-type firm. It satisfies $\rho^D < \rho^R < 1$. In addition, we assume $\rho^R > \mu_k^R \theta_k$ for any k imported from a partner country under the RTA regime. This assumption ensures that choosing the RTA regime over the MFN regime always increases the demand for k.[14]

An important property of imported inputs to which the RTA tariffs are applied is that they can also be used in the final goods produced for domestic sales. An RTA-type firm's profit from domestic sales becomes

$$\pi_h^R(i) = AB_h \left[\frac{\varphi(i)}{(\rho^R)^\alpha}\right]^{\sigma-1}. \tag{17}$$

The total profit of the RTA-type firm is given by $\Pi^R(i) = \max[\pi_x^R(i), 0] + \pi_h^R(i)$.

Figure 3 shows how the profits of RTA-type firms exceed those of the MFN-type firms. Since firms bear lower input tariffs without incurring an additional fixed cost, the profit of

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[12] When utilizing the output tariffs of RTAs, exporting firms must comply with the RoO. In this case, we suppose that the fixed and marginal costs of meeting RoO are reflected in the level of f_x and T_x', respectively. It must be noted that, known as the no-drawback rule, the inputs imported under the DD regime are not qualified as originating inputs in the RoO in RTAs (Shadikhodjaev, 2013; WTO, 2002).

[13] Firms do not use the DD system and the RTA tariffs simultaneously because it is optimal for firms to import all the inputs with the DD system (whenever they use it).

[14] This inequality is reversed if inputs imported from the RTA partners, other than k, experience a larger decline in prices and a so-called "within RTA substitution effect" dominates the substitution effect between the RTA- and non-RTA-made inputs. Considering this case substantially complicates the analysis without changing the basic insights of our analysis.

an RTA-type firm always dominates that of an MFN-type firm in each market, given the productivity level.[15]

=== Figure 3 ===

If $\varphi(i) \geq \underline{\varphi}_x^R \equiv (\rho^R)^{\alpha}(f_x/AB_x)^{1/(\sigma-1)} = (\rho^R)^{\alpha}\underline{\varphi}_x^M$ holds, we have $\pi_x^R(i) > 0$, and an RTA-type firm exports its variety. It must be noted that $\underline{\varphi}_x^R < \underline{\varphi}_x^M$ always holds because $(\rho^R)^{\alpha} < 1$. Intuitively, the RTA regime reduces the input costs and increases the profitability of exports; this enables the less productive firms to earn positive profits from exporting, compared to the case of the MFN-type firm.

Figure 4 compares the total profit of each type. We can easily confirm that $\Pi^R(i) > \Pi^M(i)$ holds if evaluated at the same level of productivity, and firms always prefer to become RTA-type firms rather than MFN-type firms. However, firms may still prefer the DD regime to the RTA regime for input procurements and become a DD-type firm because the former realizes a higher degree of input-cost reductions, though firms incur the additional fixed cost.

=== Figure 4 ===

By comparing $\Pi_k^D(i)$ with $\Pi_k^R(i)$, given that export profits are positive in both regimes, we have

$$\Pi^D(i) - \Pi^R(i) = H^{DR}A\varphi(i)^{\sigma-1} - f_D, \tag{18}$$

where $H^{DR} \equiv (\rho^R)^{\alpha(1-\sigma)}\left[B_x\{(\rho^R/\rho^D)^{\alpha(\sigma-1)} - \lambda_x^{1-\sigma}\} - B_h\right]$. By (18), $\Pi^D(i) \geq \Pi^R(i)$ is possible only if $(\rho^R/\rho^D)^{\alpha(\sigma-1)} > B_h/B_x + \lambda_x^{1-\sigma}$ holds. Firms can increase their profits from domestic sales by choosing the RTA-type; however, this opportunity cannot be availed under the DD-type. Therefore, the total profit of the DD-type firm can dominate that of the RTA-type firm only if the profit gain from reducing the input costs, $(\rho^R/\rho^D)^{\alpha(\sigma-1)}$, dominates the relative fundamental profitability of the domestic market to the foreign market plus the gains from the reduction in the output tariff, $B_h/B_x + \lambda_x^{1-\sigma}$. Suppose that this inequality holds, then a firm that engages in exporting will prefer to become a DD-type firm rather than an RTA-type firm when $\varphi(i) \geq \tilde{\varphi}_x^{D>R} \equiv [f_D/\ (H^{DR}A)]^{1/(\sigma-1)}$ holds.

As in the pre-RTA situation, each firm's export decision and choice of the regime depend on its productivity, as the following proposition suggests.

Proposition 2. *Suppose that the home country forms RTAs with some of the supplier countries. Firms with* $\varphi(i) \geq \tilde{\varphi}_x^{D>R}$ *import all inputs by the DD regime, while firms with* $\varphi(i) < \tilde{\varphi}_x^{D>R}$ *import inputs using the RTA regime from the RTA partners and the MFN regime from the non-RTA*

[15] If a firm must incur a fixed cost when importing inputs under the RTA regime, some firms whose productivity is low may choose to be an MFN- over an RTA-type firm, even after the RTA formation. However, considering this possibility does not change the main results of the paper.

partners. If $\tilde{\varphi}_x^{D>R} > \underline{\varphi}_x^R$ *holds, RTA-type firms with* $\varphi(i) \in \left[\underline{\varphi}_x^R, \tilde{\varphi}_x^{D>R}\right)$ *will sell their outputs in both the home and foreign countries, and RTA-type firms with* $\varphi(i) < \underline{\varphi}_x^R$ *will sell their outputs only in the home country.*

Thus, if $\tilde{\varphi}_x^{D>R} > \underline{\varphi}_x^R$ holds, some exporters with a relatively high productivity will choose the DD regime, while other exporters with a relatively low productivity will choose the RTA regime for importing inputs from the partner countries of RTAs.[16]

3.5. RTA Formation and Regime Switches

Let us now examine how an RTA formation influences firms' behaviors. As Figure 4 shows, some firms change their export decisions and choices of the regime in input procurements. We can calculate that

$$\tilde{\varphi}_x^{D>R} - \tilde{\varphi}_x^{D>M} = \left[\frac{f_D}{AH^{DM}H^{DR}}\right]^{\frac{1}{\sigma-1}}\left[(H^{DM})^{\frac{1}{\sigma-1}} - (H^{DR})^{\frac{1}{\sigma-1}}\right] > 0 \tag{19}$$

holds because we have $H^{DM} - H^{DR} = B_x\{\lambda_x^{1-\sigma}(\rho^R)^{\alpha(1-\sigma)} - 1\} + B_h\{(\rho^R)^{\alpha(1-\sigma)} - 1\} > 0$. This implies that firms whose productivity satisfies $\varphi(i) \in [\tilde{\varphi}_x^{D>M}, \tilde{\varphi}_x^{D>R})$ switch from the DD to RTA regime in importing inputs from the RTA partners. These firms witness an increase in the unit costs of the final goods produced because $Z^R > Z^D$, but they can save the fixed cost of using duty drawbacks. They can also enjoy a tariff reduction on the output if the RTA partner countries include country x, which is captured by λ_x.

Exporting firms with $\varphi(i) \in [\underline{\varphi}_x^D, \tilde{\varphi}_x^{D>M})$ become the MFN-type firm before an RTA formation, but they switch to the RTA-type firm and procure inputs using the RTA tariffs. In addition since $\underline{\varphi}_x^R < \underline{\varphi}_x^M$ holds, firms with $\varphi(i) \in [\underline{\varphi}_x^R, \underline{\varphi}_x^M)$ start exporting by switching from an MFN-type to an RTA-type firm. Firms with $\varphi(i) < \underline{\varphi}_x^R$ also switch to become RTA firms, even when they are still non-exporters. Proposition 3 summarizes these switches when exporting firms with different productivities choose a different regime with respect to their input procurement.

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[16] For $\tilde{\varphi}_x^{D>R} > \underline{\varphi}_x^R$ to hold, $(\rho^R/\rho^D)^{\alpha(\sigma-1)} - (f_D/f_x) < B_h/B_x + \lambda_x^{1-\sigma} < (\rho^R/\rho^D)^{\alpha(\sigma-1)}$ must be satisfied. If $B_h/B_x + \lambda_x^{1-\sigma} \leq (\rho^R/\rho^D)^{\alpha(\sigma-1)} - (f_D/f_x)$ holds, exporting firms will always choose to becomes the DD-type firm, while the non-exporting firms will choose to become the RTA-type firms. If $B_h/B_x + \lambda_x^{1-\sigma} > (\rho^R/\rho^D)^{\alpha(\sigma-1)}$ holds, all firms will choose the RTA regime, and firms with $\varphi(i) \geq \underline{\varphi}_x^R$ will export their outputs.

Proposition 3. *Consider the choices of regimes used by firms to import inputs from the partner countries of RTAs. Given that* $\tilde{\varphi}_x^{D>R} > \underline{\varphi}_x^R$ *holds, RTAs make: (i) exporting firms with* $\varphi(i) \in [\tilde{\varphi}_x^{D>M}, \tilde{\varphi}_x^{D>R})$ *switch from the DD to the RTA regime, (ii) exporting firms with* $\varphi(i) \in [\underline{\varphi}_x^M, \tilde{\varphi}_x^{D>M})$ *switch from the MFN to the RTA regime, (iii) firms with* $\varphi(i) \in [\underline{\varphi}_x^R, \underline{\varphi}_x^M)$ *switch from the MFN to the RTA regime and start exporting, and (iv) firms with* $\varphi(i) < \underline{\varphi}_x^R$ *switch from the MFN to the RTA regime, but they still do not export. Exporting firms with* $\varphi(i) \geq \tilde{\varphi}_x^{D>R}$ *continue to choose the DD regime.*

Thus, among firms that initially choose the DD regime for input procurements, those with a relatively low productivity shift to the RTA regime, while those with a high productivity remain in the DD regime.

3.6. Trade Effects of RTA Formation

Now, we investigate the trade effects of RTA formation for firms that switch to the RTA-type. Suppose, for simplicity, that country h and country x import many varieties from several foreign countries in each product category, so that RTA formations and resulting changes in firms' choices do not affect the level of the consumer price index, P_x and P_h.[17] Proposition 3 suggests that an RTA formation changes firms' type in input procurements if $\varphi(i) < \tilde{\varphi}_x^{D>R}$ holds. Firms with $\varphi(i) \geq \tilde{\varphi}_x^{D>R}$ continue as the DD-type firms.

3.6.1 The Effect on Input Trade

We examine how RTAs with supplier countries change each firm's import values of inputs. First, we consider the import of k from an RTA partner, for firms switching from the DD- to the RTA-type ($\varphi(i) \in [\tilde{\varphi}_x^{D>M}, \tilde{\varphi}_x^{D>R})$). They always export their products to the country x. Let $\Delta Im_k^{DR}(i)$ be the switching firm's change in the import value of k used for producing variety i from an RTA country. We have

$$\Delta Im_k^{DR}(i) = \Delta zm_k^{DR}(i)c_x^R + \tilde{z}_k m_k^D(i)\Delta c_x^{DR}(i) + \theta_k \tilde{z}_k m_k^R(i)c_h^R(i), \tag{20}$$

where $\Delta zm_k^{DR}(i) \equiv \tilde{z}_k\{\theta_k m_k^R(i) - m_k^D(i)\}$ is the change in each firm's import values of inputs per unit of its output. In the second term, $\Delta c_x^{DR}(i) \equiv c_x^R(i) - c_x^D(i)$ is the change in

[17] If firms' export status and their choice of regime affect the consumer price index, trade effects of RTA formation will become more complicated. Specifically, even if an RTA formation decreases the input costs of firms, some firms may not increase their exports when the RTA decreases the consumer price index. Other than that, the assumption does not qualitatively affect the results of our model.

the volume of exports of outputs. An increase in the output increases the demand for inputs, given the input prices, thereby increasing the import value of k. The third term captures the import of inputs used for domestic sales.[18] Since the switching firms start selling in the domestic market, they increase their imports of inputs. In (20), we can confirm that both $\Delta zm_k^{DR}(i)$ and $\Delta c_x^{DR}(i)$ have ambiguous signs. The detailed calculations are given in Appendix A of the Online Appendix. Therefore, the RTA formation can either increase or decrease $\Delta Im_k^{DR}(i)$.

The intuitive explanation of equation (20) is as follows. The sign of the first term is ambiguous. The switch from the DD to the RTA regime increases the price of k because firms enjoying duty drawbacks now face the RTA tariff, τ_k^{RTA}, and the cost of meeting RoO incurred to input suppliers, θ_k, is reflected in the input price. The increase in the input price directly decreases the demand for the input. However, the switch increases the price index of inputs, which increases the demand for input k due to a substitution effect. Therefore, the sign of $\Delta zm_k^{DR}(i)$ is ambiguous. Regarding $\Delta c_x^{DR}(i)$, the increase in the input cost reduces the exports of the final good. However, a reduction in tariffs on the final good promotes exports. Therefore, the sign of $\Delta c_x^{DR}(i)$ is also ambiguous if country x is an RTA partner. If country x is not an RTA partner, $\Delta c_x^{DR}(i) < 0$ always holds. Since the third term of (20) is always positive, $\Delta Im_k^{DR}(i)$ is more likely to be positive if the market size of the domestic country is sufficiently large such that the newly initiated domestic sales increase the imports of inputs.

We can calculate that

$$\Delta Im_k^{DR}(i) \gtreqless 0 \quad \Leftrightarrow \quad \frac{T_x B_h}{B_x} \gtreqless \frac{1+\left(\frac{\rho^R}{\rho^D}\right)^{\alpha\sigma}-\frac{1}{\lambda_x^\sigma}}{\left(\frac{\rho^R}{\rho^D}\right)^{v-(1-\alpha)}(\tau_k^R)^{-v}(\theta_k)^{1-v}}-1. \tag{21}$$

See Appendix A of the Online Appendix for a detailed calculation. Hence, the switching firms are more likely to increase the imports of inputs as B_h/B_x is larger, τ_k^R and θ_K are higher, T_x is higher, and the preference margin of the output, $1/\lambda_x$, is larger.

We can also examine the changes in imports at the firm level. The effect of switching on imports of inputs (i.e., inputs used for producing variety i in an input set of $K(i)$) from RTA countries at a firm level is given by

$$\Delta Import^{DR}(i) = \int_{k\in K(i)} \Delta Im_k^{DR}(i)dk. \tag{22}$$

Since $\Delta Im_k^{DR}(i)$ has an ambiguous sign, $\Delta Import^{DR}(i)$ can be either positive or negative.

Second, we consider the imports for switching firms from the MFN-type to the RTA-type ($\varphi(i) < \tilde{\varphi}_x^{D>M}$). We denote $\Delta Im_k^{MR}(i)$ as the change in the import value of k from an RTA country. We have

[18] Although we focus on the imports from the RTA member countries, we set $\theta_k = 1$ if k is imported from non-RTA countries.

$$\Delta Im_k^{MR}(i) \equiv \begin{cases} \Delta zm_k^{MR}(i)\sum_{j=h,x} c_j^R(i) + \tilde{z}_k m_k^M(i)\sum_{j=h,x}\Delta c_j^{MR}(i) & \text{for} \quad \varphi(i) \in \left[\underline{\varphi}_x^M, \tilde{\varphi}_x^{D>M}\right) \\ \Delta zm_k^{MR}(i)c_h^R(i) + \tilde{z}_k m_k^M(i)\Delta c_h^{MR}(i) + \theta_k \tilde{z}_k m_k^R(i)c_x^R & \text{for} \quad \varphi(i) \in \left[\underline{\varphi}_x^R, \underline{\varphi}_x^M\right) \\ \Delta zm_k^{MR}(i)c_h^R(i) + \tilde{z}_k m_k^M(i)\Delta c_h^{MR}(i) & \text{for} \quad \varphi(i) < \underline{\varphi}_x^R \end{cases}, \quad (23)$$

where $\Delta zm_k^{MR}(i) \equiv \tilde{z}_k\{\theta_k m_k^R(i) - m_k^M(i)\}$ is a change in each firm's import values of inputs per unit of its output. The increase in outputs also increases the import of inputs. The second term captures how the change in the total volume of sales of the final good in country $j \in \{h, x\}$, $\Delta c_j^{MR}(i) \equiv c_j^R(i) - c_j^M(i)$, affects the import value of k. The third term in the middle of (23) captures the effect of starting exports on the import value of k. The effect of switching on the imports of inputs at a firm level from an RTA country is given by

$$\Delta Import^{MR}(i) = \int_{k\in K} \Delta Im_k^{MR}(i)dk. \quad (24)$$

We can confirm that $\Delta zm_k^{MR}(i) > 0$ holds (see Appendix A of the Online Appendix) for inputs imported from RTA countries because the input tariff reduction of RTAs increases the demand for those inputs. In addition, $\Delta c_h^{MR}(i) > 0$ and $\Delta c_x^{MR}(i) > 0$ always hold, implying that each switching firm increases the amount of sales in each market it serves. Therefore, we always have $\Delta Im_k^{MR}(i) > 0$ for inputs imported from an RTA country.[19] The following proposition summarizes the trade effects on the imported inputs for switching firms.

Proposition 4. *The imported inputs from an RTA country that switched from the DD to the RTA regime are more likely to increase as the market size of the domestic country is larger, the RTA-tariff rate on input and the adjustment costs for meeting RoO are lower, the tariff on output is higher, or the preference margin on output is larger. There is always an increase in the imported inputs from an RTA country that switched from the MFN to the RTA regime.*

3.6.2 The Effect on Output Trade

Our next question is how RTAs with supplier countries affect the switching firms' exports of their varieties to country x. Let $\Delta Export^{RD}(i) \equiv \tilde{p}^R(i)c_x^R(i) - \tilde{p}^D(i)c_x^D(i)$ be the change in the export value of variety i, for firms that switched from the DD-type to the RTA-type in their importing. We have

$$\Delta Export^{DR}(i) = \frac{AB_x}{\sigma T_x}\left[\frac{\varphi(i)}{(\rho^R)^\alpha}\right]^{\sigma-1}\left[\frac{1}{\lambda_x^\sigma} - \left(\frac{\rho^R}{\rho^D}\right)^{\alpha(\sigma-1)}\right]. \quad (25)$$

[19] For inputs imported from a non-RTA country, we have $\Delta zm_k^{MR}(i) < 0$ because the lower prices of RTA inputs decrease the demand for non-RTA inputs. When this negative effect outweighs the positive effect of increased sales, the switching firms decrease the imports of non-RTA inputs.

As does $\Delta c_x^{DR}(i)$, the switching firms' decision to increase or decrease their exports will depend on the relative magnitude of the preference margin on the output, which is captured by $1/\lambda_x^{\sigma}$, and that of the increase in the input cost, which is captured by $(\rho^R/\rho^D)^{\alpha(\sigma-1)}$. If the former effect dominates the latter, $\Delta Export^{DR}(i) > 0$ holds, and vice versa. In particular, if country x is not a member of RTAs ($\lambda_x = 1$), $\Delta Export^{DR}(i) < 0$ holds.

Since the switch from the DD-type to the RTA-type increases the switching firms' input costs, there may be a decline in their export values.[20] However, the switch increases their revenues from their sales in the domestic market. If country x is not a member of RTAs, firms with high productivity that remain as the DD-type firms do not change their export values. Subsequently, firms with a medium-high productivity that switch from the DD- to the RTA-type decrease exports and increase domestic sales. This implies that RTA formations that liberalize input trade may *prevent*, rather than promote, the exports of firms with a medium-high productivity.

For medium-low and low-productive firms that switched from the MFN-type to the RTA-type, $\Delta Export^{MR}(i)$ is the switching firm's change in the export value. We have

$$\Delta Export^{MR}(i) \equiv \begin{cases} \tilde{p}^R(i)c_x^R(i) - \tilde{p}^M(i)c_x^M(i) & \text{for} \quad \varphi(i) \in \left[\underline{\varphi}_x^M, \tilde{\varphi}_x^{D>M}\right) \\ \tilde{p}^R(i)c_x^R(i) & \text{for} \quad \varphi(i) \in \left[\underline{\varphi}_x^R, \underline{\varphi}_x^M\right) \\ 0 & \text{for} \quad \varphi(i) < \underline{\varphi}_x^R \end{cases}. \tag{26}$$

The export values naturally increase in the case of firms that start exporting. For firms that initially export their varieties, we have

$$\tilde{p}^R(i)c_x^R(i) - \tilde{p}^M(i)c_x^M(i) = \frac{AB_x}{\sigma T_x}\left[\frac{\varphi(i)}{(\rho^R)^{\alpha}}\right]^{\sigma-1}\left[\frac{1}{\lambda_x^{\sigma}} - (\rho^R)^{\alpha(\sigma-1)}\right] > 0 \tag{27}$$

because $\rho^R < 1$. Thus, firms that switched from the MFN- to the RTA-type always increase the export values of their outputs if they export after the RTA formation.

Unlike the firms that switched from the DD-type, RTA formations with a part of supplier countries always promote the exports of final-good firms that chose the MFN-type before the RTA formations and switched to the RTA-type. However, these firms are less productive than the firms that initially chose the DD-type. The following proposition summarizes the trade effect on outputs for the switching firms.

Proposition 5. *If the tariff reduction of the output is sufficiently large to satisfy* $1/\lambda_x^{\sigma} > (\rho^R/\rho^D)^{\alpha(\sigma-1)}$*, firms that switched from the DD- to the RTA-type will increase exports. Otherwise,*

[20] If there is a change in the consumer price index, the consumer price index for the RTA-type firms can be larger than that for the DD-type when the degree of price increases for other firms that shifted from the DD- to the RTA-type is large. In this case, the switching firm's export value decreases when the negative effect from the increased input costs dominates the positive effect from the increased consumer price index. At least, a switching firm that experienced the highest cost-increase, among other switching firms, decreases its export value.

they will decrease exports. Firms that switched from the MFN- to the RTA-type always increase exports as long as they export after the RTA formations.

4. Empirical Framework

This section explains our empirical framework to examine how firms switching from the drawback to the RTA regime change their imports. We first discuss the methodological framework and, subsequently, present the data sources and issues.

4.1. Propensity Score Matching

As theoretically demonstrated in the previous section, there are various types of importers according to the tariff regimes in the pre- and post-RTA periods. The tariff regimes used by the importers are not randomly assigned but are chosen based on their profit comparison. The chosen regime differs on the basis of firms' characteristics. In other words, since the firm characteristics differ across the tariff regimes, a simple comparison of imports across the firm types includes not only the impacts of switching tariff regimes but also the differences in ex-ante firm characteristics. This endogeneity can be addressed by using instruments for the switching status. However, across all firm types, firms not only determine whether to switch from the drawback to the RTA regime but also choose between the MFN and RTA regimes and select whether to continue using the MFN regime. We need to consider all these selection mechanisms. As usual, however, it is difficult to find many plausible instruments. Thus, to address the selection bias above, we employ the PSM method.

This study aims to evaluate the causal effect of switching from the drawback to the RTA regime on imports. Specifically, our indicator variable for this switching is $Switch_{fcp} \in \{0,1\}$, which takes the value of one if firm f switches from the drawback regime to the RTA when importing product p from country c and the value of zero otherwise. The average effect of switching on imports (y), that is, the average treatment effect on the treated (ATT), is defined as

$$\text{ATT} \equiv \mathrm{E}\left(y_{fcp}^{1} - y_{fcp}^{0} | Switch_{fcp} = 1\right) = \mathrm{E}\left(y_{fcp}^{1} | Switch_{fcp} = 1\right) - \mathrm{E}\left(y_{fcp}^{0} | Switch_{fcp} = 1\right),$$

where y^{1}_{fcp} and y^{0}_{fcp} are the imports of firm f for cases when switching and not-switching, respectively.

We cannot observe the last term, namely, the imports that would be obtained if a switching firm does not switch to another tariff regime. Thus, we replace the last term with the observable performance of non-switchers, namely, $\mathrm{E}\left(y_{fcp}^{0} | Switch_{fcp} = 0\right)$.

$$\begin{aligned}\text{ATT} = \mathrm{E}\left(y_{fcp}^{1} | Switch_{fcp} = 1\right) - \mathrm{E}\left(y_{fcp}^{0} | Switch_{fcp} = 0\right) \\ + \left\{\mathrm{E}\left(y_{fcp}^{0} | Switch_{fcp} = 0\right) - \mathrm{E}\left(y_{fcp}^{0} | Switch_{fcp} = 1\right)\right\}.\end{aligned}$$

We can obtain a consistent estimator of the ATT only if the bracketed term is equal to zero.

However, as theoretically demonstrated in the previous section, switching and non-switching firms differ in terms of productivity and thereby imports. Thus, the bracketed term does not equal zero, and the estimates suffer from the sample selection bias.

We follow the solution advocated by Rosenbaum and Rubin (1983). We first assume the following:

$$y_{fcp}^{0} \perp Switch_{fcp} | \text{Prob}\left(Switch_{fcp} = 1 |\ \mathbf{X}_{fcp}\right).$$

$\perp$ represents mathematical independence. $\text{Prob}\left(Switch_{fcp} = 1 |\ \mathbf{X}_{fcp}\right)$ is called a "propensity score" and indicates the probability of switching, conditional upon a vector of observable variables $\mathbf{X}_{fcp}$. This assumption implies that if the probability of switching explained by a vector of observable variables $\mathbf{X}_{fcp}$ is the same between switching and non-switching firms, imports obtained when not switching are also the same between those two firms. Another assumption is:

$$\text{Prob}\left(Switch_{fcp} = 1 |\ \mathbf{X}_{fcp}\right) < 1.$$

This assumption guarantees that firms with identical characteristics (i.e., $\mathbf{X}_{fcp}$) can be observed among both switchers and non-switchers. With these two assumptions, the bracketed term in the above equation is equal to zero when the propensity score is common.

After computing the propensity scores of switching, we employ the one-to-one nearest neighbor matching method as the matching algorithm. The switching status is identified at the pair-level, that is, *fcp*. For simplicity, we denote this triple script by a single script *i*. I_0, and I_1 represent sets of non-switching and switching firms, respectively. We define the following:

$$P_i \equiv \text{Prob}(Switch_i = 1 |\ \mathbf{X}_i).$$

Then, the pairs matched with firm *i* belong to the following set:

$$A_i = \left\{ j \in I_0 | P_j = \underset{j}{\text{argmin}} \, ||P_i - P_j|| \right\}, i \in I_1 \ .$$

When the above first assumption holds between pairs $i \in I_1$ and $j \in A_i$, the following becomes a consistent estimator of switching:

$$\text{ATT}^{PSM} = \sum\nolimits_{i \in I_1} \left(y_i^1 - y_j^0\right).$$

Finally, to control for the remaining selection bias resulting from unobservable temporary time-invariant factors, such as common macro effects, we combine the matching method with a difference-in-differences (DID) approach, along the lines of Heckman et al. (1998). We add time script *t* to the outcome variable, that is, *y*. Then, instead of the above first assumption, we assume that:

$$\left(y_{it}^0 - y_{it-1}^0\right) \perp Switch_i | \text{Prob}\left(Switch_i = 1 |\ \mathbf{X}_{fcp}\right).$$

Then, the above ATT estimator is replaced by:

$$\text{ATT}^{PSM-DID} = \sum\nolimits_{i \in I_1} \left\{ \left(y_{it}^1 - y_{it-1}^1\right) - \left(y_{jt}^0 - y_{jt-1}^0\right) \right\}.$$

We compute this estimator.

The propensity of switching is estimated using the logit model. Based on data availability, a vector of $\mathbf{X}_{fcp}$ includes the following elements:

$$\mathbf{X}_{fcp} = \{\ln Total\ \ exports_f, Margin_{cp}, FE_{cs}\}$$

$Total\ \ exports_f$ is firm f's total exports evaluated at time $t-1$, while $Margin_{cp}$ represents the difference between MFN and RTA tariff rates (preference margin) when importing product p from country c at time t. FE_{cs} includes country-sector fixed effects. The theoretical analysis in the previous section demonstrates that the less productive drawback users switch to the RTA regime. Unfortunately, we do not have detailed information on firm characteristics, such as productivity or employment. Expecting that total exports are positively correlated with productivity, we use firms' total exports instead of productivity.[21] The preference margin does not have a direct impact on the choice between the drawback and RTA regimes. It affects this choice indirectly by increasing the cutoff level of productivity, $\tilde{\varphi}_x^{D>R}$. As Proposition 3 suggests, a higher $\tilde{\varphi}_x^{D>R}$ increases the likelihood of the switch from the DD to the RTA regime.

We also extend the vector $\mathbf{X}_{fcp}$ in the later estimation. For example, total exports are decomposed into average exports at a country-product-level and the number of country-product pairs. We also use the following three variables that are defined at a firm level. The first is the share of exports to RTA member countries in the total exports at time $t-1$. While our import data can identify the tariff regime used, such information cannot be identified using the export data. Therefore, by using this share, we control the possibility of claiming the RTA regime and enjoying tariff reduction in exports. However, it must be noted that exports to RTA member countries do not necessarily follow the RTA regime because its utilization incurs some costs. The second is the share of imports from RTA members in the total imports at time $t-1$. This share is expected to control for the significance of the choice of switching in each firm. In addition, we introduce a dummy variable for foreign-owned firms because they may behave differently from indigenous firms. Finally, we also control for fixed effects of firms' locations, which are identified at a province-level.

4.2. Data

Our primary data are the export and import data obtained from the Customs of Thailand. These data cover all commodity exports and imports in Thailand at the transaction level. Specifically, these include customs clearing date, HS eight-digit code,

[21] We cannot link our dataset with the industrial census owing to the absence of the common firm identification code. Nevertheless, we checked the correlation between labor productivity (i.e., total sales divided by the number of employees) and exports at an establishment-level, by employing the industrial census for 2007 (National Statistical Office, Thailand). Specifically, we regressed a log of exports on a log of labor productivity, province fixed effects, and ISIC four-digit fixed effects. As a result, the coefficient for labor productivity is estimated to be 1.13. The standard error clustered at an ISIC four-digit level is 0.04. Thus, we believe that total exports are positively associated with productivity in Thailand.

exporting/importing country, firm identification code, values, and quantities. The import data also includes the information on the tariff regime. We aggregate the import data according to firms, countries, HS eight-digit codes, tariff regimes, and years. Thus, product p is defined at the HS eight-digit level. We categorize the tariff regime into four types, including —the MFN, RTA, duty drawback, and other regimes. Although we name it "duty drawback regime," it includes the five regimes introduced in Section 2—bonded warehouses, free zones, investment promotion, duty drawback for raw materials imported for the production of exports, and duty drawback for re-exportation. There were no substantial changes in the rules of these regimes during the study period. We again use the abbreviation of DD for duty drawback in the empirical part.

We employ trade data from 2007 and 2011. Ideally, two years should be chosen based on the availability of RTAs (i.e., pre- and post-RTA periods). However, the data in 2007 is the oldest data. Indeed, Thailand already had RTAs with some countries (e.g., ASEAN countries) in 2007. Nevertheless, since few firms used RTA regimes in 2007, we believe that the choice of the year 2007 works well.[22] The year 2011 was chosen to assure the longest interval under the consistent HS version, that is, HS 2007. While the outcome variable is the log difference between imports in 2007 and 2011, the independent variables in the logit model are evaluated in 2007, except for the preference margin assessed in 2011. The data on tariffs are obtained from the Customs of Thailand. We introduce country-sector fixed effects. The sector is defined at a two-digit level of ISIC Revision 3. To convert HS eight-digit codes to two-digit codes of ISIC, we use the correspondence table between HS six-digit codes and four-digit codes of the ISIC Revision 3 compiled by the World Integrated Trade Solution[23]. We also use business data compiled by the Department of Business Development in Thailand, which includes the basic information on firms. Using these data, we create a dummy variable for foreign-owned firms and identify firms' locations (i.e., provinces).

As of 2011, four bilateral RTAs and six plurilateral RTAs came into force in Thailand. The bilateral RTAs came into force in 2005, 2004, and 2007 in Australia and New Zealand, India, and Japan, respectively.[24] Among the plurilateral RTAs, the ASEAN Trade in Goods Agreement (ATIGA) was introduced in 2010 by revising the ASEAN Free Trade Area (AFTA) that became effective among the 10 ASEAN countries (Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Laos, the Philippines, Singapore, Thailand, and Vietnam) in the 1990s. In addition, Thailand, together with the other ASEAN members, has concluded five plurilateral RTAs, called ASEAN+1 RTAs: ASEAN–Australia–New Zealand Free Trade Agreement (AANZFTA) in 2010, ASEAN–China FTA (ACFTA) in 2005, ASEAN–India FTA (AIFTA) in 2010, ASEAN–Japan Comprehensive Economic Partnership (AJCEP) in 2009, and the ASEAN–Korea FTA (AKFTA) in 2010. Thus, we define the following 15 countries as RTA

[22] In our robustness checks, we also drop country-product-pairs that were eligible to any RTAs in 2007.
[23] https://wits.worldbank.org/product_concordance.html
[24] We do not include the RTA with Peru here because it entered into force in 31 December 2011.

partner countries: the nine ASEAN countries, Australia, China, India, Japan, Korea, and New Zealand.

There are five noteworthy points. First, we restrict the sampled firms to those with positive exports, in both 2007 and 2011, because non-exporters do not have the option to use the DD regime. Second, as found above, multiple RTAs overlap in many country-pairs. For example, when trading with ASEAN countries, firms in Thailand can choose an RTA regime among six RTAs (i.e., ATIGA and five ASEAN+1 RTAs). The preference margin is computed using the lowest available RTA tariff rates at a country-HS eight-digit level. Third, we define the tariff regime with the largest imports as the main tariff regime in each country-product-year pair. We restrict the firm-country-product observations only to those wherein the main tariff regimes were the duty drawback regime in 2007 and either the duty drawback or RTA regime in 2011. Subsequently, our treatment variable, *Switch*, takes the value of one if the main regime is the RTA in 2011. Fourth, our analysis focuses on the imports of manufacturing products (15–37 in ISIC Revision 3) from these RTA partner countries. The study's country-product pairs are restricted to those eligible for any RTAs, that is, those with a positive preference margin in 2011. Finally, when we merge the trade data with the business data, a considerable number of firms are dropped partly because we have business data only for manufacturing firms. Thus, we estimate both models with and without variables obtained from the business data.

Before reporting our estimation results, we provide an overview of the import "size" according to the main tariff regimes, which is shown in Table 1.[25] It reports the share of each import value in the total imports, in 2011 at a firm-country-product-level. Here, we do not include observations not recorded in 2007 or 2011. The highest share is shown by the type where the main regime was the DD regime in both 2007 and 2011, indicating the significant role of the DD regime in imports in Thailand.[26] The combination with the second-highest share is depicted by the use of the MFN regime in both 2007 and 2011. The type that switched from the DD regime to the RTA regime, which is our treatment group in the PSM analysis, accounts for 7%. Finally, as mentioned above, few firms used the RTA regime in 2007. The type where the main regime was the RTA regime in 2007 accounted for less than 1%.

=== Table 1 ===

[25] In this table, the main regime includes the one under the regimes other than MFN, RTA, and DD regimes (i.e., *Other*). When we categorize the main tariff regime for the PSM analysis, we ignore the imports under this regime.

[26] It must be noted that there is a possibility of overestimating the magnitude of the DD imports. Even if firms import under the DD regime, they may cease to use the imported inputs for the production of export goods. In this case, they must pay import duties, while their imports remain as those under the DD regime in the statistics. We do not have statistics on how many DD imports fall into this type of change.

5. Empirical Results

This section reports our estimation results. We report the results of our analyses using the PSM method. We also conduct some robustness checks. Subsequently, we report the results of the effects on exports and of the effects of switching from the MFN regime to the RTA regime.

5.1. Basic Analyses

Before the analysis by the PSM, we conducted two basic analyses. First, Figure 5 depicts the distribution of the log-difference between the firm-country-product-level imports in 2007 and 2011. The distribution is shown for switchers and non-switchers separately. In both types, the major tariff regime was DD in 2007, but either DD or RTA in 2011. Although both cases hit a peak at around a small positive number, the distribution for switchers appears to be more positively than that for non-switchers. According to the Kolmogorov-Smirnov test on the hypothesis that non-switchers have a higher import growth than switchers, the largest difference between the distribution functions is 0.10. The approximate p-value for this is 0.000, which is significant. In summary, switchers seem to have a higher import growth than that of the non-switchers.

=== Figure 5 ===

Second, we regress the log-difference above on dummy variables, indicating the combination of the major tariff regimes between 2007 and 2011. In this regression, we include all importers, including those whose main regime was not the DD in 2007. The results of the ordinary least squares (OLS) method are reported in Table 2. We may control for country fixed effects or/and HS eight-digit-level fixed effects. The base category is the one where the major regime was DD in both 2007 and 2011. The standard errors are clustered at the firm level. The results show that switchers from the DD to the RTA have positively significant coefficients, indicating that the switchers have a higher import growth rate than that of the non-switchers, which is consistent with the findings in Figure 5. Other noteworthy results are that, compared with the non-switchers, a relatively high growth rate is found in firms that changed from the RTA or MFN to the DD, while the firms that changed from the DD or RTA to the MFN have a relatively low growth rate.

=== Table 2 ===

5.2. Baseline Results of the PSM

We begin the analyses using the PSM. Hereafter, we restrict the study observations to those in which the main regime was the DD in 2007 and either the DD or the RTA in 2011. Subsequently, the treatment variable *Switch* takes the value of one if the main regime in 2011

was the RTA. The upper panel in Table 3 reports the estimation results for the propensity scores. The standard errors are clustered at the firm level. Column (I) shows the result with the basic variables, including total exports, preference margin, and country-industry fixed effects. The coefficient for total exports is significantly negative, while the preference margin has an insignificant coefficient. Specifically, the DD importers with relatively small total exports switch to the RTA regime. This result is consistent with our theoretical prediction if total exports are positively associated with firms' productivity. The insignificant result in the preference margin is perhaps because it plays only an indirect role in the choice between the DD and RTA regimes, as mentioned in Section 4.1. As shown in column (II), this result does not change even when adding the dummy variable to foreign companies and province fixed effects. The coefficient for a foreign dummy is insignificant. It must be noted that the number of observations remarkably decreased as a result of linking trade data with the business data.[27]

=== Table 3 ===

Based on the predicted propensity scores, we matched between the switchers and non-switchers. Before discussing the results of the impacts of switching, we show the performance of our matching. The standardized difference and variance ratio of each covariate are reported in Table 4. The column numbers in this table correspond to those in Table 3. Compared to the case of the raw observations, the standardized difference among the matched observations should be smaller in absolute terms. Similarly, the variance ratio in the matched sample should be close to one. Columns (I) and (II) in Table 4 indicate that matching is successfully done in terms of standardized differences, but it is not necessarily successful in terms of variance ratios. The distribution of a log of total exports is presented in panel (a) in Figure B1 in Appendix B. Compared to the raw observations, the matched observations show a similar distribution between the switchers and non-switchers.

=== Table 4 ===

The lower panel of Table 3 reports the results for the outcome variable. We use standard errors based on the innovation of Abadie and Imbens (2016).[28] Their method takes into account the fact that propensity scores are estimated, rather than known, when calculating standard errors. Both columns (I) and (II) show the positively significant impacts on imports, indicating that switching to the RTA increases imports by 34–40%. In our theoretical analysis in Section 3, we demonstrated that switching firms could either increase or decrease their imports. Our empirical analyses show that the effect of switching on imports is positive, on an average. To investigate the source of this increase, we examine the impacts on the import quantity and price by replacing the outcome variable in the PSM. The

[27] To avoid such a decrease in the number of observations, Brandt and Morrow (2017) did not link trade data with the manufacturing survey. For completeness, we show the results in both kinds of study observations.

[28] To this end, we use the "teffects" command in Stata.

results are presented below for imports. Both the import quantity and price show positive effects, but only the effect on import quantity is significant. Thus, the increase in imports comes mainly from the increase in import quantity.

Next, we estimate other specifications in the logit model. In columns (III) and (IV), we decompose the total exports to the average exports and the number of country-product pairs. The logit results show that both variables have positive coefficients, but only the results in the average exports are significant. The DD importers with smaller average exports tend to switch to the RTA regime. In columns (V) and (VI), we introduce two variables of shares, that is, the shares of exports to and imports from RTA member countries to the specification used in columns (III) and (IV). These two variables do not have robust results. Only column (V) shows a significantly positive coefficient for the share of imports, while the significantly positive coefficient for the share of exports is found only in column (VI). The balancing tests based on these logit results are reported in the corresponding columns in Table 4. The distribution of a log of average exports is presented in panel (b), in Figure B1 in Appendix B. Similar to the case of total exports, compared to the raw observations, the matched observations show a similar distribution between the switchers and non-switchers. In all these estimations, the results of the impacts on imports remain qualitatively unchanged. Switching increases imports significantly, especially the import quantity.

5.3. Robustness Checks

We conduct five kinds of robustness checks to confirm the validity of the aforementioned results. First, we only restrict the sampled products to manufacturing products. For more consistency with our theoretical setting, we further limit only to intermediate products, for example, parts. Finished products are defined as items categorized into 112, 122, 41, 51, 52, 61, 62, or 63 in the Broad Economic Categories (BEC) classification, while the rest are intermediate products. The results for the imports of parts are reported in Table B1, in Appendix B. The logit results are similar to those in Table 3. Both the total and average exports have significantly negative coefficients. However, the results for the outcome variables are not robust. Some specifications show insignificant impacts on import prices as well as imports and import quantities.

Second, we restrict import observations only to those that were not eligible for any RTAs in 2007. So far, we used the observations in 2007 for indicating those before the entry of RTAs into force. However, as mentioned in Section 4.2, Thailand already had RTAs in some countries, such as ASEAN countries. Although Table 1 indicates little use of RTA regimes when importing in 2007, we use the study observations that are more consistent with the theoretical setting, by restricting to the country-product pairs where no RTA tariffs were available in 2007. The estimation results are presented in Table B2 in Appendix B. Similar to the results for the imports of parts (i.e., Table B1), the logit results are similar to

those in Table 3, while the results of significantly positive coefficients in the outcome variables are not robust.

The third and fourth checks are also used to estimate subsamples. As the third check, we exclude import observations from Japan, which has been a top investing country in and has maintained a close economic relationship with Thailand. Thus, the trade between Japan and Thailand may follow different economic mechanisms, such as intra-firm trade. The fourth check excludes outliers in terms of the import growth. Specifically, we drop observations with the top 3% or the bottom 3% of import growth. The results of these two checks are shown in Tables B3 and B4 in Appendix B. The results for both the logit model and the impacts are similar to those in Table 3—switching increases imports and import quantity.

The last robustness check examines the effect of switching on imports at a firm level. So far, we estimated the model defined at a firm-country-product-level. Suppose that a firm switches the tariff regime for one product, but not for another product. In this case, the change in imports in the former product may also affect imports in the latter product if these products are interrelated. To incorporate such effects, we estimate the propensity of switching at a firm level and examine the effects on firm-level imports. The major tariff regime is also defined at the firm level. In this categorization of the major regime, we use the sum of imports of RTA-eligible products from RTA member countries. Subsequently, we focus on firms whose imports under the DD regime were larger than those under the RTA regime in 2007. *Switch* takes a value of one if imports under the RTA regime are higher than those achieved under the DD regime in 2011. The results are shown in Table 5. The logit estimation results indicate a weak result in total exports, while the average exports have significantly negative coefficients. The impacts on imports from RTA members are reported in the lower panel and again show positive effects. Specifically, the results indicate that switching increases imports from RTA member countries by around 30%.

=== Table 5 ===

5.4. Impacts on Exports

In this subsection, we examine the impacts of switching on firms' exports. Since these exports are defined at a firm level, matching is conducted by using the same model as that in Table 5. The impacts on firms' total exports are shown in the lower panel of Table 5. The results indicate the insignificant effects of switching on total exports. We also examine the impacts on the exports to RTA member and non-member countries separately because the RTA formation not only led to a decline in input tariffs when importing but also led to a decline in output tariffs when exporting to the member countries. However, it must be noted that firms do not necessarily use RTA tariffs even when exporting to RTA member countries

because of the existence of their utilization costs.[29] The results are reported in Table B5 in Appendix B but show insignificant results for both exports to RTA member and non-member countries.

In Section 3, we theoretically demonstrate that there are two opposing effects on exports. The positive effect is based on the utilization of RTA tariffs in exporting, that is, the use of lower tariffs, while the negative effect comes from a surge in the input costs because of the compliance with RoO. The former effect works only when exporting to RTA partner countries and utilizing RTA tariffs. We also found a positive effect of switching on import prices for many specifications, but such an effect was insignificant. Our results on the impacts on exports, especially exports to RTA member countries, indicate that exports did not increase as greatly as offsetting the (insignificant) rise in input costs. Nevertheless, we found a significant increase in imports, especially import quantities. One possible reason for this increase in imports is that additional inputs are used to produce goods for the domestic market. Indeed, as shown in Figure 6, the share of domestic sales in the total sales is higher in switching firms.[30] In sum, the switching firms increase their imports from RTA partner countries to produce goods for the domestic market, rather than to expand their exports.

=== Figure 6 ===

5.5. Switching from the MFN Regime to the RTA Regime

Finally, we examine the impacts of switching from the MFN to RTA regime on imports in order to cover the entire perspective on firms that switch to the RTA regime. To this end, we restrict firm-country-product observations only to those wherein the main tariff regime was the MFN regime in 2007, and either the MFN or RTA regime in 2011. Our treatment variable, *Switch*, takes the value of one if the main regime was the RTA regime in 2011. We use the same variables for estimating the propensity of this type of switching, as in the case of switching from the DD regime. As shown in Table 1, in terms of imports, firms switching from the MFN to the RTA regime account for 16%, which is more than twice as large as those switching from the DD regime to the RTA regime. Thus, the impacts of the former type of switchers may have potentially larger impacts on national imports.

Table 6 presents the results. The logit estimation results indicate that the coefficients for the average exports are positive, which is opposite to the case of switching from the DD, though they are insignificant.[31] Another noteworthy result is that the coefficients for the

[29] It must be noted that the information on the tariff regime used in exporting is not available.

[30] This figure depicts the distribution of domestic sales shares in 2010. The domestic sales are computed by subtracting total exports from total sales. The data on total sales are obtained from the business data. It must be noted that we have those data only for 2010. This result is consistent with the theoretical prediction that the switching firm increases the domestic sales because firms in the DD regime do not sell their products in the domestic market.

[31] The results for imports of parts are shown in Table B6 in Appendix B. One result indicates the

preference margin are significantly positive, indicating that MFN users are more likely to switch to the RTA regime when the difference between MFN and RTA tariffs is larger. This result is natural because the difference between MFN and RTA tariffs directly affects the choice between the MFN and RTA regimes, unlike the choice between DD and RTA regimes. The results for the other variables are similar to those switching from the DD regime. The higher share of imports from RTA members is associated with a higher propensity to switch from the MFN to the RTA regime. Foreign-owned firms tend to keep using the MFN regime.

=== Table 6 ===

Impacts on imports are reported in the lower panel and show positive effects. Specifically, the results indicate much larger coefficients than those in switching from the DD regime. Switching from the MFN regime to the RTA regime increases imports from RTA member countries by 71–107%. While the impacts on the import quantity are significantly positive with almost the same magnitude as those on imports, the import prices receive negative and insignificant effects (except for column (V)). Thus, as in the case of switching from the DD regime, most of the increase in imports comes from the increase in import quantities. The negative (but insignificant) impacts on import prices are not consistent with our expectation because of the measure of tariff-exclusive import prices. In the theoretical model, the fundamental price of the imported input is assumed to be constant. If each input is provided by a monopolistically competitive firm and the price–cost margin is not constant, then the RTA use can decrease import prices by decreasing the price–cost margin, as indicated by Hayakawa et al. (2019a). This also suggests that the adjustment costs to meet RoO are not significant.

6. Concluding Remarks

This study theoretically and empirically examined how the entry of RTAs into force changes firms' imports and exports in the presence of duty drawback regimes. We theoretically demonstrate that firms switching from the DD to the RTA regime could either increase or decrease their imports from RTA member countries, given that the use of RTA regimes does not provide additional benefit in terms of duty exemption and import prices may rise owing to the compliance with RoO. In the detailed firm-level trade data in Thailand, we found that firms' switch from the DD to the RTA regime increases their imports from RTA member countries by around 30%. The switch from the MFN to the RTA regime increases imports by approximately 90%. However, it has also been revealed that mid-sized firms switching to the RTA regime in terms of total exports. The large-sized firms continue using the duty drawback regime in importing even after the entry of RTAs into force. Therefore, the impacts of RTAs on trade might not be substantial at a national level. Indeed,

significantly positive coefficient for the average exports.

in Thailand, the share of imports by these two kinds of switching firms is only 23%, even in the post-RTA period.

We also found that firms switch from the DD to the RTA regime to increase the imported inputs and use them to produce goods for the domestic market, rather than expand their exports. This result implies an increased presence of the domestic firms in the domestic market of the downstream or finished goods. This scenario toughens competition, and thereby dampens the imports of finished goods from RTA member countries. Specifically, RTAs may increase the trade in materials or inputs but not in finished goods. Indeed, when we estimate the gravity equation with RTA dummy variables for the worldwide trade, we find significantly positive trade creation effects for trade in materials but not for trade in finished goods (see Table B7 in Appendix B). In sum, under the presence of duty drawback regimes, the magnitude of trade creation effects by RTAs will differ according to the stages of production.

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Table 1. The Share of Imports in Total Imports in 2011 according to the Major Tariff Regime in 2007 and 2011 (%)

	2011			
2007	DD	MFN	RTA	Other
DD	28	3	7	1
MFN	4	23	16	6
RTA	0.1	0.05	0.63	0
Other	0.5	2	9	0.4

Source: Customs, Kingdom of Thailand

Table 2. Simple OLS Estimation

Base: 2007 = DD & 2011 = DD	(I)	(II)	(III)
1 if 2007 = DD & 2011 = RTA	0.286***	0.239***	0.213**
	[0.075]	[0.078]	[0.086]
1 if 2007 = DD & 2011 = MFN	-1.029***	-1.074***	-1.051***
	[0.081]	[0.080]	[0.083]
1 if 2007 = DD & 2011 = Other	-0.276	-0.285	-0.134
	[0.308]	[0.293]	[0.298]
1 if 2007 = RTA & 2011 = DD	1.816***	1.812***	2.098***
	[0.458]	[0.455]	[0.500]
1 if 2007 = RTA & 2011 = RTA	0.596***	0.641***	0.713***
	[0.169]	[0.169]	[0.192]
1 if 2007 = RTA & 2011 = MFN	-0.713**	-0.696**	-0.720**
	[0.321]	[0.334]	[0.344]
1 if 2007 = MFN & 2011 = DD	1.451***	1.407***	1.380***
	[0.079]	[0.081]	[0.081]
1 if 2007 = MFN & 2011 = RTA	0.616***	0.636***	0.645***
	[0.045]	[0.045]	[0.048]
1 if 2007 = MFN & 2011 = MFN	0.078**	0.069*	0.069*
	[0.035]	[0.037]	[0.039]
1 if 2007 = MFN & 2011 = Other	0.323***	0.409***	0.383***
	[0.081]	[0.113]	[0.112]
1 if 2007 = Other & 2011 = DD	0.511*	0.473	0.568
	[0.278]	[0.305]	[0.396]
1 if 2007 = Other & 2011 = RTA	0.301***	0.310***	0.282***
	[0.051]	[0.061]	[0.074]
1 if 2007 = Other & 2011 = MFN	-0.261**	-0.411***	-0.339***
	[0.116]	[0.096]	[0.104]
1 if 2007 = Other & 2011 = Other	0.420**	0.587***	0.621***
	[0.194]	[0.209]	[0.238]
Country FE		X	
HS FE		X	
Country-HS FE			X
R-squared	0.026	0.0696	0.1153
Number of obs.	98,159	97,472	93,097

Notes: We estimate the model using the OLS method. The dependent variable is the log-difference between imports in 2007 and 2011 at a firm-country-product-level. The independent variables include various dummy variables indicating the combination of the major tariff regime between 2007 and 2011. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. The square brackets denote the standard errors clustered by firms. We may control for country fixed effects or/and HS eight-digit-level fixed effects.

Table 3. Effects of Switching on Imports of All Products

	(I)	(II)	(III)	(IV)	(V)	(VI)
Logit results						
ln Total exports	-0.145***	-0.158***				
	[0.030]	[0.052]				
ln Average exports			-0.189***	-0.181***	-0.195***	-0.183***
			[0.044]	[0.065]	[0.044]	[0.064]
ln # of country-product pairs			-0.084	-0.125	-0.066	-0.07
			[0.067]	[0.092]	[0.071]	[0.102]
Share of exports to RTA members					0.01	0.745**
					[0.238]	[0.348]
Share of imports from RTA members					0.499*	-0.019
					[0.293]	[0.383]
Margin	-0.175	1.738	-0.182	1.74	-0.102	1.665
	[0.720]	[1.269]	[0.719]	[1.262]	[0.697]	[1.265]
Foreign dummy		-0.279		-0.282		-0.384
		[0.220]		[0.222]		[0.234]
Province FE		X		X		X
Country-ISIC 2-digit FE	X	X	X	X	X	X
Pseudo R2	0.2021	0.2429	0.203	0.2432	0.2047	0.2484
Log pseudolikelihood	-2876.6	-1609.4	-2873.6	-1608.9	-2867.4	-1597.8
Impacts						
ln Imports	0.344***	0.401***	0.307***	0.455***	0.277***	0.464***
	[0.093]	[0.129]	[0.094]	[0.138]	[0.101]	[0.144]
ln Quantity	0.222*	0.325**	0.213*	0.303*	0.265**	0.373**
	[0.116]	[0.148]	[0.117]	[0.167]	[0.127]	[0.169]
ln Price	0.122	0.076	0.094	0.153	0.012	0.091
	[0.077]	[0.093]	[0.070]	[0.105]	[0.078]	[0.094]
Number of obs.	13,834	7,484	13,834	7,484	13,834	7,484
Treated obs.	1,006	615	1,006	615	1,006	615
Control obs. (Raw)	12,828	6,869	12,828	6,869	12,828	6,869

Notes: This table reports the results of PSM. The observations are restricted to those in which the main regime was the DD in 2007 and either the DD or the RTA in 2011. Then, the treatment variable *Switch* takes the value of one if the main regime in 2011 was the RTA. The upper panel reports the estimation results for the propensity scores. The standard errors are clustered at the firm level. The results for the outcome variable are reported in the lower panel. The standard errors are the Abadie-Imbens robust errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

Table 4. Balancing Test for Matched Firms in Table 3

		(I)	(II)	(III)	(IV)	(V)	(VI)
ln Total exports							
Raw	S.D.	-0.500	-0.472				
	Var R	1.020	1.469				
Matched	S.D.	0.024	0.101				
	Var R	0.811	0.681				
ln Average exports							
Raw	S.D.			-0.459	-0.411	-0.459	-0.411
	Var R			1.022	1.440	1.022	1.440
Matched	S.D.			-0.009	-0.002	-0.023	-0.016
	Var R			0.908	0.734	0.959	0.791
ln # of country-product pairs							
Raw	S.D.			-0.372	-0.376	-0.372	-0.376
	Var R			1.177	1.365	1.177	1.365
Matched	S.D.			0.089	-0.059	0.045	0.018
	Var R			1.091	0.920	0.975	0.881
Share of exports to RTA members							
Raw	S.D.					-0.131	0.048
	Var R					0.942	0.907
Matched	S.D.					-0.134	-0.133
	Var R					0.924	0.988
Share of imports from RTA members							
Raw	S.D.					-0.128	-0.176
	Var R					0.926	1.049
Matched	S.D.					0.035	-0.095
	Var R					0.811	0.869
Margin							
Raw	S.D.	0.193	0.290	0.193	0.290	0.193	0.290
	Var R	1.587	2.208	1.587	2.208	1.587	2.208
Matched	S.D.	-0.031	0.051	0.072	-0.006	0.063	0.043
	Var R	0.557	1.142	1.420	0.954	1.447	1.236
Foreign dummy							
Raw	S.D.		-0.425		-0.425		-0.425
	Var R		2.006		2.006		2.006
Matched	S.D.		0.011		0.025		0.025
	Var R		0.989		0.976		0.976

Notes: This table reports the balancing tests for the matching conducted in Table 3. We show the standardized differences (S.D.) and variance ratio (Var R) of each covariate. The column numbers correspond to those in Table 3.

Table 5. Effects of Switching on Imports and Exports: Firm-level Analyses

	(I)	(II)	(III)	(VI)
Logit results				
ln Total exports	-0.024	-0.051*		
	[0.018]	[0.028]		
ln Average exports			-0.091***	-0.114***
			[0.026]	[0.039]
ln # of country-product pairs			0.090**	0.058
			[0.037]	[0.057]
Share of exports to RTA members	-0.285**	-0.072	-0.249*	-0.034
	[0.133]	[0.206]	[0.136]	[0.211]
Share of imports from RTA members	0.394**	0.164	0.432***	0.209
	[0.160]	[0.240]	[0.162]	[0.241]
Foreign dummy		-0.18		-0.203
		[0.156]		[0.157]
Province FE		X		X
ISIC 2-digit FE	X	X	X	X
Pseudo R2	0.0717	0.1223	0.0755	0.1254
Log pseudolikelihood	-1548.5	-744.1	-1542.0	-741.5
Impacts				
ln Imports from RTA members	0.382***	0.300**	0.305***	0.294**
	[0.095]	[0.124]	[0.093]	[0.115]
ln Total exports	0.002	-0.011	-0.038	-0.033
	[0.115]	[0.129]	[0.121]	[0.145]
Number of obs.	2,758	1,354	2,758	1,354
Treated obs.	808	432	808	432
Control obs. (Raw)	1,950	922	1,950	922

Notes: This table reports the results of PSM at the firm level. The observations are restricted to those in which imports under the DD regime are larger than those under the RTA regime in 2007. Then, the treatment variable *Switch* takes the value of one if firms had larger imports under the RTA regime than those under the DD regime in 2011. The upper panel reports the estimation results for the propensity scores. The standard errors are clustered at the firm level. The results for the outcome variable are reported in the lower panel. The standard errors are the Abadie-Imbens robust errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

Table 6. Effects of Switching from the MFN to RTA Regime

	(I)	(II)	(III)	(IV)	(V)	(VI)
Logit results						
ln Total exports	-0.076***	-0.03				
	[0.012]	[0.025]				
ln Average exports			0.032	0.02	0.026	0.021
			[0.021]	[0.032]	[0.020]	[0.032]
ln # of country-product pairs			-0.230***	-0.097*	-0.213***	-0.084
			[0.028]	[0.054]	[0.028]	[0.053]
Share of exports to RTA members					-0.065	0.076
					[0.112]	[0.181]
Share of imports from RTA members					1.053***	0.748***
					[0.136]	[0.233]
Margin	2.327***	2.076***	2.595***	2.231***	2.532***	2.251***
	[0.393]	[0.786]	[0.393]	[0.777]	[0.378]	[0.757]
Foreign dummy		-0.678***		-0.661***		-0.666***
		[0.146]		[0.147]		[0.150]
Province FE		X		X		
Country-ISIC 2-digit FE	X	X	X	X	X	X
Pseudo R2	0.2111	0.2244	0.2185	0.2256	0.2276	0.2298
Log pseudolikelihood	-15116.3	-3749.7	-14974.9	-3743.9	-14800.2	-3723.9
Impacts						
ln Imports	0.723***	1.065***	0.709***	1.007***	0.746***	1.046***
	[0.053]	[0.098]	[0.051]	[0.097]	[0.052]	[0.098]
ln Quantity	0.773***	1.153***	0.724***	1.179***	0.741***	1.105***
	[0.062]	[0.121]	[0.059]	[0.126]	[0.060]	[0.126]
ln Price	-0.05	-0.089	-0.016	-0.172	0.006	-0.058
	[0.039]	[0.076]	[0.038]	[0.084]	[0.039]	[0.082]
Number of obs.	45,906	12,950	45,906	12,950	45,906	12,950
Treated obs.	6,746	1,596	6,746	1,596	6,746	1,596
Control obs. (Raw)	39,160	11,354	39,160	11,354	39,160	11,354

Notes: This table reports the results of the PSM at a firm-country-product-level. The observations are restricted to those in which the main regime was the MFN in 2007 and either the MFN or the RTA in 2011. Then, the treatment variable *Switch* takes the value of one if the main regime in 2011 was the RTA. The upper panel reports the estimation results for the propensity scores. The standard errors are clustered at the firm level. The results for the outcome variable are reported in the lower panel. The standard errors are the Abadie-Imbens robust errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

Figure 1: Profit in Each Country before the Formation of RTAs

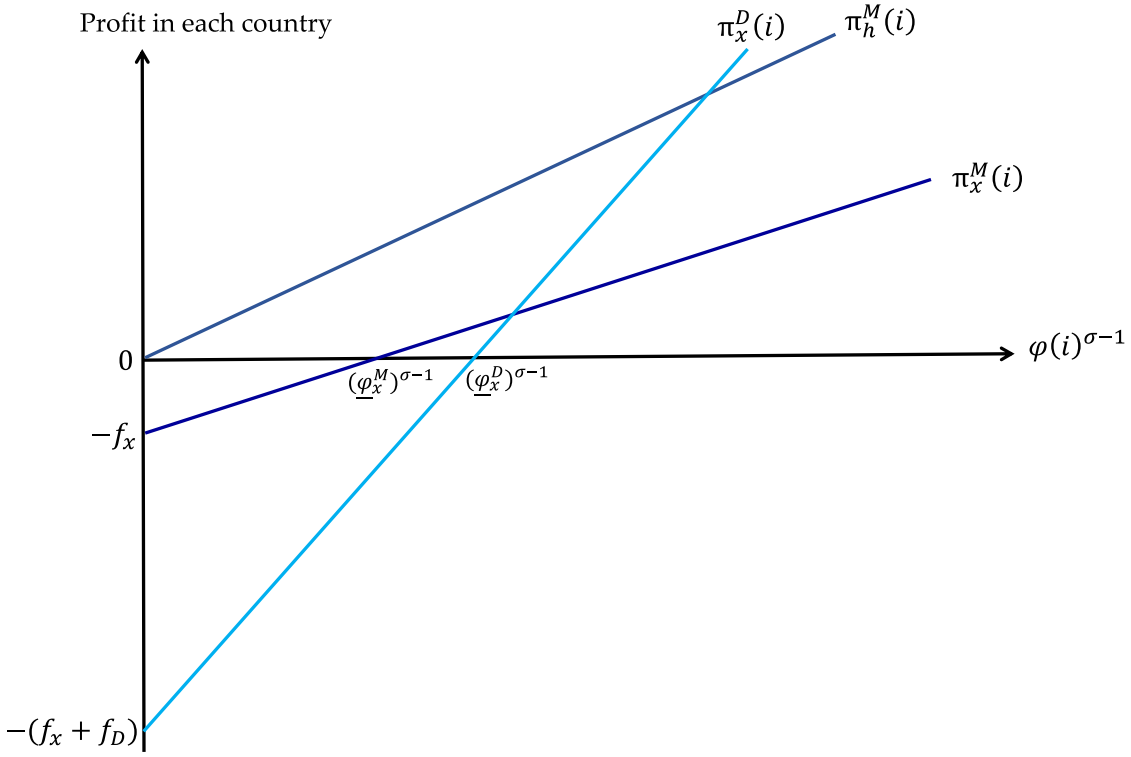


Figure 2: Total Profit before the Formation of RTA

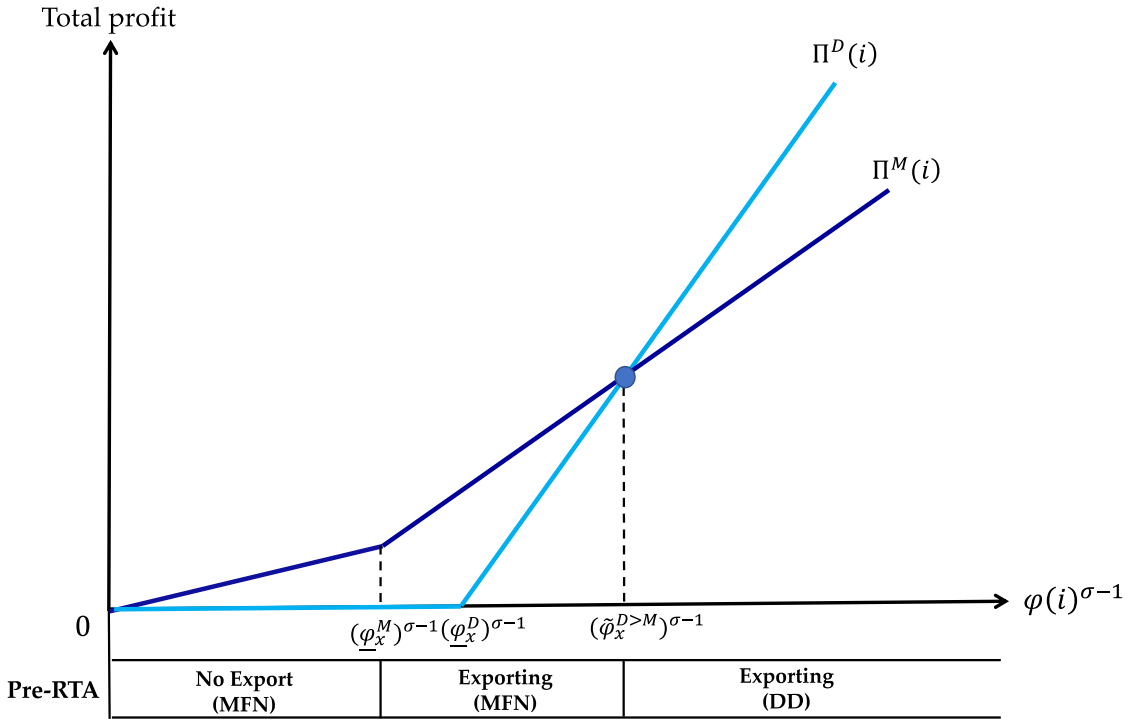


Figure 3: Profit in Each Market in the RTA Regime

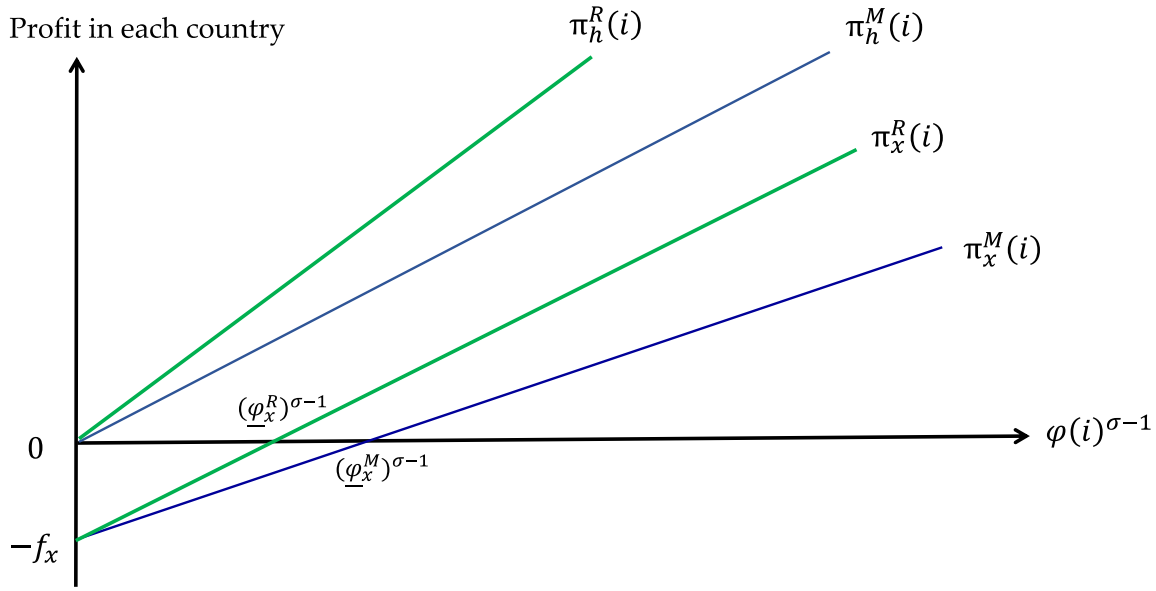


Figure 4: Total Profit after the Formation of RTA

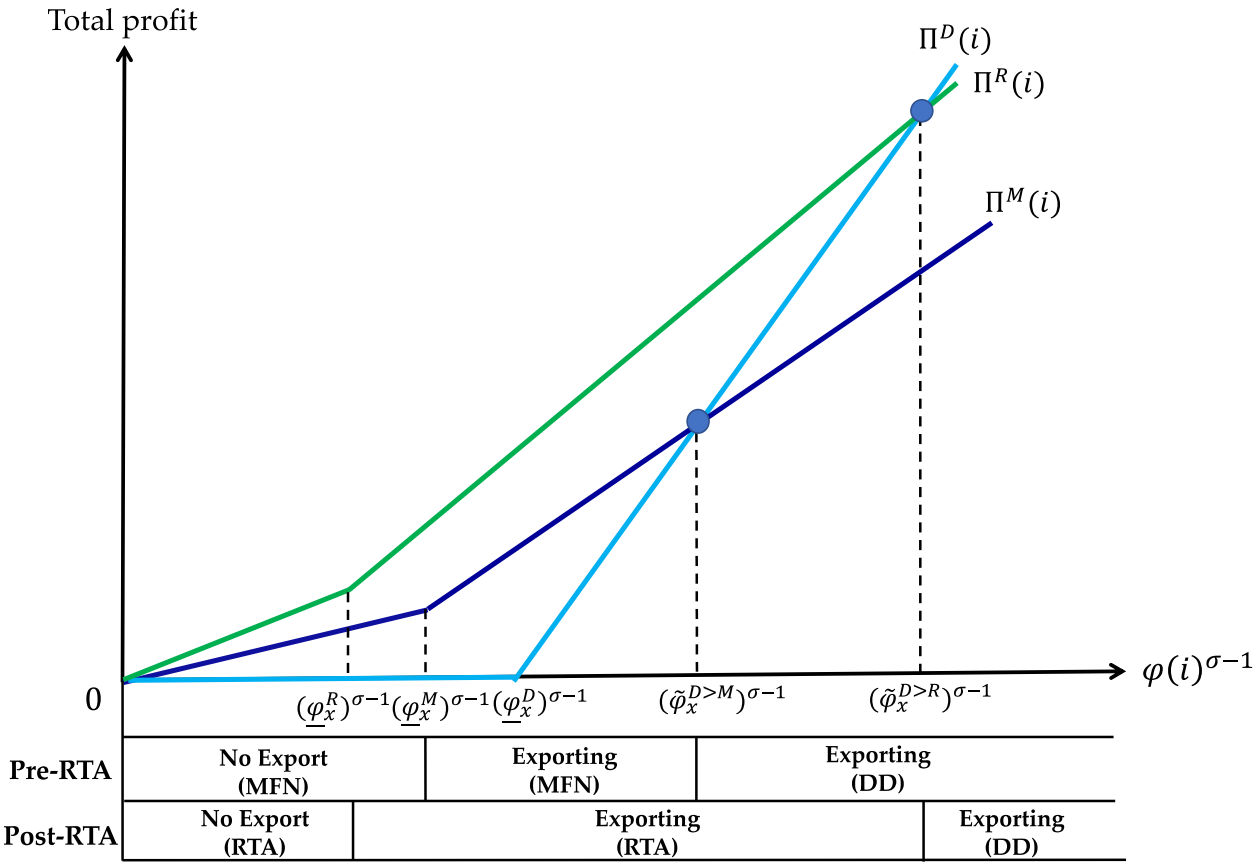
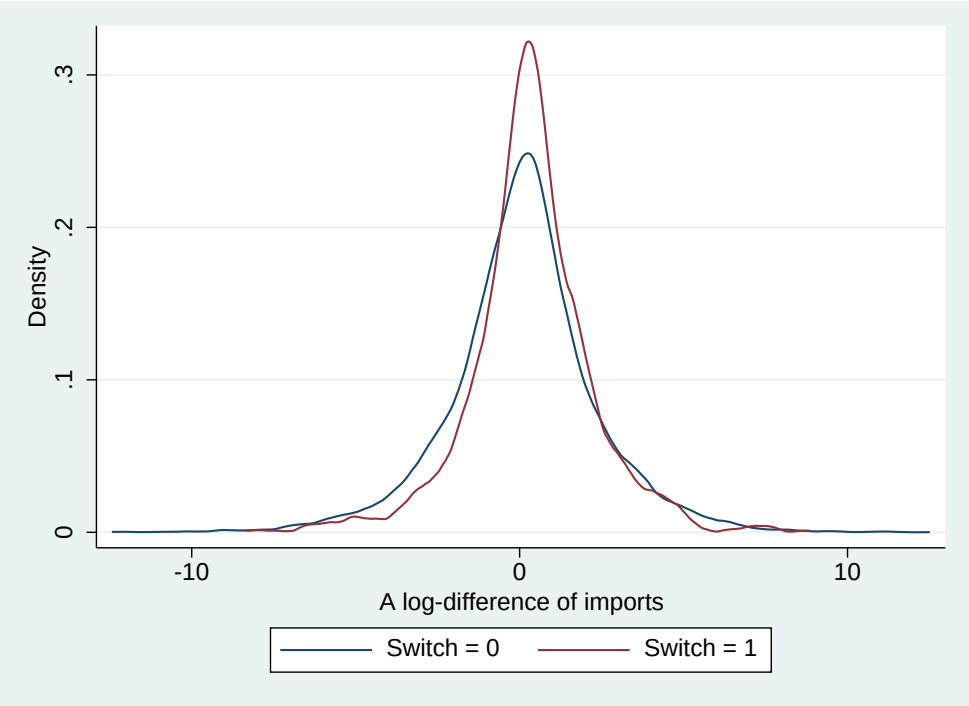


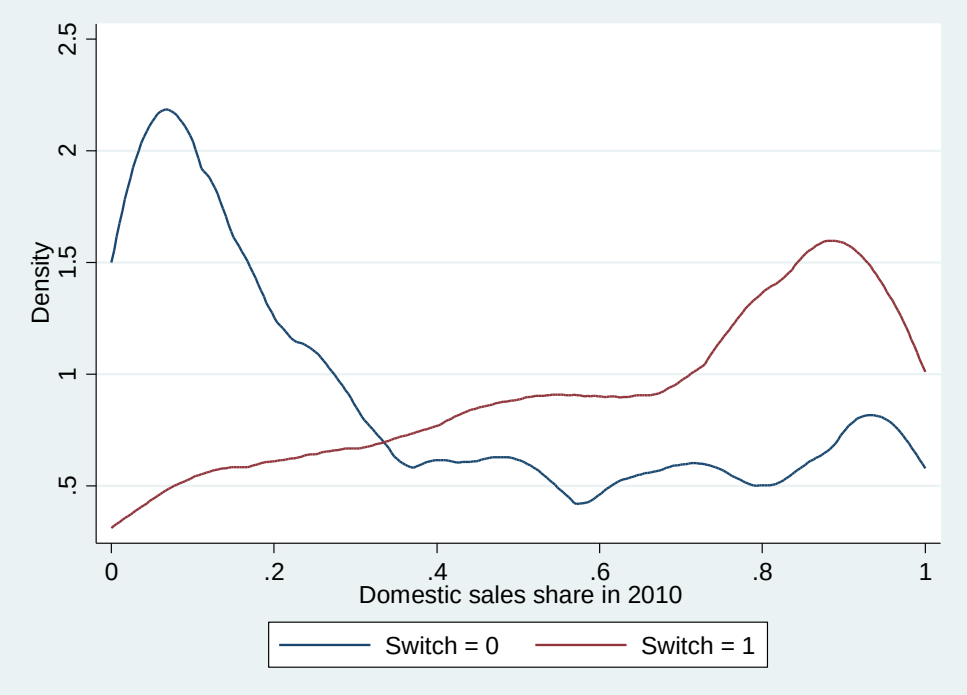
Figure 5. The Distribution of Import Growth Rates



Source: Authors' compilation

Notes: The study observations are restricted to those in which the main regime was the DD in 2007 and either the DD or the RTA in 2011. *Switch* takes the value of one if the main regime in 2011 was the RTA.

Figure 6. The Distribution of Domestic Sales Shares



Source: Authors' compilation.

Online Appendix for "Trade Creation Effect of Regional Trade Agreements in the Presence of Duty Drawbacks"

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Appendix A. The Derivation of Trade Effects of RTA Formation

Regarding the sign of $\Delta zm_k^{DR}(i)$, we have

$$\Delta zm_k^{DR}(i) = \tilde{z}_k m_k^D(i)\left[\left(\frac{\rho^R}{\rho^D}\right)^{v-(1-\alpha)} \quad (\tau_k^R)^{-v}(\theta_k)^{1-v} - 1\right].$$

A switch from the DD regime to the RTA regime increases the trade price of k from $\tilde{z}_k$ to $\theta_k\tilde{z}_k$. This direct effect increases the import value of k. An increase in the price of the input from $\tilde{z}_k$ to $\theta_k\tau_k^R\tilde{z}_k$ reduces the demand for k. Since the latter effect dominates the former, a higher $\theta_k\tau_k^R$ reduces $\Delta zm_k^{DR}(i)$. Moreover, the import price of k^* imported from a non-partner country also increases from $\tilde{z}_{k^*}$ to $\tau_{k^*}^M\tilde{z}_{k^*}$ because firms no longer use the duty-drawback system. The latter effect increases the demand for k and it is reflected in the increase in the price index of inputs, ρ^R/ρ^D.[32] Therefore, we have

$$\Delta zm_k^{DR}(i) \gtreqless 0 \quad \Leftrightarrow \left(\frac{\rho^R}{\rho^D}\right)^{v-(1-\alpha)} \gtreqless \quad (\tau_k^R)^v(\theta_k)^{v-1}.$$

Regarding $\Delta c_x^{DR}(i)$, we have

$$\Delta c_x^{DR}(i) = \lambda_x^{-\sigma}\left(\frac{1}{\rho^R}\right)^{\alpha\sigma} c_x^M(i) - \left(\frac{1}{\rho^D}\right)^{\alpha\sigma} c_x^M(i) = \frac{c_x^M(i)}{(\rho^R)^{\alpha\sigma}}\left[\frac{1}{\lambda_x^\sigma} - \left(\frac{\rho^R}{\rho^D}\right)^{\alpha\sigma}\right],$$

and

$$\Delta c_x^{DR}(i) \gtreqless 0 \quad \Leftrightarrow \frac{1}{\lambda_x^\sigma} \gtreqless \left(\frac{\rho^R}{\rho^D}\right)^{\alpha\sigma}.$$

Although the tariff reduction on the final good promotes exports, the increase in the input costs by the switch from the DD to the RTA discourages them. The former effect is captured

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[32] Furthermore, if other inputs imported from RTA-partner countries experience a larger increase in input prices, they increase ρ^R/ρ^D, and the price index of inputs is more likely to dominate the increase in the price of k.

by $1/\lambda_x^{\sigma}$, while the latter effect is captured by $(\rho^R/\rho^D)^{\alpha\sigma}$. If $\lambda_x = 1$, $\Delta c_x^{DR}(i) < 0$ always holds. Substituting $\Delta z m_k^{DR}(i)$ and $\Delta c_x^{DR}(i)$ into Eq. (20), we have

$$\Delta I m_k^{DR}(i) = \tilde{z}_k m_k^D(i) c_x^R \left[\left(\frac{\rho^R}{\rho^D}\right)^{v-(1-\alpha)} (\tau_k^R)^{-v} (\theta_k)^{1-v} \left(1 + \frac{T_x B_h}{B_x}\right) - 1 + \frac{1}{\lambda_x^{\sigma}} - \left(\frac{\rho^R}{\rho^D}\right)^{\alpha\sigma} \right]$$

and

$$\Delta I m_k^{DR}(i) \gtreqless 0 \quad \Leftrightarrow \quad \frac{T_x B_h}{B_x} \gtreqless \frac{1 + (\rho^R/\rho^D)^{\alpha\sigma} - \lambda_x^{-\sigma}}{(\rho^R/\rho^D)^{v-(1-\alpha)} \quad (\tau_k^R)^{-v}(\theta_k)^{1-v}} - 1.$$

Concerning firms that switched from the MFN to the RTA regime, $\Delta z m_k^{MR}(i)$ for those imported from RTA countries is given by

$$\Delta z m_k^{MR}(i) = \tilde{z}_k m_k^D(i)(\tau_k^R)^{-v} \left(\frac{\rho^R}{\rho^D}\right)^{v-(1-\alpha)} \left[(\theta_k)^{1-v} - \left(\frac{1}{\rho^R}\right)^{v-(1-\alpha)} (\mu_k)^v \right]$$
$$> \tilde{z}_k m_k^D(i)(\tau_k^R)^{-v} \left(\frac{\rho^R}{\rho^D}\right)^{v-(1-\alpha)} (\theta_k)^{1-v} \left[1 - \frac{(\mu_k)^{1-\alpha}}{(\theta_k)^{\alpha}} \right] > 0.$$

The first inequality is because of $\rho_R > \mu_k \theta_k$, under which the cost decrease of k imported from a partner country, $\mu_k \theta_k$, dominates the overall cost-decrease of inputs, ρ_R. See Section 3.4 for details. The second inequality is owing to $\theta_k > 1$ and $\mu_k < 1$.

If *k* is imported from the non-RTA countries, the changes in the value of inputs per unit of output become

$$\Delta z m_k^{MR}(i) = \tilde{z}_k m_k^D(i)(\tau_k^M)^{-v} \left(\frac{\rho^R}{\rho^D}\right)^{v-(1-\alpha)} \left[1 - \left(\frac{1}{\rho^R}\right)^{v-(1-\alpha)} \right] < 0.$$

Regarding $\Delta c_x^{MR}(i)$ and $\Delta c_h^{MR}(i)$, we have

$$\Delta c_x^{MR}(i) = c_x^M(i) \left[\frac{1}{\lambda_x^{\sigma}} \left(\frac{1}{\rho^R}\right)^{\alpha\sigma} - 1 \right] > 0 \quad \text{and} \quad \Delta c_h^{MR}(i) = c_h^M(i) \left[\left(\frac{1}{\rho^R}\right)^{\alpha\sigma} - 1 \right] > 0.$$

Therefore, if *k* is imported from an RTA country, the switch from the MFN to the RTA regime will always increase the firms' imports of that input. If *k* is imported from a non-RTA country, the shift will increase imports only when the positive output effects dominate the negative unit-value effect.

Appendix B. Other Tables

Table B1. Effects of Switching on Imports of Parts

	(I)	(II)	(III)	(IV)	(V)	(VI)
Logit results						
ln Total exports	-0.148***	-0.131***				
	[0.030]	[0.049]				
ln Average exports			-0.186***	-0.130**	-0.188***	-0.132**
			[0.046]	[0.065]	[0.046]	[0.065]
ln # of country-product pairs			-0.096	-0.132	-0.083	-0.079
			[0.065]	[0.091]	[0.068]	[0.098]
Share of exports to RTA members					0.071	0.793**
					[0.254]	[0.372]
Share of imports from RTA members					0.282	-0.125
					[0.308]	[0.399]
Margin	0.127	2.18	0.136	2.181	0.149	1.975
	[0.746]	[1.545]	[0.741]	[1.547]	[0.736]	[1.549]
Foreign dummy		-0.317		-0.316		-0.423*
		[0.234]		[0.235]		[0.246]
Province FE		X		X		X
Country-ISIC 2-digit FE	X	X	X	X	X	X
Pseudo R2	0.1886	0.2278	0.1892	0.2278	0.19	0.2336
Log pseudolikelihood	-2280.8	-1273.6	-2278.9	-1273.6	-2276.8	-1264.1
Impacts						
ln Imports	0.223**	0.315	0.394***	0.271	0.357***	0.265
	[0.105]	[0.218]	[0.095]	[0.218]	[0.100]	[0.188]
ln Quantity	0.141	0.22	0.340***	0.125	0.325***	0.191
	[0.134]	[0.211]	[0.114]	[0.218]	[0.127]	[0.198]
ln Price	0.082	0.095	0.054	0.147	0.032	0.074
	[0.089]	[0.100]	[0.068]	[0.097]	[0.082]	[0.102]
Number of obs.	9,320	5,145	9,320	5,145	9,320	5,145
Treated obs.	835	504	835	504	835	504
Control obs. (Raw)	8,485	4,641	8,485	4,641	8,485	4,641

Notes: This table reports the results of PSM. The observations are restricted to those in which the main regime was the DD in 2007 and either the DD or the RTA in 2011. Then, the treatment variable *Switch* takes the value of one if the main regime in 2011 was the RTA. The upper panel reports the estimation results for the propensity scores. The standard errors are clustered at the firm level. The results for the outcome variable are reported in the lower panel. The standard errors are the Abadie-Imbens robust errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. In this table, we restrict the sample to intermediate products, which are categorized into neither 112, 122, 41, 51, 52, 61, 62, nor 63 in the BEC classification.

Table B2. Effects of Switching on Imports: Ineligible Pairs in 2007

	(I)	(II)	(III)	(IV)	(V)	(VI)
Logit results						
ln Total exports	-0.149***	-0.130*				
	[0.037]	[0.068]				
ln Average exports			-0.193***	-0.144*	-0.203***	-0.151*
			[0.051]	[0.083]	[0.052]	[0.082]
ln # of country-product pairs			-0.09	-0.11	-0.05	-0.031
			[0.074]	[0.113]	[0.079]	[0.130]
Share of exports to RTA members					0.199	0.986**
					[0.296]	[0.465]
Share of imports from RTA members					0.684*	-0.036
					[0.349]	[0.502]
Margin	-2.858	-0.193	-2.857	-0.196	-2.621	-0.888
	[1.951]	[2.579]	[1.939]	[2.576]	[1.918]	[2.609]
Foreign dummy		-0.501*		-0.505*		-0.656**
		[0.275]		[0.278]		[0.302]
Province FE		X		X		X
Country-ISIC 2-digit FE	X	X	X	X	X	X
Pseudo R2	0.1681	0.2124	0.169	0.2125	0.1736	0.2225
Log pseudolikelihood	-1462.3	-764.7	-1460.7	-764.6	-1452.6	-754.8
Impacts						
ln Imports	0.171	0.338*	0.214	0.569***	0.230	0.388**
	[0.135]	[0.186]	[0.152]	[0.194]	[0.143]	[0.179]
ln Quantity	0.061	0.107	0.167	0.717***	0.095	0.373
	[0.164]	[0.242]	[0.182]	[0.238]	[0.182]	[0.247]
ln Price	0.109	0.232*	0.047	-0.149	0.135	0.015
	[0.108]	[0.138]	[0.098]	[0.140]	[0.105]	[0.149]
Number of obs.	5,832	3,110	5,832	3,110	5,832	3,110
Treated obs.	522	293	522	293	522	293
Control obs. (Raw)	5,310	2,817	5,310	2,817	5,310	2,817

Notes: This table reports the results of PSM. The observations are restricted to those in which the main regime was the DD in 2007 and either the DD or the RTA in 2011. Then, the treatment variable *Switch* takes the value of one if the main regime in 2011 was the RTA. The upper panel reports the estimation results for the propensity scores. The standard errors are clustered at the firm level. The results for the outcome variable are reported in the lower panel. The standard errors are the Abadie-Imbens robust errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. This table reports the results when focusing on import observations that were not eligible for any RTAs in 2007.

Table B3. Effects of Switching on Imports: Excluding Japan

	(I)	(II)	(III)	(IV)	(V)	(VI)
Logit results						
ln Total exports	-0.173***	-0.231***				
	[0.028]	[0.046]				
ln Average exports			-0.214***	-0.253***	-0.224***	-0.253***
			[0.048]	[0.071]	[0.049]	[0.070]
ln # of country-product pairs			-0.118*	-0.202**	-0.089	-0.156*
			[0.065]	[0.083]	[0.067]	[0.089]
Share of exports to RTA members					-0.011	0.607*
					[0.236]	[0.332]
Share of imports from RTA members					0.747**	-0.002
					[0.301]	[0.398]
Margin	-0.222	1.975	-0.231	1.976	-0.105	1.916
	[0.766]	[1.344]	[0.765]	[1.339]	[0.741]	[1.339]
Foreign dummy		-0.29		-0.293		-0.388
		[0.242]		[0.243]		[0.252]
Province FE		X		X		X
Country-ISIC 2-digit FE	X	X	X	X	X	X
Pseudo R2	0.1823	0.2466	0.1831	0.2467	0.1874	0.2508
Log pseudolikelihood	-2160.1	-1137.0	-2158.0	-1136.7	-2146.6	-1130.6
Impacts						
ln Imports	0.202*	0.582***	0.183*	0.373***	0.241**	0.528***
	[0.115]	[0.147]	[0.108]	[0.137]	[0.103]	[0.134]
ln Quantity	0.152	0.451**	0.102	0.128	0.212*	0.607***
	[0.128]	[0.181]	[0.131]	[0.169]	[0.124]	[0.151]
ln Price	0.05	0.132	0.08	0.245**	0.029	-0.079
	[0.080]	[0.112]	[0.083]	[0.095]	[0.079]	[0.097]
Number of obs.	7,782	4,090	7,782	4,090	7,782	4,090
Treated obs.	830	495	830	495	830	495
Control obs. (Raw)	6,952	3,595	6,952	3,595	6,952	3,595

Notes: This table reports the results of PSM. The observations are restricted to those in which the main regime was the DD in 2007 and either the DD or the RTA in 2011. Then, the treatment variable *Switch* takes the value of one if the main regime in 2011 was the RTA. The upper panel reports the estimation results for the propensity scores. The standard errors are clustered at the firm level. The results for the outcome variables are reported in the lower panel. The standard errors are the Abadie-Imbens robust errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. This table reports the results when excluding import observations from Japan.

Table B4. Effects of Switching on Imports: Excluding Outliers

	(I)	(II)	(III)	(IV)	(V)	(VI)
Logit results						
ln Total exports	-0.146***	-0.159***				
	[0.030]	[0.053]				
ln Average exports			-0.190***	-0.185***	-0.195***	-0.188***
			[0.044]	[0.066]	[0.045]	[0.065]
ln # of country-product pairs			-0.085	-0.123	-0.066	-0.065
			[0.066]	[0.093]	[0.071]	[0.103]
Share of exports to RTA members					-0.003	0.746**
					[0.238]	[0.350]
Share of imports from RTA members					0.527*	0.055
					[0.294]	[0.386]
Margin	-0.074	1.846	-0.079	1.856	-0.002	1.786
	[0.719]	[1.290]	[0.716]	[1.281]	[0.703]	[1.289]
Foreign dummy		-0.247		-0.251		-0.357
		[0.220]		[0.223]		[0.234]
Province FE		X		X		X
Country-ISIC 2-digit FE	X	X	X	X	X	X
Pseudo R2	0.1991	0.2367	0.1999	0.2369	0.2018	0.2426
Log pseudolikelihood	-2737.3	-1523.8	-2734.4	-1523.2	-2727.9	-1512.0
Impacts						
ln Imports	0.195**	0.403***	0.246***	0.410***	0.304***	0.437***
	[0.077]	[0.103]	[0.080]	[0.105]	[0.080]	[0.109]
ln Quantity	0.098	0.349***	0.173*	0.335***	0.215**	0.334**
	[0.105]	[0.123]	[0.102]	[0.131]	[0.103]	[0.143]
ln Price	0.097	0.054	0.073	0.075	0.089	0.103
	[0.073]	[0.092]	[0.068]	[0.096]	[0.075]	[0.104]
Number of obs.	12,678	6,850	12,678	6,850	12,678	6,850
Treated obs.	967	584	967	584	967	584
Control obs. (Raw)	11,711	6,266	11,711	6,266	11,711	6,266

Notes: This table reports the results of PSM. The observations are restricted to those in which the main regime was the DD in 2007 and either the DD or the RTA in 2011. Then, the treatment variable *Switch* takes the value of one if the main regime in 2011 was the RTA. The upper panel reports the estimation results for the propensity scores. The standard errors are clustered at the firm level. The results for the outcome variable are reported in the lower panel. The standard errors are the Abadie-Imbens robust errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. This table excludes the import observations from outliers in terms of import growth, that is, observations with the top 3% or bottom 3% of import growth.

Table B5. Effects of Switching on Imports and Exports: Firm-level Analyses

	(I)	(II)	(III)	(VI)
Logit results				
ln Average exports	-0.089***	-0.084**	-0.128***	-0.155***
	[0.027]	[0.042]	[0.032]	[0.047]
ln # of country-product pairs	0.151***	0.130**	0.042	0.01
	[0.040]	[0.063]	[0.046]	[0.068]
Share of exports to RTA members	-0.023	0.16	0.174	0.337
	[0.152]	[0.237]	[0.154]	[0.240]
Share of imports from RTA members	0.242	0.124	0.620***	0.326
	[0.170]	[0.255]	[0.171]	[0.257]
Foreign dummy		-0.111		-0.118
		[0.166]		[0.171]
Province FE		X		X
ISIC 2-digit FE	X	X	X	X
Pseudo R2	0.0852	0.1302	0.0901	0.138
Log pseudolikelihood	-1411.3	-674.9	-1209.4	-608.2
Impacts				
ln Exports to RTA members	0.086	0.099		
	[0.098]	[0.124]		
ln Exports to Non-members			0.127	0.113
			[0.127]	[0.191]
Number of obs.	2,606	1,250	2,180	1,124
Treated obs.	727	390	651	361
Control obs. (Raw)	1,879	860	1,529	763

Notes: This table reports the results of PSM at the firm level. The observations are restricted to those in which imports under the DD regime are larger than those under the RTA regime in 2007. Then, the treatment variable *Switch* takes the value of one if firms had larger imports under the RTA regime than those under the DD regime in 2011. The upper panel reports the estimation results for the propensity scores. The standard errors are clustered at the firm level. The results for the outcome variable are reported in the lower panel. The standard errors are the Abadie-Imbens robust errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively.

Table B6. Effects of Switching from the MFN to the RTA Regime on Imports of Parts

	(I)	(II)	(III)	(IV)	(V)	(VI)
Logit results						
ln Total exports	-0.069***	-0.017				
	[0.012]	[0.026]				
ln Average exports			0.036*	0.044	0.031	0.045
			[0.019]	[0.034]	[0.019]	[0.034]
ln # of country-product pairs			-0.218***	-0.098*	-0.200***	-0.091*
			[0.030]	[0.054]	[0.030]	[0.054]
Share of exports to RTA members					0.018	0.02
					[0.106]	[0.192]
Share of imports from RTA members					0.800***	0.525**
					[0.130]	[0.243]
Margin	3.066***	4.205***	3.312***	4.369***	3.199***	4.283***
	[0.576]	[0.997]	[0.580]	[1.012]	[0.581]	[1.015]
Foreign dummy		-0.653***		-0.624***		-0.629***
		[0.141]		[0.143]		[0.146]
Province FE	X	X			X	X
Country-ISIC 2-digit FE	X	X	X	X	X	X
Pseudo R2	0.2125	0.2286	0.2197	0.2304	0.2252	0.2324
Log pseudolikelihood	-8723.6	-2446.0	-8644.4	-2440.2	-8583.7	-2434.0
Impacts						
ln Imports	0.708***	1.073***	0.718***	1.088***	0.654***	1.038***
	[0.071]	[0.128]	[0.068]	[0.117]	[0.063]	[0.144]
ln Quantity	0.786***	1.130***	0.851***	1.261***	0.757***	1.090***
	[0.082]	[0.144]	[0.079]	[0.149]	[0.075]	[0.177]
ln Price	-0.078	-0.057	-0.132***	-0.174	-0.103**	-0.052
	[0.048]	[0.089]	[0.051]	[0.122]	[0.051]	[0.113]
Number of obs.	26,791	8,150	26,791	8,150	26,791	8,150
Treated obs.	3,878	1,071	3,878	1,071	3,878	1,071
Control obs. (Raw)	22,913	7,079	22,913	7,079	22,913	7,079

Notes: This table reports the results of the PSM at a firm-country-product-level. The observations are restricted to those in which the main regime was the MFN in 2007 and either the MFN or the RTA in 2011. Then, the treatment variable *Switch* takes the value of one if the main regime in 2011 was the RTA. The upper panel reports the estimation results for the propensity scores. The standard errors are clustered at the firm level. The results for the outcome variable are reported in the lower panel. The standard errors are the Abadie-Imbens robust errors. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. In this table, we restrict the sample only to intermediate products, which are categorized as neither 112, 122, 41, 51, 52, 61, 62, and 63 in the BEC classification.

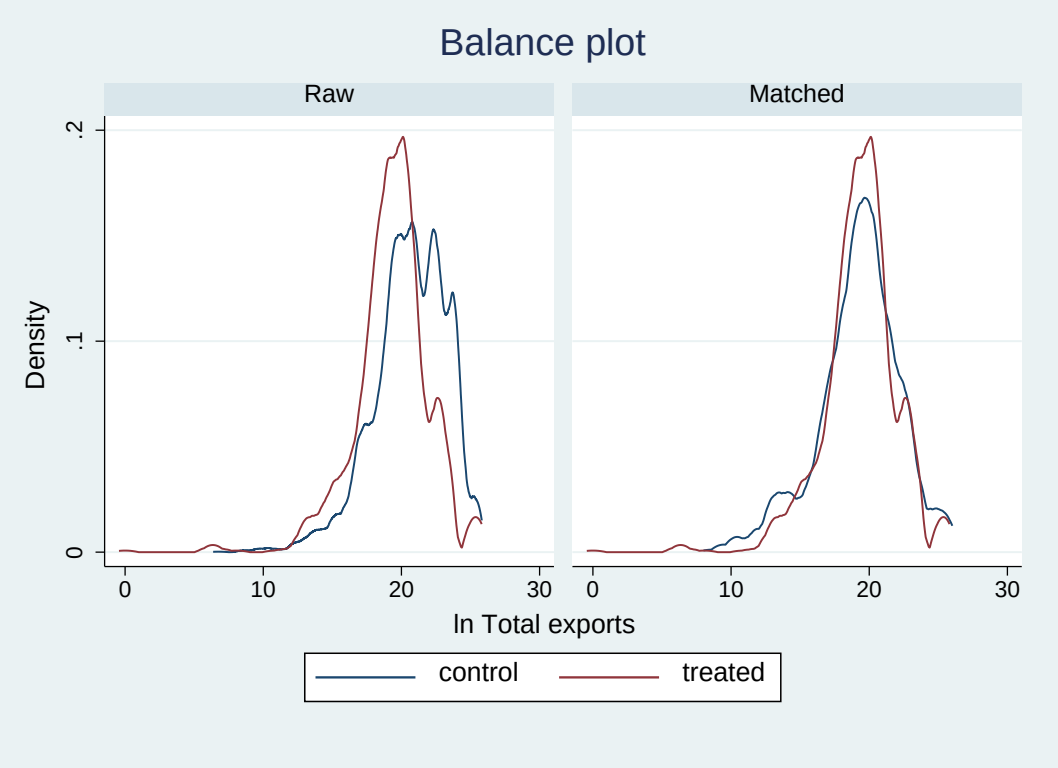
Table B7. Gravity Results using the Pseudo-Poisson Maximum Likelihood Estimator

	(I) Material	(II) Finish	(III) Material	(IV) Finish
RTA	0.081**	-0.011		
	[0.038]	[0.049]		
CU			0.150***	0.024
			[0.051]	[0.059]
FTA			0.065*	-0.049
			[0.036]	[0.045]
PSA			0.025	0.271***
			[0.070]	[0.060]
Number of observations	551,547	556,189	551,547	556,189
Log pseudolikelihood	-4.E+09	-2.E+09	-4.E+09	-2.E+09
Pseudo R-squared	0.9903	0.9928	0.9903	0.9928

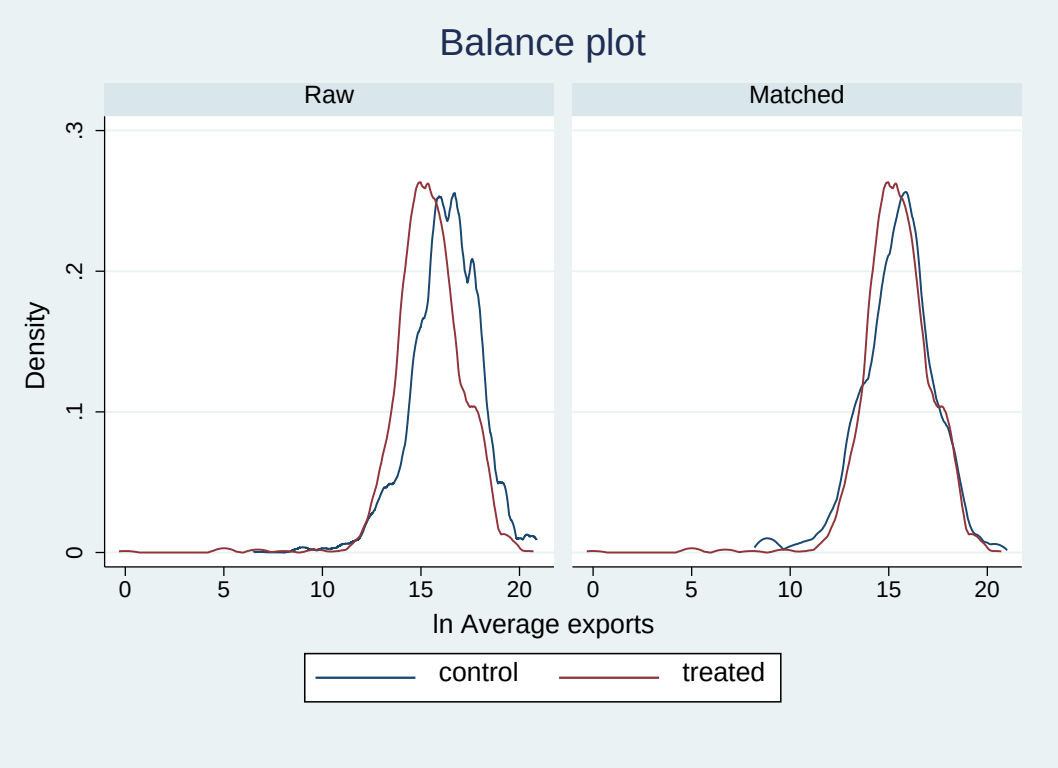
Notes: This table reports the estimation results of the gravity equations for trade among 222 countries during 1995–2017. The standard errors are clustered by country pairs. ***, **, and * indicate 1%, 5%, and 10% significance, respectively. We employ the BACI database available in the CEPII. The RTA dummy variable is drawn from Egger and Larch (2008) and its 2020 update by using RTA information available on the World Trade Organization website (Egger, Peter, & Larch, Mario, 2008, Interdependent Preferential Trade Agreement Memberships: An Empirical Analysis, *Journal of International Economics*, 76(2): 384-399). CU, FTA, and PSA take a value of 1 for trade among the members of the customs union, free trade agreement, and partial scope agreement, respectively. RTA takes a value of 1 if any of these dummy variables takes a value of 1. Finished products (*Finish*) are defined as items categorized into 112, 122, 41, 51, 52, 61, 62, or 63 in the Broad Economic Categories (BEC) classification, while the rest are intermediate products (*Material*). We also control for exporter-year fixed effects, importer-year fixed effects, and country-pair fixed effects.

Figure B1. Balance Plots

(a) Total exports: Column (I) in Table 3.



(b) Average exports: Column (III) in Table 3.



Source: Authors' compilation.