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Rules of origin and consumer-hurting free trade agreements *

Hiroshi Mukunoki[a] Hirofumi Okoshi[b]

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Abstract

This study examines how the rules of origin (RoO) of a free trade agreement (FTA) affect firms' pricing strategies. A value-added criterion (VAC) of the RoO requires firms to add more than a certain level of values within an FTA when firms use inputs originating from outside the FTA. The VAC may have a collusive effect that benefits all firms if it induces an offshoring firm to manipulate its output price. Meanwhile, a consumer-hurting FTA formation is possible even if all firms make tariff-free exports. Furthermore, such an FTA formation may worsen total welfare.

Keywords: Rules of origin; Free trade agreement; Pricing strategy

JEL classification: F13; F15; L11

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[a]Faculty of Economics, Gakushuin University, Mejiro 1-5-1, Toshima-ku, Tokyo 171-8588, Japan

[b]Corresponding author. University of Munich, Munich Graduate School of Economics, Seminar for Economic Policy, Akademiestr. 1/II, D-80799 Munich, Germany

1 Introduction

Economic integration has boosted worldwide fragmentation and resulted in increased international trade over the last few decades. During this period, export prices have increased. Based on World Bank data, Table 1 shows the transition of export unit value from 2000 to 2010 of OECD countries and BRICs.[1] Similarly, according to UNCTAD statistics, based on 2000, the unit value indexes of worldwide exports and imports were 128.7 and 126.4 in 2005, respectively. These values further increased to 161.2 and 156.7 in 2010.[2] Empirical research provides evidence of such an increase in trade prices.[3]

One of the main vehicles of economic integration is the proliferation of regional trade agreements (RTAs).[4] Understanding the effects of RTAs is an essential task for policy-makers. Although trade liberalization through RTAs seems to reduce trade costs, decrease consumer prices, and benefit consumers, the effect is not as simple as it seems.[5] For instance, some empirical studies investigating the impact of free trade agreements (FTAs) have cast a skeptical eye on the fruitfulness of trade liberalization because of rules of origin (RoO). If firms export their products by utilizing preferential tariffs in an FTA, then firms must comply with RoO and prove that the exported products are produced within the FTA. Conconi et al. (2018) showed that RoO used in the NAFTA significantly reduce imports of intermediate products from non-member countries relative to member ones, which implies there is input relocation from more efficient input production countries to less efficient ones to meet RoO. Takahashi and Urata (2010) and Hayakawa et al. (2013) found that not all firms utilize FTA tariffs owing to RoO, which indicates that the impact of forming an FTA is heterogeneous across firms and may be overestimated. Unfortunately, in spite of such practical importance, the complexity of RoO makes it difficult to conduct

[1] See https://data.worldbank.org/indicator/TX.UVI.MRCH.XD.WD

[2] See http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=16421

[3] Recent studies have found that the increase in trade prices is motivated by quality upgrading. For example, see Amiti and Khandelwal (2013) for export data to the U.S., Bas and Strauss-Kahn (2015) and Fan et al. (2015) for Chinese data, and Flach (2016) for Brazilian data.

[4] As of May 2018, 287 RTAs were in force. The number of cumulative notifications of RTAs in 2000, 2005, and 2010 were 94, 180, and 309, respectively. See http://rtais.wto.org/UI/charts.aspx

[5] Goldberg and Pavcnik (2016, p. 164) pointed out that '*the world may not be as liberalized as it seems and that failure to document significant effects of trade policies may instead be due to measurement and identification challenges rather than the absence of such effects*.' Thus, identifying the impact of trade policy correctly remains challenging work for researchers and further appropriate research on RTAs is necessary.

empirical research on the impact of RoO so that little empirical investigation has been undertaken.[6]

Country	2005	2010	Country	2005	2010
Australia	152.91	258.61	Lithuania	131.98	168.85
Austria	139.92	163.53	Luxembourg	122.83	131.62
Belgium	144.07	168.80	Mexico	126.88	151.06
Canada	127.15	153.15	Netherlands	133.22	160.01
Chile	155.68	255.72	New Zealand	139.63	173.36
Czech Republic	152.49	183.29	Norway	161.58	215.83
Denmark	141.37	160.97	Poland	149.17	180.62
Estonia	112.85	135.28	Portugal	135.04	161.41
Finland	133.88	161.14	Slovak Republic	155.82	167.78
France	142.34	171.49	Slovenia	136.15	160.49
Germany	137.73	162.15	Spain	145.93	176.15
Greece	130.89	171.92	Sweden	134.26	159.61
Hungary	130.67	148.68	Switzerland	139.94	189.20
Iceland	131.66	144.12	Turkey	133.26	155.68
Ireland	129.51	140.75	United Kingdom	141.33	174.00
Israel	114.40	140.58	United States	106.87	123.12
Italy	148.71	185.04	Brazil	120.06	197.06
Japan	109.06	137.67	China	107.80	122.58
Korea, Rep.	97.58	95.80	India	124.34	159.53
Latvia	137.30	172.44	Russian Federation	158.36	229.11

Source: World Bank data (*The base year is 2000.*)

Table 1: Transition of export unit value

This study examines how RoO affect firms' incentives to set the prices of final goods in an oligopoly model with one input offshoring firm and one firm using inputs produced inside the FTA. Among several methods to check the origin of products, the valued-added criterion (VAC) is the focus of this study. Let p denote the export value of the product and c denote the value of input materials not originating in the FTA; then, the VAC typically requires that the value-added ratio, $\frac{p-c}{p}$, is larger than the specified level. This method of calculating the value-added content is called the "transaction value method." Estevadeordal and Suominen (2003) reported that among 87 FTAs they analysed, 68 FTAs employed this method, at least in a particular product category. Because the value-added ratio is associated with an exporting firm's pricing as well as its input sourcing, the VAC can be a

[6]Research analysing the impact of RoO on prices includes Cadot et al. (2005) and Hayakawa et al. (2019). Cadot et al. (2005) found that RoO has a price-increasing effect while the latter showed insignificant effects. However, they did not consider the VAC method.

commitment device to increase output price.

We demonstrate that there is a case in which an FTA formation with RoO increases prices of all goods, even when all firms export tariff-free products within the FTA. This result provides rationale for the current two trends described above. This is because a firm that uses inputs outside the FTA has an incentive to increase its product price to comply with the VAC of RoO. In other words, the firm can credibly commit to set high export prices with RoO. In response, the other exporting firm, which is a rival in the product market, also increases its export price. Because of this collusive effect, more stringent RoO can benefit all firms. If the induced increases in export prices outweigh the tariff-elimination effect that should reduce the consumer price, the FTA formation hurts consumers even though tariffs against all firms are eliminated in equilibrium. Furthermore, such stringent RoO may make an FTA formation welfare reducing for inside countries even compared to welfare before the FTA.

Extant theoretical studies have focused on how RoO change input sourcing (Ju and Krishna, 2005), the degree of market integration inside an FTA (Ishikawa et al., 2007), and the patterns of foreign direct investment (Mukunoki, 2017). Jinji and Mizoguchi (2016a,b) have analysed the optimal choice of RoO. However, these studies have not considered price manipulation to comply with RoO. The closest research to the current study is another paper of ours, Mukunoki and Okoshi (2019), which focuses on transfer-price manipulation of a multinational firm for complying with the VAC of RoO. Mukunoki and Okoshi (2019) complements the current study in that both focus on different levels of price manipulations.

The rest of the paper is organized as follows. The next section introduces our model and derives the optimal strategy of firms. The welfare impacts are scrutinized in the 3rd section. Section 4 concludes.

2 Model

Two firms (I and O) produce differentiated products only in a home country (H) and sell them in a foreign country (F).[7] Countries H and F are potential FTA partners.

[7]Even if we consider the market in country H, the qualitative nature of our results remains unchanged, as long as the two markets are segmented and firms can make independent decisions in each market.

The production of final products requires inputs made either in country H or in countries outside the two countries. One unit of inputs is transformed into one unit of output at constant marginal cost, which is normalized to 0. The input market is under perfect competition and the prices of the "inside inputs" produced in country H are given by c, while the prices of the "outside inputs" produced outside the two countries are lower, given by $c - \Delta$ ($\Delta \in (0, c)$). We assume that only firm O is an offshoring firm, which can use inputs imported from outside the two countries. Firm I always uses the inputs produced in country H, because the firm lacks knowledge about foreign input markets and it cannot cover the cost of searching for appropriate suppliers and matching with them.

The indirect utility of the representative consumer in country F is $V(p_I, p_O) = \bar{V} - a(p_I + p_O) + \frac{(p_I)^2 + (p_O)^2}{2} - bp_I p_O + Y$, where $\bar{V}$ is a positive constant, p_i is the price of product i manufactured by firm $i \in \{I, O\}$, b is the degree of substitutability of products, and Y is the consumption of the numéraire good. The utility maximization yields

$$x_i = a - p_i + bp_j, \tag{1}$$

where x_i is the demand for product i in country F, and $j \in \{I, O\}$ $(j \neq i)$.

A specific import tariff, τ, is imposed on both products by country F. There are no tariffs on inputs. The FTA formation removes τ, but zero tariff is applied only if firms comply with RoO. Firm O may use the local inputs to meet the RoO and thus, its marginal cost is either c or $c - \Delta$. Firm i's profit is given by

$$\Pi_i = (p_i - c_i - \lambda_i \tau) x_i, \tag{2}$$

where $c_I = c$ and $c_O \in \{c, c - \Delta\}$. λ_i is an index that takes zero if firm i meets the RoO after an FTA formation and takes one otherwise.

For the RoO, we consider that a VAC that requires the firms to add at least $\underline{\alpha}$ fraction of values of the exported products within the FTA countries. Since firm I never uses the imported inputs, it always meets the VAC upon the FTA formation and enjoys tariff-free access to country F. However, firm O needs to use either (i) the local inputs or (ii) the

outside inputs, and sets its export price such that the following is satisfied:

$$\alpha\left(p_O\right) \equiv \frac{p_O - (c - \Delta)}{p_O} \geq \underline{\alpha}. \tag{3}$$

Since $\alpha\left(p_O\right)$ increases with p_O, even if firm O procures the outside inputs, $\alpha(p_O)$ exceeds the required level ($\underline{\alpha}$) if p_O is high enough.

Equilibrium

Given that (3) is not binding, the equilibrium price of good i is obtained by maximizing (2):

$$\tilde{p}_i = \frac{(2+b)\,a + 2c_i + bc_j + \left(2\lambda_i + b\lambda_j\right)\tau}{4 - b^2} \quad (j \neq i). \tag{4}$$

The equilibrium sales of good i are $\widetilde{x}_i$ and the equilibrium profit and consumer surplus become $\widetilde{\Pi}_i = \left(\widetilde{x}_i\right)^2$ and $\widetilde{CS} = V(\widetilde{p}_I, \widetilde{p}_O) - Y$, respectively. By (4), we can characterize the equilibrium in the following regimes.

- No Agreement (N): Before the FTA formation, a tariff is imposed on both goods ($\lambda_I = \lambda_O = 1$). Firm O uses the outside inputs, $c_O = c - \Delta$. By substituting these parameters into (4), we obtain the equilibrium prices denoted as p_i^N.

- Non-compliance (NC): After the FTA formation, firm O uses the outside input and the tariff is imposed only on firm O's product. By substituting $\lambda_I = 0$, $\lambda_O = 1$, and $c_O = c - \Delta$ into (4), the equilibrium price becomes p_i^{NC}. If τ satisfies $\tau \geq \tau^{exit} \equiv \frac{(2+b)(a-c+bc)}{2-b^2}$, firm O exits the market.

- Input relocation (IR): After the FTA formation, firm O uses the inside inputs to comply with the RoO. With $\lambda_I = \lambda_O = 0$ and $c_O = c$ in (4), the equilibrium price is p_i^{IR}.

Alternatively, suppose that firm O uses the outside inputs ($c_O = c - \Delta$) after the FTA formation and still complies with the RoO. There are two sub-cases.

- Unbinding RoO (UB): Both firms set the unconstrained, optimal prices p_i^{UB} given by substituting $c_O = c - \Delta$ and $\lambda_I = \lambda_O = 0$ into (4). The VAC is unbinding if

$$\alpha(p_O^{UB}) = \frac{p_O^{UB} - (c - \Delta)}{p_O^{UB}} = \frac{(2+b)(a - c + bc) + (2 - b^2)\Delta}{(2+b)(a+c) - 2\Delta} \equiv \alpha^{UB} \geq \underline{\alpha} \tag{5}$$

  holds.

- Binding RoO (B): If $\alpha^{UB} < \underline{\alpha}$ holds, the RoO are binding and firm O sets the price, p_O^B, such that $\alpha\left(p_O^B\right) = \underline{\alpha}$ is satisfied. The equilibrium prices become

$$p_O^B = \frac{(c - \Delta)}{(1 - \underline{\alpha})} \text{ and } p_I^B = \frac{(a+c)}{2} + \frac{b(c - \Delta)}{2(1 - \underline{\alpha})}. \tag{6}$$

  If $\underline{\alpha}$ is high enough to satisfy $\alpha^{exit} \equiv \frac{(2+b)(a-c+bc)+(2-b^2)\Delta}{(2+b)a+bc}$, then firm O exits the market, where $\underline{\alpha}^{UB} < \alpha^{exit}$ holds.

The profits and the consumer surplus under regime $\omega \in \{N, NC, IR, UB, B\}$ are given by Π_i^ω and CS^ω, respectively. The total welfare of member countries is given by $W^\omega \equiv CS^\omega + \Pi_O^\omega + \Pi_I^\omega + TR^\omega$, where TR^ω is tariff revenue under Regime ω.

Firm's choices of FTA use and input relocation

When the RoO are unbinding ($\underline{\alpha} \leq \alpha^{UB}$), $\Pi_O^{UB} > \max[\Pi_O^{NC}, \Pi_O^{IR}]$ holds. Thus, firm O always chooses UB and both firms use the FTA without changing their pricing and sourcing strategies. The FTA formation lowers the prices of all goods and benefits consumers and all firms.

However, when the RoO are binding ($\underline{\alpha} > \alpha^{UB}$), firm O chooses among NC, IR, and B. We confirm that $\Pi_O^{NC} \geq \Pi_O^{IR}$ holds if $\tau \leq \Delta$ while $\Pi_O^{IR} > \Pi_O^{NC}$ holds if $\tau > \Delta$.[8] When the tariff that is eliminated by complying with RoO is lower than the additional marginal cost from input relocation, firm O prefers NC to IR, and vice versa.

We confirm that Π_O^B takes an inverse U-shaped form in $\underline{\alpha} \in [\alpha^{UB}, \alpha^{exit}]$. Specifically, $\Pi_O^B = \Pi_O^{UB}$ at $\underline{\alpha} = \alpha^{UB}$, Π_O^B takes the maximum at $\underline{\alpha} = \alpha^{\max} \equiv \frac{(2+b)a+bc-\left(2-b^2\right)(c-\Delta)}{(2+b)a+bc+(2-b^2)(c-\Delta)}$ and

[8] Given $\tau < \tau^{exit}$ such that $\Pi_O^{NC} > 0$, $\Pi_O^{NC} - \Pi_O^{IR} = (\Delta - \tau)\left(2 - b^2\right)^2 (2\tau^{exit} - \tau + \Delta)$. This means that $\Pi_O^{NC} \gtreqless \Pi_O^{IR} \Longleftrightarrow \Delta \gtreqless \tau$.

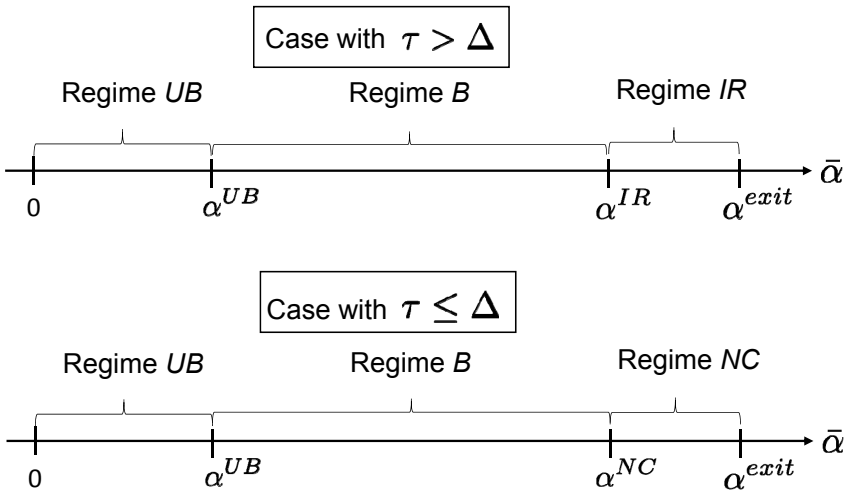

Figure 1: RoO and Equilibrium Regime

$\Pi_O^B = 0$ at $\underline{\alpha} = \alpha^{exit}$. This result implies that there is a unique cut-off level of the VAC, α^{NC}, such that $\Pi_O^B > \Pi_O^{NC}$ holds with $\alpha^{UB} < \underline{\alpha} < \alpha^{NC}$ and $\Pi_O^{NC} \geq \Pi_O^B$ with $\alpha^{NC} \leq \underline{\alpha}$. Similarly, there is a unique cut-off level, α^{IR}, such that $\Pi_O^B > \Pi_O^{IR}$ holds with $\alpha^{UB} < \underline{\alpha} < \alpha^{IR}$ and $\Pi_O^{IR} \geq \Pi_O^B$ with $\alpha^{IR} \leq \underline{\alpha}$. Note that $\alpha^{IR} < \alpha^{NC}$ holds if $\tau > \Delta$ holds and $\alpha^{NC} \leq \alpha^{IR}$ otherwise. The following proposition summarizes the choice of firm O.

Proposition 1. After an FTA formation, (i) the RoO are unbinding (Regime UB) if $\underline{\alpha} \leq \alpha^{UB}$ holds; (ii) firm O complies with the RoO with price manipulation (Regime B) if $\alpha^{UB} < \underline{\alpha} < \min[\alpha^{NC}, \alpha^{IR}]$ holds; (iii) firm O complies with the RoO with input relocation (Regime IR) if $\Delta \leq \tau$ and $\alpha^{NC} \leq \underline{\alpha}$ hold; and (iv) firm O does not comply with the RoO (Regime NC) if $\Delta > \tau$ and $\alpha^{IR} \leq \underline{\alpha}$ hold.

The equilibrium choice presented in Proposition 1 is depicted in Figure 1

3 Profit-enhancing RoO and consumer-hurting FTA

In the previous section, we characterize which regime becomes the equilibrium outcome. Here, we discuss the welfare effect of forming an FTA and how it is related to the stringency of RoO. In line with traditional models, it is easily confirmed that the total welfare of member countries is improved when RoO changes neither firm O's pricing nor its input

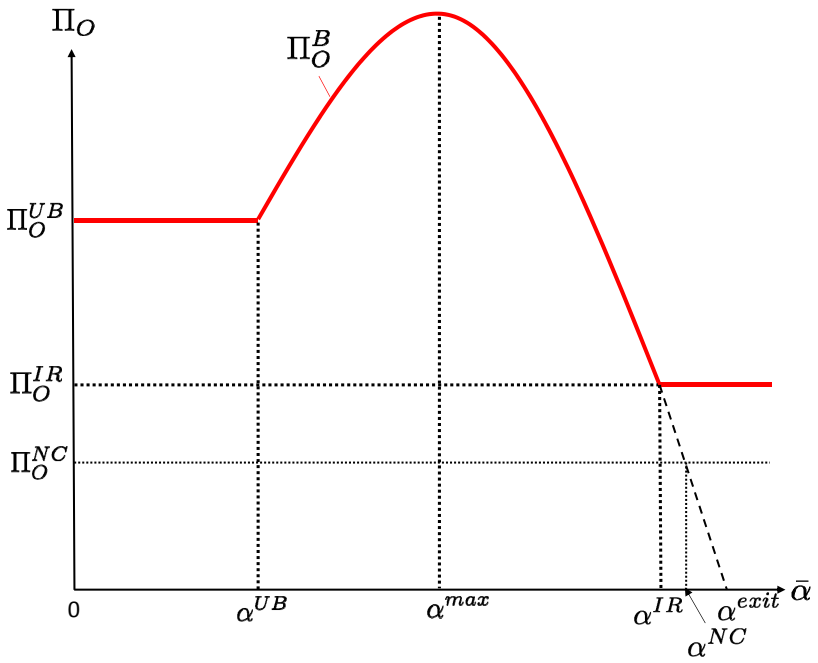

Figure 2: RoO and Profit of Firm O

sourcing. Thus, an FTA formation always improves total welfare inside the FTA if the post-FTA equilibrium regime is Regime UB. However, as analysed, a stricter VAC of RoO can influence firm O's pricing or input sourcing.

Under regime B in Figure 1, firm O sets the price to satisfy the VAC, regardless of how firm I sets the price of its product, and the price is higher than p_O^{UB}. Then, firm I's optimal reaction is to raise its own price. If $\underline{\alpha}$ is not so high, these increases in prices raise the profits of both firms.

Proposition 2. Under Regime B, the profits of all firms increase as the VAC becomes more stringent for $\underline{\alpha} \in [\alpha^{UB}, \alpha^{\max})$.

In other words, the RoO become a commitment device for firms to weaken price competition. If $\underline{\alpha}$ is very high, however, the price increase is too large for firm O and its profit falls below Π_O^{UB}. In other words, firm O's profits appears inverse U-shaped, which is shown in Figure 2 in the case of $\Delta \leq \tau$.

Moreover, the price-increasing effect of binding RoO substantially changes the effects of

an FTA formation. Under non-binding RoO, input relocation, or non-compliance, an FTA formation decreases prices and benefits consumers and firms that use the FTA. However, the price-increasing effect of the RoO might overturn the positive effect for consumers, as the following proposition states (the proof is in the Appendix).

Proposition 3. When the post-FTA equilibrium regime is Regime B, there exists a unique cut-off level of the VAC, α_B^*, such that an FTA formation raises the prices of all goods, benefits all firms, and hurts consumers for $\underline{\alpha} > \alpha_B^*$, even though all imports become tariff free with the FTA.

From proposition 3, the overall impact of FTA formation that leads to Regime B on total welfare is not obvious, and reduces overall welfare of member countries with $\underline{\alpha} > \alpha_B^*$, even though all imports become tariff free. Even if $\underline{\alpha} < \alpha_B^*$ holds and the FTA formation decreases the price of good I, it can reduce overall welfare, because the negative effect of an increase in the price of good O can dominate the positive effect of a decrease in the price of good I. Since we confirm that $\frac{\partial W^B}{\partial \underline{\alpha}} < 0$ holds, $W^B < W^N$ at $\underline{\alpha} = \alpha_B^*$ means that there is a cut-off level of the VAC, α_B^W ($< \alpha_B^*$), such that $W^B < W^N$ if and only if $\underline{\alpha} > \alpha_B^W$ holds under Regime B. The level of α_B^W is depicted in Figure 3 in the case of $\Delta \leq \tau$.[9,10]

In an extreme case $b = 0$, there are no interactions between firms. In this case, an increase in p_O does not affect the equilibrium level of p_I and an FTA formation worsens welfare only if $\underline{\alpha}$ is sufficiently large (shaded area of Regime B in Figure 3). As b becomes higher, an increase in p_O has a more collusive effect in the sense that it increases the equilibrium level of p_I more, and an FTA formation is more likely to be welfare reducing. The following proposition summarizes the welfare effect when the post-FTA regime is Regime B.

Proposition 4. When the post-FTA equilibrium regime is Regime B, there exists a unique cut-off level of the VAC, α_B^W, such that an FTA formation worsens total welfare if $\alpha_B^W < \underline{\alpha} < \min[\alpha^{NC}, \alpha^{IR}]$ holds.

[9] From eq. (5), $\frac{\partial \underline{\alpha}^{UB}}{\partial b} > 0$ is obtained. Furthermore, $\frac{\partial \tilde{\Pi}_O^{\omega}}{\partial b} > 0$ and $\frac{\partial^2 \tilde{\Pi}_O^B}{\partial \underline{\alpha} \partial b} > 0$ implies $\underline{\alpha}^*$ is increasing in b.

[10] We confirm that $\frac{\partial^2 \Pi_O^B}{(\partial \underline{\alpha})^2} < 0$ holds for $\underline{\alpha} \in [\underline{\alpha}^{UB}, \underline{\alpha}^{exit}]$, where $\frac{\partial \Pi_O^B}{\partial \underline{\alpha}} > 0$ at $\underline{\alpha} = \underline{\alpha}^{UB}$ and $\frac{\partial \Pi_O^B}{\partial \underline{\alpha}} < 0$ at $\underline{\alpha} = \underline{\alpha}^{exit}$. The detailed calculation is available upon request.

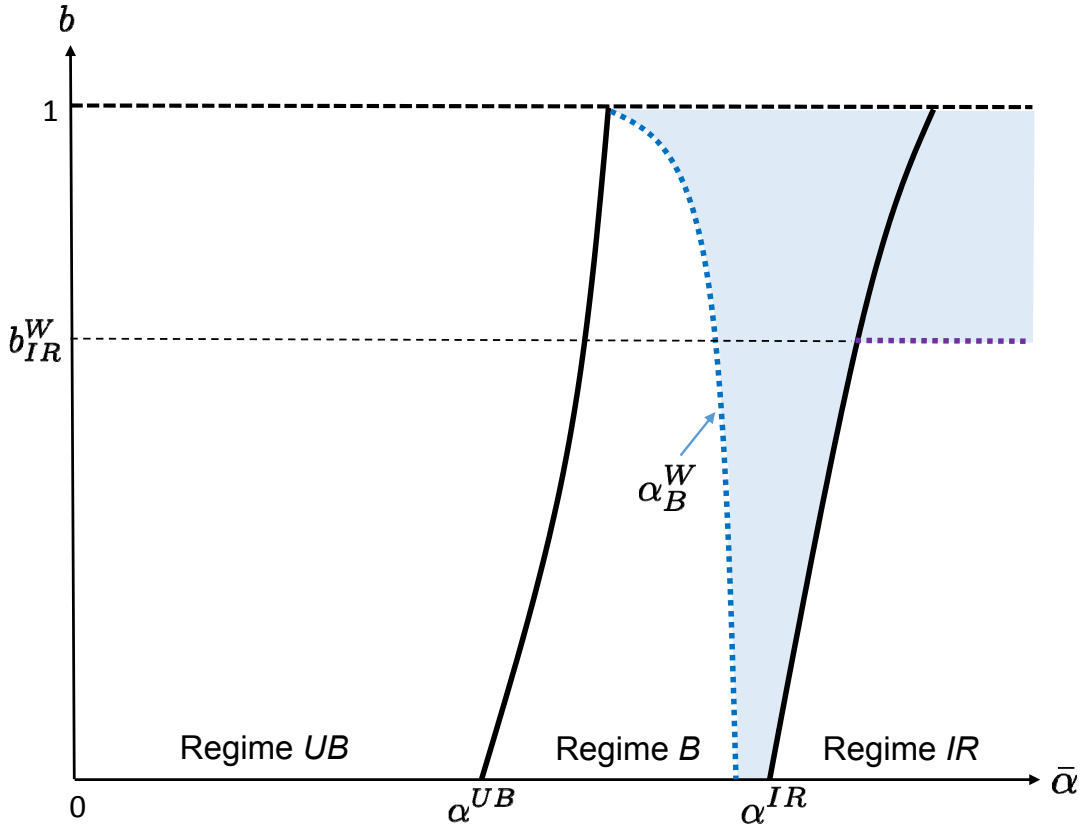

Figure 3: RoO and Welfare

We should also note that even if the post-FTA equilibrium regime is either Regime IR or Regime NC, an FTA formation may worsen welfare. Regime IR has a similar threshold b_{IR}^W such that the FTA worsens the total welfare if $b \in (b_{IR}^W, 1]$. This area is depicted in Figure 3 as the shaded area in Regime IR.[11] If τ is only slightly greater than Δ, then the FTA formation is always harmful for the member countries (see the proof of Proposition 5 for details). This is because that input relocation increases the marginal cost of production of firm O with limited declines in consumer prices. Therefore, an FTA that leads to Regime IR results in welfare reduction.

Proposition 5. When the post-FTA equilibrium regime is Regime IR, if the initial tariff level is large, there exists a unique cut-off level of b, $b_{IR}^W (\in (0,1))$, such that an FTA formation worsens total welfare if $b \in (b_{IR}^W, 1)$ holds. If the initial tariff level is small, the FTA formation always worsens total welfare.

[11] $\frac{\partial^2 (W^{IR} - W^N)}{(\partial b)^2} < 0$ and $(W^{IR} - W^N)|_{b=1} < 0$ always hold and $(W^{IR} - W^N)|_{b=0} > 0$ also holds if $\tau \geq \sqrt{\{2(a-c)+\Delta\}\{2(a-c)+7\Delta\}} - \{2(a-c)+\Delta\} > 0$.

Similarly, if the post-FTA equilibrium outcome is Regime NC, there also exists a unique level of the substitutability of product, b^W_{NC}, such that an FTA formation reduces total welfare for $b \in (b^W_{NC}, 1]$.[12] In Regime NC, the production cost of firm O is lower than that of firm I. Since the tariff is eliminated only for good I in this regime, the production and exports of good O decrease while those of good I increase. This "trade diversion" effect causes inefficiency and an FTA can be welfare reducing. As the two goods become closer substitutes, the substitution effect between the two goods becomes larger and an FTA that leads to Regime NC is more likely to become welfare reducing.

Proposition 6. When the post-FTA equilibrium regime is Regime NC, there exists a unique cut-off level of b, $b^W_{NC}(\in (0,1))$, such that an FTA formation worsens total welfare if $b \in (b^W_{NC}, 1)$ holds.

4 Conclusion

This study has revisited the welfare effects of an FTA when exporting firms must meet a VAC to comply with RoO. When the value-added threshold is neither very low nor very high, a firm manipulates its output price to satisfy the VAC. In this case, RoO soften product market competition and the resulting increase in prices can hurt consumers but benefit firms. Because of this collusive effect, an FTA formation with RoO might hurt consumers, even though all trade within the FTA is tariff free. Moreover, the total impact of the conflicting effects may be negative if the required threshold is sufficiently high. Furthermore, even if all firms keep the input procurement from efficient countries and enjoy tariff-free trade, the similarity of goods and the degree of restriction of the VAC play core roles in explaining whether the FTA is harmful or not.

These results suggest that a VAC can transform a consumer-benefiting (or welfare-improving) FTA into a consumer-hurting (or welfare-reducing) FTA. RoO of FTAs should be designed such that they do not produce a collusive effect. One policy option is to employ the net-cost method, by which a calculation of the value-added ratio is unrelated to output prices.

[12] $\frac{\partial^2 (W^{NC} - W^N)}{(\partial b)^2} < 0$, $(W^{NC} - W^N)|_{b=0} > 0$ and $(W^{NC} - W^N)|_{b=1} < 0$ show this uniqueness.

There is room for further research. This study has assumed that the prices of inputs are exogenously given, but it would be interesting to consider how the VAC changes input prices. Another possible extension is to consider firms' location choices between inside and outside the FTA. The development of empirical analysis is left as the most important future task.

Appendixes

Proofs

Proof of Proposition 3

By (6), both p_O^B and p_I^B are increasing in $\underline{\alpha}$, while p_O^N and p_I^N are independent of $\underline{\alpha}$. We have

$$\begin{aligned} p_O^B - p_O^N &= \frac{\left(4-b^2\right)(c-\Delta) - (1-\underline{\alpha})\left\{(2+b)(a+\tau)+2(c-\Delta)+bc\right\}}{\left(4-b^2\right)(1-\alpha)}, \\ p_I^B - p_I^N &= \frac{b\left(4-b^2\right)(c-\Delta) - (1-\underline{\alpha})\left\{(2+b)(ab+2\tau)+2b(c-\Delta)+b^2c\right\}}{2\left(4-b^2\right)(1-\alpha)}. \end{aligned}$$

By these equations, $p_O^B > p_O^N$ and $p_I^B > p_I^N$ hold if and only if

$$\begin{aligned} \alpha > \alpha' &\equiv 1 - \frac{\left(4-b^2\right)(c-\Delta)}{(2+b)(a+\tau)+2(c-\Delta)+bc} \text{ and} \\ \alpha > \alpha_B^* &\equiv 1 - \frac{b\left(4-b^2\right)(c-\Delta)}{(2+b)(ab+2\tau)+2b(c-\Delta)+b^2c} \end{aligned}$$

hold, respectively.

Since we have $\alpha_B^* - \alpha' = \frac{\left(4-b^2\right)(c-\Delta)\tau}{\{(2+b)(a+\tau)+2(c-\Delta)+bc\}\{(2+b)(ab+2\tau)+2b(c-\Delta)+b^2c\}} > 0$, both $p_O^B > p_O^N$ and $p_I^B > p_I^N$ hold if and only if $\alpha > \alpha_B^*$ holds. There is a case where this cutoff level, α_B^*, satisfies $\alpha_B^* < \min[\alpha^{NC}, \alpha^{IR}]$, implying that the price-increasing FTA when Regime B becomes the equilibrium outcome. For instance, we know that $\alpha^{\max}$ always satisfies $\alpha^{UB} < \alpha^{\max} < \min[\alpha^{NC}, \alpha^{IR}]$. If we compare α_B^* and $\alpha^{\max}$, we have

$$\alpha^{\max} - \alpha_B^* = \frac{b^3\{(2+b)a+bc-(2-b^2)(c-\Delta)\} - 4(2+b)(2-b^2)\tau}{\{(2+b)(ab+2\tau)+2b(c-\Delta)+b^2c\}\{(2+b)a+bc+(2-b^2)(c-\Delta)\}}.$$

Thus, as long as the tariff satisfies $\tau < \frac{b^3\{(2+b)a+bc-(2-b^2)(c-\Delta)\}}{4(2+b)(2-b^2)}$, $\alpha^{\max} > \alpha_B^*$ holds and we have $\alpha_B^* < \min[\alpha^{NC}, \alpha^{IR}]$ because $\alpha^{\max} < \min[\alpha^{NC}, \alpha^{IR}]$ always holds. ■

Proof of proposition 5

The welfare comparison between regime IR and N yields:

$$W^{IR} - W^N = \frac{2(1-b)(2+b)^2\Xi - \Delta\{2a(2+b)^2(3-2b) + (12-9b^2+2b^4)\Delta\}}{2(2-b)^2(2+b)^2}.$$

where $\Xi \equiv \tau^2 + \{2(a-c+bc) + \Delta(1-b)\}\tau + \Delta(3-2b)c$. We can confirm that

$$\begin{aligned}
(W^{IR} - W^N)|_{b=0} &= \frac{2(\tau-\Delta)\{2(a-c)+\tau+\Delta\} - \Delta\{2(a-c)+\Delta-2\tau\}}{8}, \\
(W^{IR} - W^N)|_{b=1} &= \frac{-\Delta(18a+5\Delta)}{18} < 0, \text{and} \\
\frac{\partial^2(W^{IR} - W^N)}{(\partial b)^2} &= \frac{-2(1+b)(2+b)^4\tau^2 + \Phi}{(2-b)^4(2+b)^4} < 0,
\end{aligned}$$

where $\Phi \equiv -2\tau\{2b^2(2b^3+15b^2+40b+40)c + 32(a-c) + (a-\Delta)b^2(2b^3+15b^2+20b+20)\} - 2\Delta\{3c(16+16b-8b^2-16b^3-7b^4-b^5) + 6b^2(7b^2+8) + 16(a-\Delta)\} + \tau\{-12\Delta(\tau-\Delta) - 20\Delta\tau - 6ab^2\tau(b^2+8b+24)\} - 2ab\{96\tau - (40b+40b^2+15b^3+2b^4)\Delta\} < 0 \quad (\because \tau > \Delta)$.

The sign of $(W^{IR} - W^N)|_{b=0}$ is ambiguous, and it is increasing in τ. $(W^{IR} - W^N)|_{b=0} > 0$ holds if and only if $\tilde{\tau} \equiv \sqrt{\{2(a-c)+\Delta\}\{2(a-c)+7\Delta\}} - \{2(a-c)+\Delta\} < \tau$ holds. In this case, there exists a unique level of b, $b_{IR}^W \in (0,1)$, such that $W^{IR} > W^N$ holds for $b < b_{IR}^W$, $W^{IR} = W^N$ holds at $b = b_{IR}^W$, and $W^{IR} < W^N$ holds for $b > b_{IR}^W$.

Besides that, $\frac{\partial W^{IR} - W^N}{\partial b}|_{b=0} \geq 0$ holds if and only if

$$\hat{\tau} \equiv \frac{\Delta(a+2c)}{2c-\Delta} < \tau$$

By substituting $\tau = \hat{\tau}$ into $(W^{IR} - W^N)|_{b=0}$, we get

$$(W^{IR} - W^N)|_{\tau=\hat{\tau},\ b=0} = \frac{\Delta\{2(4c-\Delta)a^2 - 8(2c^2-4\Delta+\Delta^2)a + 8c^2 - 12\Delta c^2 + 14\Delta^2 c - 3\Delta^3\}}{8(2c-\Delta)^2},$$

which takes minimum at $a = \tilde{a} \equiv \frac{2(c^2-4\Delta c+\Delta^2)}{4c-\Delta}$ and the minimum level is given by $(W^{IR} -$

$W^N)|_{\tau=\hat{\tau},\ b=0,\ a=\tilde{a}} = \frac{\Delta(2c-\Delta)^2(18c-5\Delta)}{4c-\Delta} > 0$. This implies that $\tilde{\tau} < \hat{\tau}$ and $\frac{\partial W^{IR}-W^N}{\partial b}|_{b=0} < 0$ whenever $(W^{IR} - W^N)|_{b=0} < 0$ holds. Therefore, if $\tau \leq \tilde{\tau}$ holds, we have $W^{IR} \leq W^N$ for any $b \in [0,1)$. ■

Proof of proposition 6

The welfare gains from FTA formation under regime NC is computed as;

$$W^{NC} - W^N = \frac{\tau[2\{(4-3b^2-b^3)a - 2(2-b^2)b\Delta\} - 2(1-b)^2(2+b)^2c + (4-3b^2-2b^3)\tau]}{(2-b)^2}.$$

We have

$$\begin{aligned}
(W^{NC} - W^N)|_{b=0} &= \frac{[2(a-c)+\tau]\tau}{8} > 0, \\
(W^{NC} - W^N)|_{b=1} &= -\frac{(4\Delta+\tau)\tau}{18} < 0, \text{and} \\
\frac{\partial^2(W^{NC} - W^N)}{(\partial b)^2} &= -\frac{\Theta\tau}{(2-b)^4(2+b)^4} < 0,
\end{aligned}$$

where $\Theta \equiv (2b^5+9b^4+64b^3+56b^2+96b+16)\tau + (4b^3+30b^2+86b+80)b^2c + 32(a-c) + 2b\{(48+56b+32b^2+9b^3+b^4)a - 2(20+b^2)b^2\Delta\} > 0$. Thus, there exists a unique cut-off level of b, $b^W_{NC} \in (0,1)$, such that $W^{NC} > W^N$ holds for $b < b^W_{NC}$, $W^{NC} = W^N$ holds at $b = b^W_{NC}$, and $W^{NC} < W^N$ holds for $b > b^W_{NC}$. ■

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