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A Political Economy Analysis of Rules of Origin Requirements of Korea-US FTA with a New Measure of the Requirements

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Our paper contributes to the literature on the rules of origin (ROO) requirements of regional trade agreements by developing a new measure of ROO requirements and by modifying and testing an existing political economy model of ROO requirements with the data of the Korea-United States Free Trade Agreement (KORUS FTA). In explaining the utilization rates of KORUS FTA, Bindingness Index, the new measure of ROO requirements taking the status quo local content of a product into consideration, performs better than the existing measure proposed by Estevadeordal (2000). To reflect that the US has agreed to immediate and complete liberalization on most products in KORUS FTA, we modify the political economy model of ROO requirements of Cadot et al. (2006) by assuming that the preferential tariff rates are zero. This modification leads to testable predictions, some of which differs from the prediction of Cadot et al. (2006), and our empirical analysis supports the predictions of our modified political economy model.

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I. Introduction

In response to proliferation of regional trade agreements (RTAs) intensified since the early 1990s, numerous studies investigated the causes and effects of such proliferation both theoretically and empirically.[1] Most of these works largely focus

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[1] Freund and Ornelas (2010) provide a survey of the literature on RTAs.

on elimination of restrictive measures on trade between members of RTAs in their analysis, leaving rules of origin (ROO) requirements of RTAs as a relatively less explored subject.[2] Our paper contributes this relatively small but growing literature on ROO requirements of RTAs by developing a new measure of strictness of ROO requirements and testing a political economy model of ROO determination with the data of Korea-US Free Trade Agreement (KORUS FTA).

ROO requirements specify the conditions for products to receive preferential treatments under RTAs. Because ROO requirements take various forms across products even within one RTA, developing a measure of strictness of ROO requirements is not a trivial task. For example, North American Free Trade Agreements (NAFTA) utilizes three distinctive ways to define ROO requirements: a change in tariff classification, requiring the product to change its tariff heading under the Harmonized Commodity Description System in the originating country; a domestic content rule or regional value contents, requiring a minimum percentage of local value added in the originating country; a technical requirement, prescribing that the product must go through specific manufacturing process operations in the originating country. For the empirical analysis of ROO requirements of NAFTA, Estevadeordal (2000) develops an index to measure the strictness of ROO requirements in a manner that is comparable across products. Using the fact that most ROO requirements are expressed as a required change in tariff heading at various levels of aggregation, Estevadeordal's index takes values that increases in the level of aggregation of the required change, the idea being that a change at a more aggregate level requires a more stringent transformation.

Estevadeordal's index, however, ignores the status-quo local content of a product in measuring the restrictiveness of a ROO requirement for a preferential treatment under a RTA. Consider a Estevadeordal's index for an agricultural good, which is typically higher than the one for an electronic product. A higher index value for an agricultural good does not necessarily imply that its ROO requirement is more stringent, thus harder to satisfy than the one for an electronic product. This is because an agriculture good naturally has a higher level of local content than the one for an electronic product.

To properly quantify the strictness of a ROO requirement for a product to receive a preferential treatment under a RTA, thus, we develop a new measure that adjusts Estevadeordal's index to reflect the status quo local content of a product. Utilizing the import inducement coefficient from the input-output table of a country that computes the ratio of foreign value added of a good to its total value, we construct a measure of local content of a product. By deflating Estevadeordal's index using this measure of local content of a product, we obtain a new measure of ROO's strictness, denoting it by Bindingness index. Based on the ROO requirements of KORUS

[2] Krishna (2006) provides a survey of literature on ROO requirements of RTAs.

FTA ratified in 2011, we first construct a measure of ROO's strictness that directly follows the method of Estevadeordal's index for NAFTA, denoting it by ROO index. Using the import inducement coefficient from the input-output table of Korea, then we construct Bindingness index measuring the strictness of ROO requirements for Korean exports to obtain preferential treatments into the US market. Some preliminary evidences on the utilization rates of KORUS FTA reported by the US International Trade Commission (USITC) on imports from Korea indicate that Bindingness index works better than ROO index as a measure of ROOs' strictness.[3]

The other contribution of our paper is to modify an existing political economy model of ROO determination to reflect some salient feature of free trade agreements (FTAs) under the World Trade Organization (WTO), and to test this modified model using the data of KORUS FTA together with Bindingness index described above. As previous studies of ROO requirements of FTAs emphasize, it is important to understand that their role in FTAs goes beyond their overt motivation: ROO requirements are meant to prevent trans-shipment of goods imported from non-member countries, via member countries with lower external tariffs into those with higher ones, by requiring a certain level of local content for a good to obtain tariff-free access to member countries. Despite this rather benign motivation to deter trade deflection, ROOs can nullify the liberalization effect of FTAs by raising the local content requirements so that it is too costly to satisfy such requirements for preferential access to member states. Given the extensiveness of global production networks prevalent for many products, it is not difficult to utilize ROOs as a tariff-replacing protective measure under FTAs.[4]

As noted by Krueger (1993), a role of ROO requirements in a FTA is to induce member countries' producers to purchase intermediate inputs from member countries, even when their prices are higher than those from non-member countries, in order to qualify for the preferential treatments.[5] Given such a role of ROO requirements, Krishna and Ju (2005) emphasize the conflicting interests of intermediate good producers and final good producers by showing that imports of the intermediate goods first fall and then rise in response to tightening ROO requirements, with the opposite pattern occurring for the final goods. Having the structure of initial tariffs being determined by political-economy factors as analyzed by Grossman and Helpman (1995), Duttagupta and Panagariya (2007) demonstrate

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[3] The utilization rate which measures the proportion of Korean exports to the US that obtain the preferential treatment of KORUS FTA is, for example, negatively correlated with Bindingness index but positively correlated with ROO index.

[4] Using ROO index of Estevadeordal (2000) on NAFTA, Cadot et al. (2002) show that the severity of ROO requirements measured by ROO index reduced Mexican exports and tariffs preferences given in NAFTA raised them, having the net effect being close to zero.

[5] Krishna and Krueger (1995) demonstrate that different ways of specifying ROO requirements of a FTA affect the possible effects of ROO requirements on imports of intermediate goods from member states of the FTA .

that ROO requirements can sometime make preferential trade agreements politically feasible in circumstances where they wouldn't be otherwise.

Cadot et al. (2006) develop a political economy model of determination of ROO requirements, showing that ROO requirements can work as an export subsidy to producers of intermediate goods. As we modify their model for its application to KORUS FTA in our analysis, we provide a more detailed explanation for their analysis. In the context of North-South trade in which North exports intermediate goods to South and imports final goods from South, they show that ROO requirements of the North-South FTA induce the Southern final good assemblers to utilize the Northern intermediate goods in order to obtain preferential access to the Northern market. This in turn raises the demand for the Northern intermediate goods, thus their prices. These higher prices of Northern intermediate goods can work as an export subsidy to the producers of these goods if the Northern government sets ROO requirements and tariff preferences so that the Southern final good assemblers' producer price remains unchanged after signing the FTA: the reduction in the tariff revenue of North collected from the Southern final goods turns into a higher revenue of the Northern intermediate producers under such a FTA.

Given the set up described above, Cadot et al. (2006) analyze the lobby incentives of Northern intermediate input producers in determining the strictness of ROO requirements and tariff preferences of the FTA, via the political economy model of Grossman and Helpman (1995). According to their model, the strictness of ROO requirements depends on the North's most-favored-nation (MFN) tariff and a vector product of input-output coefficients multiplied by the North's intermediate-good exports upstream of the good to which ROO requirements apply. Cadot et al. (2006) test this prediction of their model using the data of the NAFTA, treating the US and Mexico as the North and the South, respectively. As a measure of strictness of ROO requirements of the NAFTA, they utilize the qualitative index developed by Estevadeordal (2000). The empirical analysis of Cadot et al. (2006) generates results that strongly support their political economy model of determination of ROO requirements.

As mentioned earlier, we modify the political economy model of Cadot et al. (2006) to incorporate an important feature of FTAs. Preferential tariff rates need to equal to zero for most of products due to the rule of the WTO, which in turn implies that each country's tariff preferences are practically set to its MFN tariffs under a FTA. This aspect of tariff preferences under a FTA is in conflict with the model of Cadot et al. (2006), in which both the levels of ROOs and the levels of tariff preferences are choice variables of the Northern government.[6] We modify this

[6] Cadot et al. (2006) justify their assumption on preferential tariff rates by claiming that countries may choose preferential tariff rates that are higher than zero during a phase-out period of the

assumption of Cadot et al. (2006), by assuming that the tariff preferences given to FTA member countries are equal to MFN tariff rates, thus no longer choice variables of negotiating governments. This modification leads to testable predictions of the determinants of ROO requirements, some of which differs from the prediction of Cadot et al. (2006). The empirical analysis using Bindingness index of KORUS FTA described above generates the results that support the predictions of our modified political economy model.

Section 2.1 explains the construction process of Bindingness index based on ROO index and the import inducement coefficient of the input-output table of a country. Using the utilization rates of KORUS FTA of Korean exports to the US market, Section 2.2 compares ROO index and Bindingness index as a measure of strictness of ROO requirements, by regressing the utilization rates on these indexes. Section 3 first replicates the political economy model of ROO determination of Cadot et al. (2006), then derives testable implications based on our modified model, of which Section 4 provides the empirical analysis using the data of KORUS FTA. Section 5 concludes with a discussion of possible extensions.

II. Bindingness Index of ROO Requirements

As discussed in the introduction, the existing measure of strictness of ROO requirements such as Estevadeordal (2000) ignores the status-quo local content, thus being potentially biased toward products that have high status quo local contents. To correct this short-coming of Estevadeordal's index, we develop a new measure that takes the status-quo local content into consideration.

2.1. Construction of Bindingness Index

We do not have any ready-made measure of strictness of ROO requirements of KORUS FTA, such as the one constructed by Estevadeordal (2000) for the NAFTA. Following the method of Estevadeordal (2000), we first build such an index for KORUS FTA, denoting it by ROO index. Estevadeordal's index is a categorical variable which takes on integer values from one to seven, with a higher integer value corresponding to a stricter ROO requirement. As explained in Appendix A, ROO index fine-tunes Estevadeordal's method of classifying ROO requirements, having our ROO index takes on integer values from one to eight.

Because ROO index directly follows the construction method of Estevadeordal's

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agreement. However, countries often agree to set preferential tariff rates to zero for most of products almost immediately, and they agree to do so prior to engaging in more-detailed negotiations on ROO requirements, as they did in KORUS FTA.

index, it is subject to the same short-coming of not being corrected for the status quo local content bias. For an agricultural product, KORUS FTA typically requires "wholly obtained or produced" to qualify for the preferential treatment under the FTA, thus having 8 for its ROO index value.[7] Despite the fact that we assign the highest ROO index value to such an agricultural product, it can be very easy for producers of the product to meet the ROO requirement because agricultural products are typically "wholly obtained or produced."

To develop a new index of strictness of ROO requirements that can correctly reflect how hard ROO requirements are for producers to satisfy them, we first construct a measure of local contents of a product, denoted by Local Content index, taking values between 1 and 8. In constructing Local Content index, we utilize the import inducement coefficient obtained from the input-output table. As explained in Appendix A, the import inducement coefficient of a good in an economy measures the percentage of value added of the good that is created outside the economy under consideration: for example, if the import inducement coefficient is 26%, then the local content of the good is 74%. When the import inducement coefficient is 0 for a product (implying 100% local contents), then we assign the highest Local Content index value, 8. If the import inducement coefficient is higher than 0, then we assign a Local Content index value that is strictly less than 8, according to the conversion rule shown in Table 1.

[Table 1] Conversion Table of Import Inducement Coefficient and Local Content Index

Import Inducement Coefficient	Local Content Index	ROO Index
0	8	8
(0, 30)	6.5	6-7
[30, 50]	4.5	4-5
(50, 65)	2.5	2-3
[65, 100]	1	1

The following is why we assign Local Content index value of 6.5 to a product of which the import inducement coefficient belongs to (0, 30), assign 4.5 to a product of which the import inducement coefficient belongs to [30, 50], and so on. When the ROO index value of a product is 6 or 7, then the corresponding local content requirement belongs to (70, 100) percent, or equivalently (0, 30) in terms of the import inducement coefficient, as explained in Appendix A. For a product of which the import inducement coefficient belongs to (0, 30), we assign 6.5 for its Local Content index, the average of the corresponding ROO Index values, 6 and 7. This conversion rule enables Local Content index to take the same numeric value of the

[7] A product is "wholly obtained or produced" means that it must contain no parts or materials not originated from member countries of a FTA.

ROO index value or the average of the ROO index values that require the same level(s) of local contents.

To understand how we can use these two indexes to develop a new index of strictness of ROO requirements, denoted by Bindingness index, consider two products that have the same ROO index value, 7, as an example. The first product's the import inducement coefficient is equal to 60, having 2.5 for its Local Content index value, and the second product's import inducement coefficient is 30, having 6.5 for its Local Context index value. Even though these two products have the same ROO index value, we can say that it is harder to satisfy the ROO requirement for the first product than for the second one because the necessary increase in the proportion of local contents beyond its status quo level is higher for the first product than for the second one. Once we have Local Content index as well as ROO index for a product, we are ready to construct Bindingness index by subtracting Local Content index from ROO index for the product under consideration, which then takes categorical integer values between 1 and 7, as shown in Table 2. The higher a Bindingness index value is for a product, the harder the ROO requirement is for producers of the product to satisfy.

[Table 2] Definition of Bindingness Index

1	if ROO Index − Local Content Index < 0
2	if 0 ≤ ROO Index − Local Content Index < 1
3	if 1 ≤ ROO Index − Local Content Index < 2
4	if 2 ≤ ROO Index − Local Content Index < 3
5	if 3 ≤ ROO Index − Local Content Index < 4
6	if 4 ≤ ROO Index − Local Content Index < 5
7	Otherwise

It is important to note that Local Content index value of a product depends on its originating country because the input-output table may differ across member countries of a FTA. As we use both ROO index and Local Content index in deriving Bindingness index, this means that Bindingness index depends on which member country's input-output table that we use for creating Local Content index. If we use the input-output table of the US, for example, Bindingness index measures the strictness of ROO requirements for the US exports to obtain preferential treatments into the Korean market.

Table 3 shows the percentage of products that belongs to each integer value of ROO index and Bindingness index of KORUS FTA, with Bindingness index being constructed from the import inducement coefficient obtained from the Korean input-output table for the year of 2007.[8] Thus, the Bindingness index in Table 3

[8] Despite the availability of a more recent input-output table of Korea, we use the input-output table

measures the strictness of ROO requirements for Korean exports to obtain preferential treatments into the US market. As shown in Table 3, the distribution of products across different index values changes quite dramatically from ROO index to Bindingness index, indicating that these two indexes measure the strictness of ROO requirements differently from each other. This raises the following question: which measure performs better as a measure of strictness of ROO requirements. The following subsection addresses this question using the utilization rates of KORUS FTA reported by the USITC on the US imports from Korea.

[Table 3] The Percentage of Products for Each Index Level

ROO Index	Percentage in Number of Products	Bindingness Index	Percentage in Number of Products
1	2.91	1	53.40
2	11.31	2	8.71
3	1.06	3	22.57
4	40.42	4	7.87
5	9.25	5	6.36
6	19.34	6	0.84
7	10.29	7	0.25
8	5.41		

2.2 Utilization of KORUS FTA: Bindingness Index versus ROO Index

One way to compare Bindingness index with ROO index as a measure of strictness of ROO requirements is to check which index performs better in explaining the variation in utilization rates of preferential tariffs across traded goods between member countries of a FTA: a higher index measuring a stricter ROO requirement is likely to have a negative effect on the utilization rate, controlling for other variables that may affect the utilization rate. With regard to the utilization rates of tariff preferences of KORUS FTA, the USITC defines and reports "utilization rate" as follows:

$$\text{utilization rate} \equiv \frac{\text{Import amount under free special duty programs}}{\text{Import amount under all provision codes}},$$

of 2007 due to the following reason. The official negotiation for KORUS FTA has started in June of 2006 and ended in June 2007. While it took more than 4 year for KORUS FTA to be ratified in November 2011, with some additional negotiations taking place during the second half of 2010, it is important to note that most of detailed negotiations about preferential tariff reductions and ROO requirements occurred during the original negotiation period from June 2006 to June 2007. In addition, it is reasonable to assume that negotiators were concerned about strictness of ROO requirements that matter during the time of negotiation, thus Bindingness index based on the 2007 input-output table would properly represent the strictness of ROO requirements that negotiators had intended as the outcome of their negotiation.

for the US import from Korea at 6 digit code level of the Harmonized Commodity Description System (HS), starting in 2012, measuring the proportion of Korean exports to the US that utilize the preferential tariffs under KORUS FTA by satisfying the ROO requirements.[9]

Using these utilization rates of KORUS FTA for the year of 2012, we compare the performance of Bindingness index and ROO index as a measure of strictness of ROO requirements. First, note that the utilization rate defined above will take values between 0 and 1. The following table shows the frequency of the utilization rates for 0, (0, 1) and 1 at the 6 digit HS code product level, excluding the products of which MFN tariffs are zero (thus, providing no tariff preferences under KORUS FTA).

[Table 4] Utilization Rates of KORUS FTA on 1661 Import Products of the US from Korea in 2012 with Positive US MFN Tariffs

1661	0	(0,1)	1
Utilization rate	384 (23.12%)	42 (2.53%)	1235(74.35%)

Table 4 shows that utilization rates mostly take two extreme values, either 0 or 1. To analyze the effect of ROO requirements on the utilization rates, thus we use the probit estimation with the results being summarized in the following table.[10]

[Table 5] Probit Regression Results on the Utilization Rates in 2012

Probit	(1)	(2)	(3)	(4)	(5)	(6)
Bindingness Index	-0.080 [.026]***	-0.063 [.027]**	-0.096 [.045]**			
ROO Index				0.015 [.019]	0.064 [.024]***	0.114 [.037]***
MFN US		-0.017 [.008]**			-0.036 [.009]***	
Tariff Preference			1.875 [.149]***			2.151 [.169]***
Cons.	0.921	0.961	-0.449	0.660	0.607	-1.269
Observation	1599	1537	1537	1649	1585	1585
Pseudo R^2	0.0056	0.0081	0.6541	0.0003	0.0087	0.6605

Note: * significant at 10 percent level, ** significant at 5 percent level and *** significant at 1 percent level.

[9] While the Harmonized Tariff Schedule of Korea (HSK) is defined at a 10 digit level, ROO requirements are negotiated at 6 digit HS code levels.

[10] We also run the logit estimation for all 6 specifications in Table 5, and the results from the logit estimation are qualitatively identical to the ones from the probit estimation in Table 5.

Table 5 shows the regression results using Bindingness index in the first three columns and the ones using ROO index in the last three columns. In the first three columns, the coefficient on Bindingness index is negative and statistically significant, implying that a higher Bindingness index will decrease the utilization rate of KORUS FTA, controlling for other factors that can influence the utilization rate. Given that a stricter ROO requirement would make it harder for a product to qualify for a preferential treatment of a FTA, this result indicates that Bindingness index works properly as a measure of strictness of ROO requirements. In contrast, the coefficient on ROO index is positive and statistically significant in the last two columns of Table 5, implying a stricter ROO requirement will increase the utilization rate. This raises a serious doubt on the validity of ROO index as a proper measure of strictness of ROO requirements.

The results on other controlling variables are also noteworthy. “MFN US” denotes the most favored nation tariff of the US on the product under consideration and “Tariff Preference” is defined by the multiplication of “MFN US” and “Liberalization Dummy (LD),” with LD taking the value of 1 if the product is liberalized immediately in 2012 under KORUS FTA and taking the value of 0 otherwise. The higher the level of a preferential treatment that a product can enjoy under a FTA, the higher the incentive to qualify for such a treatment by meeting the ROO requirement. Because “Tariff Preference” measures the level of a preferential treatment that a product can enjoy in 2012 under KORUS FTA, we should expect a positive coefficient on this variable. The results in Table 5 strongly support this conjecture. Also note that the pseudo R-squared value increases sharply when we add this variable to the regressions.

While the regression results in Table 5 support Bindingness index as a proper measure of strictness of ROO requirements, disapproving ROO index as such a measure, one may raise the following question: How can we explain the positive and statistically significant coefficient on ROO index in the above regressions? One potential explanation can be given as follows. Note that a higher value for ROO index might reflect a higher value for a “natural” or a status quo local content of a product rather than a stricter ROO requirement to meet. In fact, the correlation between ROO index and Local Content index of KORUS FTA is 0.3214, indicating a strong and positive correlation between ROO index and the status quo local content. If a product has a higher value for the status quo local content, then the net benefit for local factors of production from receiving a given preferential treatment under a FTA can be bigger, possibly generating a stronger incentive for the producers of such a product to utilize the preferential treatment under a FTA by meeting the ROO requirement.

III. A Political Economy Model of ROO Requirements

As mentioned in the introduction, Cadot et al. (2006) develop a political economy model of determination of ROO requirements in the context of a FTA between an intermediate good producing North and a final good assembling South. In deriving their theoretical predictions on the determinants of ROO requirements, they assume that both the levels of ROO requirements and the levels of tariff preferences are choice variables. However, preferential tariff rates need to be zero due to the rule of the WTO, implying that tariff preferences are not really choice variables in the negotiation for a FTA. Cadot et al. (2006) justify their assumption on preferential tariff rates by claiming that countries may choose preferential tariff rates that are higher than zero during a phase-out period of the agreement. The justification of Cadot et al. (2006) for their assumption on preferential tariff rates is subject to a potentially serious problem. Preferential tariff rates need to be zero "eventually", and this "eventual event" often comes very quickly. As shown in Table 6, for example, the preferential tariff rates of the US were scheduled to be zero for approximately 84% of its imported goods immediately after the ratification of KORUS, and the same percentage reaches above 95% within 5 years.

[Table 6] Liberalization Schedule under KORUS FTA

(1) Years	(2)	(3)	(4) Years	(5)	(6)
0	83.56	78.91	0	76.90	62.17
1	85.04	80.11	1	81.01	74.04
2	89.15	88.81	2	86.58	83.19
3	90.38	89.64	3	87.46	85.67
4	94.70	92.95	5	92.32	92.64
5	95.72	93.23	7	93.61	94.33
6	96.43	93.45	9	97.91	97.75
7	96.83	93.68	11	98.46	99.15
9	99.98	100	14	99.58	99.73
11	100	100	19	99.75	99.78

Note: (1) & (4) Years after ratifying KORUS FTA.
(2) & (5) Liberalization in the number of products by US & by Korea.
(3) & (6) Liberalization in the value of import of 2007 by US & by Korea.

In this section, we modify this assumption of Cadot et al. (2006), by assuming that the tariff preferences given to FTA member countries are equal to the MFN tariff rates: the preferential tariff rates are zero, thus no longer choice variables of negotiating governments.[11] This modification leads to testable predictions of the

[11] As correctly pointed out by a referee, governments negotiate the schedule of tariff lines, possibly having preferential tariff rates gradually lowered during a phase-out period of the agreement. Thus,

determinants of ROO requirements, some of which differs from the prediction of Cadot et al. (2006).

3.1. Basic setup of the Model

The basic set up of the model of ROO requirements of a FTA follows Cadot et al. (2006). We consider a FTA formed by two small economies: North and South. North produces an intermediate goods (I) and exports it to South which uses it to assemble a final good (F).[12] North imports the final good from South but also imports it from the rest of world (ROW) as South's production is not enough to satisfy the demand of North. Under a FTA with North, South will end up importing all its own consumption of the final good from ROWand exporting all its production to North, as shown later in this section.

Consumers in both countries consume the final good and a numeraire good, over which the utility function is quasi-linear and identical across countries:

$$U = c_0 + u(c_F), \tag{1}$$

where c_0 and c_F represent consumption levels of the numeraire good and the final good, respectively, with $u' > 0$ and $u'' < 0$.

The production of the final good, F, combines a value added part and the intermediate good, I. The production function of the value added part is $f(l,k)$, of which l denotes the intersectorally mobile labor input and k denotes the sector-specific capital input. The production of F, denoted by y_F, takes the following Leontieff functional form over the value added part and I:

$$y_F = \min\{f(l,k); x_I / a_{IF}\}, \tag{2}$$

where x_I denotes the amount of intermediate goods used and a_{IF} is the input-

one can argue that preferential tariff rates may still be a choice variable for the governments even though the tariffs would be eliminated later. One possible way to incorporate this feature of FTA negotiation is to extend the model into a dynamic one in which governments negotiate the schedule of liberalization as well as the static rule of origin requirements for each product, a possible direction for a future extension. Given the static set up of our model that follows Cadot et al. (2006), however, it is reasonable to focus on analyzing the governments' incentive in determining the strictness of ROO requirements by assuming that the tariffs are supposed to be zero under a FTA, especially for KORUS FTA in which tariffs are scheduled to be fully eliminated within one year from its ratification for more than 80% of all products.

[12] In an earlier version of this paper, we generalize this model into the one in which there are M number of intermediate goods and N−M number of final goods with N > M being arbitrary positive integer numbers. The results under this generalization are similar to the ones in this paper and they are available upon request.

output coefficient for I and F, representing units of I required to produce one unit of F.

Prior to considering the objective functions of industries and governments with regard to the negotiation of a FTA, we consider the producer surplus under free trade. Let p_I^* and p_F^* respectively represent the world-market prices of I and F. Given the production function in (2), the net price out of which a Southern producer can remunerate its value added part is

$$p^* = p_F^* - a_{IF} p_I^* \tag{3}$$

Under free trade, then the Southern F producer's surplus under free trade, denoted by π_F^*, is a monotone increasing function of p^* as follows:

$$\pi_F^* = p^* y_F - w^S l_F ,$$

and the Northern I producer's surplus is

$$\pi_I = p_I^* y_I - w^N l_I , \tag{4}$$

where w^S and w^N denote the wage rates of South and North, respectively.

To analyze the formation of a FTA between North and South, we assume the existence of following MFN tariffs. Northern tariffs are respectively denoted by t_F^N and t_I^N and Southern ones by t_F^S and t_I^S. Following Cadot et al. (2006), we set $t_F^S = t_I^S = 0$, thus focusing on the effects of eliminating Northern tariffs and imposing ROO requirements on imports of Southern F to qualify for preferential treatments under a FTA.[13] Denote the level of tariff preference that the Southern F producer may obtain under the FTA by δ. In contrast to the assumption of Cadot et al. (2006) that makes δ as a choice variable of North in the FTA negotiation, we set $\delta = t_F^N$, reflecting the rule of the WTO that preferential tariff rates need to be zero. Denote the regional value content of a ROO requirement by r. Then, the price at which Southern final-good producers can sell in North is

$$p_F = \begin{cases} p_F^* + t_F^N & if\ x_I^N \geq r x_I \\ p_F^* & otherwise, \end{cases} \tag{5}$$

where x_I^N denotes the amount of Northern I used in the production of Southern F. The net price faced by the Southern assemblers is

[13] As discussed by Cadot et al. (2006), extensions to other cases add little to the analysis.

$$p = \begin{cases} p_F^* + t_F^N - a_{IF}[rp_I + (1-r)p_I^*] & if\ x_I^N \geq rx_I \\ p_F^* - a_{IF} p_I^* & otherwise, \end{cases} \tag{6}$$

where p_I denotes the price of the Northern I sold to the Southern assemblers that try to satisfy the ROO requirement.

3.2. The Politics of ROOs

Following Cadot et al. (2006), we assume that North makes a take-it-or-leave-it offer to South which South accepts as long as its participation constraint is not violated. Given the basic set-up of the model, the ROO requirement r is determined in the political process of negotiating the FTA. With the politics described as in Grossman and Helpman (1995), the Northern producers of I have an incentive to lobby its government with a contribution schedule $C(r;t_F^N)$. Then, the lobby function C has the "truthfulness property" that satisfies

$$\left.\frac{\partial C}{\partial r}\right|_{r^e} = \left.\frac{\partial \pi_I}{\partial r}\right|_{r^e} \tag{7}$$

where the superscript e denotes equilibrium values.

In the absence of hidden actions, the single lobby group will be able to appropriate the entire protection rents attained through tightening the ROO requirement, implying that the lobby's contribution compensates the government for its (subjective) monetary equivalent of the efficiency loss generated by the ROO requirement. Having the tariff preference given to the Southern F be equal to t_F^N, the Northern government determines r to maximize a linear combination of welfare (valued at a constant monetary equivalent a) and the lobby's contribution:

$$G^N \equiv C(r;t_F^N) + aW^N(r;t_F^N), \tag{8}$$

with

$$W^N(r;t_F^N) \equiv \pi_I + w^N l_I + t_F^N(c_F - y_F) + u(c_F) - p_F c_F. \tag{9}$$

There are two constraints that the Northern government needs to satisfy in maximizing its objective function in (8). The first constraint is South's participation constraint:

$$p_F^* + t_F^N - a_{IF}[rp_I + (1-r)p_I^*] \geq p_F^* - a_{IF} p_I^*, \tag{10}$$

which guarantees that the net price of the Southern F producers under the FTA is greater or equal to the its net price in the absence of such an agreement. The second constraint is the market-clearing condition for the Northern I:

$$ra_{IF}y_F(p^a) = y_I(p_I)\,, \tag{11}$$

where $p^a \equiv p + a_{IF}p_I^* \geq p_F^*$, an adjusted version of the Southern assembler's net price of its final good, which facilitates some comparative static analysis in the following subsection. (11) determines p_I by equating the Southern assemblers' demand of the Northern I, $ra_{IF}y_F(p^a)$, to the Northern supply of it, $y_I(p_I)$. Note that (11) implicitly assumes that $p_I > p_I^*$ so that the Southern assemblers would demand the Northern I only up to the required level. Also, p_I that satisfies (11) is assumed to be greater than $p_I^* + t_I^N$ so that the Southern demand of the Northern I is large enough to consume all of the Northern supply.[14]

To derive the solution to the maximization of (8) with respect to r subject to (10), (11), (7), and $0 \leq r \leq 1$, we obtain the following first order condition:

$$\begin{aligned}\frac{\partial G^N}{\partial r} &= \frac{\partial \pi_I}{\partial r} + a\frac{\partial W^N}{\partial r} \\ &= (1+a)y_I\frac{\partial p_I}{\partial r} + a\left[t_F^N\frac{\partial y_F}{\partial p^a}ra_{IF}\frac{\partial p_I}{\partial r} + t_F^N\frac{\partial y_F}{\partial p^a}a_{IF}(p_I - p_I^*)\right]\end{aligned} \tag{12}$$

In deriving the second equality, note that we use the assumption that North imports a positive amount of F from ROW under the FTA, having the local price of F in North being fixed at $p_F^* + t_F^N$, thus fixing c_F regardless of the value of r. Also note that $\partial G^N / \partial r > 0$ if $\partial p_I / \partial r > 0$.

To determine the sign of $\partial p_I / \partial r$, we totally differentiate the market clearing condition in (11), obtaining the following expression:

$$\begin{aligned}\left[y_I' + (ra_{IF})^2 y_F'\right]\frac{\partial p_I}{\partial r} &= a_{IF}y_F\left[1 - \varepsilon_F\frac{ra_{IF}(p_I - p_I^*)}{p^a}\right] \\ &\geq a_{IF}y_F\left(1 - \varepsilon_F\frac{t_F^N}{p_F^*}\right),\end{aligned} \tag{13}$$

where $\varepsilon_F \equiv p^a y_F' / y_F$ represents the elasticity of supply of the Southern assemblers and the last inequality comes from $t_F^N \geq ra_{IF}(p_I - p_I^*)$ and $p^a \geq p_F^*$. Note that

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[14] Because both of these implicit assumptions need to hold to make the ROO requirement be a constraint that matters, there is no loss of generality in introducing the market-clearing constraint as in (11) for our analysis.

t_F^N / p_F^* is equivalent to the ad valorem tariff rate of North on F. Therefore, we can derive the following lemma on the sign of $\partial G^N / \partial r$.[15]

Lemma 1 $\partial G^N / \partial r > 0$ *if* $\varepsilon_F (t_F^N / p_F^*) < 1$.

Consider the case in which the ad valorem tariff rate of North and the elasticity of supply of the Southern assemblers are sufficiently low to satisfy the condition for Lemma 1. Then, the Northern government will have an incentive to raise r as long as the constraints of the maximization of (8) are not violated, implying that the participation constraint of South will hold with equality as long as $r^e < 1$. This observation leads to the following proposition with regard to the choice of r:

Proposition 1 *If* $\varepsilon_F (t_F^N / p_F^*) < 1$, *then the Northern government will raise* r *so that South's participation constraint holds with equality,* $t_F^N = ra_{IF}(p_I - p_I^*)$ *as long as the equilibrium value of* r *is strictly less than 1.*

3.3. Testable Predictions of the Model

Proposition 1 leads the following prediction on the relationship between t_F^N and r:

Corollary 1 *Holding other things constant, a higher* t_F^N *would imply a higher* r *if* $\varepsilon_F (t_F^N / p_F^*) < 1$.

Cadot et al. (2006)) make a similar claim on the relationship between t_F^N and r based on the following key equation that they derive, assuming that both δ (tariff preference) and r are choice variables of the Northern government:

$$r = \frac{\delta a \varepsilon_I}{a_{IF} p_I}, \tag{14}$$

where $\varepsilon_I \equiv p_I y_I' / y_I$, representing the Northern I's supply elasticity, which they assume to be constant.[16] While the preferential tariff rate may differ from t_F^N, they approximate δ with t_F^N in their regression analysis, testing the hypothesis that a

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[15] We can prove a result that is similar to Lemma 1 for the case in which there are M number of Northern intermediate goods and N−M number of Sothern final goods with N > M. The proof for this generalization contained in an earlier version of this paper is available upon request.

[16] When δ is a choice variable, then the Northern government will choose δ so that the Southern participation constraint is satisfied with equality for any choice of $r : \delta = ra_{IF}(p_I - p_I^*)$. This makes the net price of the Southern assemblers fixed at $p_F^* - a_{IF} p_I^*$ regardless of its choice over r. Then, $\partial G / \partial r = (p_I y_I / r)[1/\varepsilon_I - a\delta / (ra_{IF} p_I)] = 0$, which in turn yields the expression in (14).

higher t_F^N implies a higher r based on (14). The other prediction that Cadot et. al. (2005) make is a negative relationship between r and $a_{IF} p_I / \varepsilon_I$ based on (14).[17]

To make a comparison with the predictions of Cadot et al. (2006), we make the following observation on the value of $\partial G^N / \partial r$:

$$\frac{\partial G^N}{\partial r} = (1+a) y_I \frac{\partial p_I}{\partial r} + a\left[\frac{t_F^N}{p^a}\varepsilon_F y_I \frac{\partial p_I}{\partial r} + \frac{t_F^N}{p^a}\varepsilon_F y_F a_{IF}(p_I - p_I^*)\right]$$
$$= \left(\frac{a_{IF} p_I}{\varepsilon_I}\right)\frac{y_F y_I^{/}\left[1 + a\left(1 + \frac{t_F^N}{p^a}\varepsilon_F\right)\right]\left[1 - \varepsilon_F \frac{r a_{IF}(p_I - p_I^*)}{p^a}\right]}{\left[y_I^{/} + (r a_{IF})^2 y_F^{/}\right]}$$
$$+ a\left[\frac{t_F^N}{p^a}\varepsilon_F y_F a_{IF}(p_I - p_I^*)\right] \qquad (15)$$

As shown above, note that $a_{IF} p_I / \varepsilon_I$ is multiplied to an expression that takes a positive value when Lemma 1 holds, thus a higher $a_{IF} p_I / \varepsilon_I$ implies a higher $\partial G^N / \partial r$. This observation leads to the following corollary:[18]

Corollary 2 *Holding other things constant, a higher* $a_{IF} p_I / \varepsilon_I$ *would imply a stronger incentive for the Northern government to raise r with a higher* $\partial G^N / \partial r$ *if* $\varepsilon_F (t_F^N / p_F^*) < 1$.

If $\partial G^N / \partial r > 0$ with the condition for Lemma 1 being satisfied, then having a higher value for $\partial G^N / \partial r$ with a higher value for $a_{IF} p_I / \varepsilon_I$ does not necessarily imply a higher value for r. This is because the Northern government would choose the highest possible value of r, possibly having South's participation constraint binding with $r = t_F^N / [a_{IF}(p_I - p_I^*)]$, regardless of the size of $\partial G^N / \partial r$.

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[17] This prediction of Cadot et al. (2006) comes from treating δ in (14) as an exogenous variable that is fixed even when $a_{IF} p_I / \varepsilon_I$ changes. However, note that δ will change in response to any change in r, with $\delta = r a_{IF}(p_I - p_I^*)$. Once we correctly treat δ as a variable that changes in response to a change in some parameter value, for example ε_I , then we can show that r and $a_{IF} p_I / \varepsilon_I$ no longer have a negative relationship. Consider a decrease in ε_I , which raises the value of $a_{IF} p_I / \varepsilon_I$ in the political equilibrium. Then δ will increase more than the increase in $a_{IF} p_I / \varepsilon_I$, resulting in an increase in the political equilibrium value of r . Therefore, r and $a_{IF} p_I / \varepsilon_I$ have a positive relationship even when δ and r are both choice variables of the Northern government. This is a result that disproves the prediction of Cadot et al. (2006). Proof for this result is available upon request.

[18] An earlier version of this paper provides a proof for a result that is similar to Corollary 2 for the case in which there are two Northern intermediate goods and two Southern final goods. This proof is available upon request. We conjecture that Corollary 2 would hold under a more general case in which there are M number of intermediate goods and N−M number of final goods with N> M.

However, note that the preceding sentence is based on the following assumption on the relative bargaining power in the FTA negotiation: North has all the bargaining power.[19] Once we relax this assumption by allowing South to have some bargaining power, then $\partial G^N / \partial r > 0$ does not necessarily imply that North would be able to choose r that makes South's participation constraint binding. While developing a formal model of bilateral bargaining between North and South is beyond the scope of this paper, a stronger incentive of the Northern government to raise r with a higher value for $\partial G^N / \partial r$ would imply a positive relationship between $a_{IF} p_I / \varepsilon_I$ and r if South has some bargaining power in the FTA negotiation. This leads to the prediction of a positive relationship between $a_{IF} p_I / \varepsilon_I$ and r, a prediction that is just opposite to Cadot et al. (2006).

IV. Empirical Analysis of the Political Economy Model

To empirically test the predictions of our political economy model of determination of ROO requirements, we construct a data set of KORUS FTA. The official negotiation for KORUS FTA was launched in June, 2006, yielding the initial text of KORUS FTA in June, 2007. Due to the demand of the US congress and the congress of Korea, there was an additional negotiation that has partially changed the original text of KORUS FTA during 2010. This final version of KORUS FTA was ratified in October 2011, taking effect in March 15, 2012.

4.1. The Data

4.1.1. The data on ROO requirements

As a measure of ROO requirements of KORUS FTA, we will use both Bindingness index and ROO index, of which Section 2 and Appendix A provide a detailed explanation for their construction process. For Bindingness index, recall that we need to use the import inducement coefficients obtained from the input-output table of a specific country for a specific year. Because we assume that Korea is South and the US is North in our political economy model of ROO requirements, Bindingness index should measure the strictness of ROO requirements for Korean

[19] As correctly pointed out by a referee, it may not be appropriate to consider the negotiation of KORUS FTA as a unilateral negotiation because Korea has exerted some bargaining power in determining the ROO requirements of KORUS FTA. Even when we introduce some bargaining power of South into the formal modeling, however, we can conjecture that the result of Corollary 2 will hold because a higher $a_{IF} p_I / \varepsilon_I$ would imply a higher $\partial G^N / \partial r$, thus a stronger incentive for the Northern government to raise r even in the presence of some bargaining power of South. In fact, we use this conjecture in deriving the prediction of a positive relationship between $a_{IF} p_I / \varepsilon_I$ and r, implicitly assuming some bargaining power of South.

exports to obtain preferential treatments into the US market. Therefore, we will use the input-output table of Korea. For the year, we choose to use the input-output table of 2007. This is because the measure is supposed to measure the strictness of ROO requirements as countries would intend in their negotiation and the ROO requirements of KORUS FTA were mostly negotiated during initial negotiation ended in 2007.

4.1.2. The data on trade and tariff rates

For the empirical analysis, we also construct the data on MFN tariffs of Korea and of the US for the year of 2007. We use Korean trade data for the same year to construct a measure for $a_{IF} p_I / \varepsilon_I$, of which the following subsection provides a detailed discussion. The MFN tariff rates are complied from the WTO sources and the trade data are obtained from UN Comtrade data at the 6-digit HS level disaggregation. Table 7 provides descriptive statistics of ROO index, ROO Bindingness index, MFN tariff rates of Korea and the US for 5 different product groups.

[Table 7] Means of Each Variable by Product Groups[20]

	Roo Index	Bindingness Index	MFN Korea	MFN US
Agricultural	5.66	1.70	22.69	2.67
Raw Materials	5.30	1.43	19.73	2.92
Intermediate Goods	4.65	2.82	9.17	4.08
Consumer Goods	5.25	1.87	10.29	5.01
Capital Goods	3.11	1.12	6.21	1.58
Total	4.57	2.09	9.51	3.60

4.2. Empirical Estimation

To test the predictions of the political economy model of ROO requirements, we first replicate the estimation equation of Cadot et al. (2006) by taking the log on their political economy equation in (14) as follows:

$$\ln r = \beta_0 + \beta_1 \ln\left(\frac{a_{IF} p_I}{\varepsilon_I}\right) + \beta_2 \ln \delta \,. \tag{16}$$

[20] Categorical classification of products follows "HS Standard Product Groups" of "Reference Data" of World Integrated Trade Solution of World Bank; simple averages of ROO index and Bindingness index are calculated for each product category; simple average MFN tariff rates are calculated based on MFN tariff rates obtained from "Tariff Download Facility" of World Trade Organization.

Cadot et al. (2006) predict the following signs on coefficients: $\beta_1 < 0$ and $\beta_2 > 0$. Because of lack of information of p_I and ε_I, they replace $a_{IF} p_I / \varepsilon_I$ with $a_{IF} y_I / y'_I$, using $\varepsilon_I \equiv p_I y'_I / y_I$. In addition, they generalize the above estimation equation to the case of multiple intermediate goods and final goods, deriving the following estimation equation:

$$\ln r_j = \beta_0 + \beta_1 \ln\left(\sum_i \frac{a_{ij} y_i}{y'_i}\right) + \beta_2 \ln \delta_j + \beta_3 s_j, \tag{17}$$

where subscript j and i represent a final good j of North and an intermediate good i of South, respectively, and s_j denotes other variables, such as dummies indicating an agricultural good or a consumption good. Cadot et al. (2006) approximate δ_j with the MFN tariff rate of North on a good j and approximate $\sum a_{ij} y_i / y'_i$ with $\sum a_{ij} y_i$, namely "upstream" measure, assuming that y'_i are identical across intermediate goods of North.

We run the same ordered probit regression of the equation in (17) as in Cadot et al. (2006), allowing a direct comparison of our empirical analysis using the data of KORUS FTA with their analysis using the data of NAFTA. To test the predictions of our theoretical analysis, we can derive an estimation equation that is similar to the one in (17) by taking the log on South's binding participation constraint, $t_F^N = r a_{IF}(p_I - p_I^*)$, based on Proposition 1. As stated in Corollary 1, such a regression equation would predict a positive coefficient on t_F^N as in (17). While our theoretical analysis does not directly generate the upstream variable, $\sum a_{ij} y_i$, as an explicit explanatory variable for r_j, Corollary 2 enables us to conjecture a positive relationship between r_j and $\sum a_{ij} y_i$ in a more general model in which the Southern government has some bargaining power in its negotiation for a FTA with North, predicting a positive value for the coefficient β_1 rather than a negative one for it.

4.3. Results

Estimation results are shown in Table 8. The first three columns demonstrate the results when we use Bindingness index as a measure for ROO requirements. In all specifications using Bindingness index as the dependent variable, the sign of the coefficient on the US MFN tariff is positive and statistically significant at 1 percent level, as both our theoretical analysis and Cadot et al. (2006) predict. The sign of the coefficient on the "upstream" regressor is positive and statistically significant at 1 percent level, again, in all specifications shown in the first three columns of Table 8. This result supports the prediction of our analysis, rejecting the prediction of Cadot et al. (2006).

[Table 8] Regression Results on the Determinants of ROO Requirements

Ordered Probit	(1)	(2)	(3)	(4)	(5)	(6)
Upstream	0.241 [.014]***	0.222 [.014]***	0.293 [.015]***	-0.111 [.012]***	-0.075 [.012]***	-0.020 [.012]
MFN US	0.413 [.028]***	0.517 [.031]***	0.241 [.035]***	0.729 [.028]***	0.649 [.029]***	0.280 [.032]***
MFN Korea		-0.291 [.047]***	-0.337 [.048]***		0.466 [.041]***	0.565 [.042]***
Agricultural		0.082 [.199]	0.417 [.202]**		0.526 [.175]***	1.045 [.178]***
Final goods		-0.381 [.048]***	-0.404 [.049]***		0.493 [.045]***	0.665 [.047]***
Textile			1.076 [.059]***			1.854 [.064]***
Observation	2724	2696	2696	2714	2686	2686
Pseudo R^2	0.0543	0.0706	0.1131	0.0956	0.1295	0.2257

Note: (1), (2) & (3) Bindingness index and (4), (5) & (6) ROO Index.
** significant at 5 percent level and *** significant at 1 percent level.

The sign of the coefficient on the Korean MFN tariff is negative and statistically significant at 1 percent level both in column (2) and in column (3), supporting the common view that ROO requirements meant to discourage trans-shipment of goods imported from non-member countries, via member countries with lower external tariffs into those with higher ones. The positive coefficient on the agricultural dummy implies that the ROO requirement gets stricter for agricultural goods, and the opposite is true for final goods. This last result on final goods differs from the one obtained by Cadot et al. (2006), possibly reflecting some structures of final good trade between Korea and the US that are different from those between Mexico and the US. For example, a large portion of Korean exports to the US is consumer electronics, for which both Korea and the US are competitive in producing intermediate goods, such as computer chips.[21] For such an industry, requiring a higher level of local contents will have a little effect on inducing Korean exporters to switch their sources for intermediate goods from the rest of world to the US - they are already using local intermediate goods. Such a trade structure may

[21] Electronics (classified as a HS code 85) accounts for 24% of Korean export to the US. The intra-industry trade index, defined by 1−|(export−import)/(export+import)| of the electronics is 0.353, a number that is more than double the average of all industries, 0.172, indicating the importance of intra-industry trade for the electronics industry. The trade specialization index, defined by (export−import)/(export+import) of Korea to the US for the intermediate goods in the electronics industry is -0.129, and the same index for its the final goods in the electronics industry is 0.032. While Korea is a net importer of intermediate goods and a net exporter of final goods in its electronics trade with the US, these specialization indexes indicate that the US also extensively imports intermediate goods from Korea and exports its final goods to Korea in the electronics industry.

discourage the US intermediate good producers for consumer electronics from engaging in costly lobbying activities for a stringent ROO requirement, potentially contributing to the negative coefficient on final goods in column (2) and (3).

In the third column, we add a dummy for the textile industry because the US textile industry is well-known for its strong lobby activities for stringent ROO requirements to protect itself from exports of countries signing a FTA with the US. The coefficient on this textile dummy has an expected positive sign, that is both statistically significant at 1 percent level and higher than any other estimated coefficient values.[22]

The last three columns show the regression results using ROO index as a measure for the strictness of ROO requirements. As in the regression results of Cadot et al. (2006), the coefficient on the "upstream" regressor is negative and statistically significant at 1 percent level in the first two specifications shown by column (4) and column (5), but it becomes statistically insignificant when we add the textile dummy. This last result questions the validity of the negative coefficient result on the upstream regressor in other specifications: once we control the influence of the textile sector, then having a higher upsteamness value no longer exerts a negative effect on the strictness of ROO requirements. The sign of the coefficient of the US MFN tariff is positive and statistically significant at 1 percent level for all three specifications, confirming the common prediction of the model of Cadot et al. (2006) and ours. Having a positive and statistically significant coefficient on the Korean MFN tariff is different from the one obtained by Cadot et al. (2006), not supporting the view that ROO requirements are meant to avoid trade deflection.[23]

As shown in Section 2, Bindingness index works better than ROO index as a measure of the strictness of ROO requirements for Korean exports to obtain preferential treatments into the US market under KORUS FTA. This implies that the positive coefficient result on the upstream regressor based on Bindingness index is more trustworthy than the negative coefficient result based on ROO index, supporting the prediction of our modified political economy model as opposed to the one of Cadot et al. (2006). In addition, other results in Table 8 cast doubts on the validity of using ROO index as a measure of the strictness of ROO requirements. For example, the coefficient estimate on the Korea MFN tariff is negative for the case of Bindingness index, confirming the expected role of ROO requirements to discourage trade deflection, but the coefficient estimate changes its sign into a negative one when we use ROO index.

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[22] We would like to thank Chul Chung for his suggestion of including the textile dummy.

[23] If ROO requirements are meant to discourage trade deflection, the harder to enter the Korean market with a higher MFN tariffs of Korea, the less strict a ROO requirement should get.

V. Conclusion

Because the ROO requirements play a crucial role in determining the effectiveness of a FTA as a vehicle of liberalization, understanding the negotiation of ROO requirements is important in analyzing causes and effects of FTAs proliferating across the globe. By modifying the political economy model developed by Cadot et al. (2006) and testing it with the data of the recently formed FTA between Korea and the US, we extend such understanding of ROO requirements. In addition, we construct a new measure of the strictness of ROO requirements that reflect the status quo local contents of products, namely Bindingness index. Our empirical analysis indicates that Bindingness index works better than the existing measure proposed by Estevadeordal (2000) as a measure of strictness of ROO requirements.

Our empirical analysis also shows the necessity to generalize the current theoretical model of ROO requirements. The explanatory power of the current model measured by pseudo R^2 is not very high, and comparing with the corresponding one of Cadot et al. (2006) also shows that it is smaller for KORUS FTA than for NAFTA. This is not surprising because the North-South trade model may work better for trade between Mexico and the US than for trade between Korea and the US. In particular, Korean economy plays both the role of final goods assemblers and the role of intermediate good suppliers to the US economy, as in the case of smart phones and automobiles. In the negotiation for KORUS FTA, Korea might have had some bargaining power in its negotiation with the US. Developing a more general model that allows a richer set of global production chains as well as bargaining among negotiating countries is going to be a significant step forward for understanding FTAs, ROO determinations, and their implication toward the world economy.

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Appendix A

We construct a new measure of strictness of ROO requirements, Bindingness index, taking status-quo local contents into consideration. In the process of constructing "Bindingness index", first we build ROO index using the ROO requirements of KORUS FTA, the index that follows the construction method of the index of Estevadeordal (2000) for NAFTA. To reflect more detailed specifications on ROO requirements in KORUS FTA than those in NAFTA, we fine-tune Estevadeordal's index in constructing ROO index: while we adhere to the basic principle of Estevadeordal (2000) in classifying ROO requirements into different index values, we extend the number of index values from 7 to 8.

In classifying ROO requirements of NAFTA into 7 index values, Estevadeordal (2000) uses the following two rules. First, a change in tariff heading at the level of chapter (CC) is more restrictive than a change at the level of heading (CH), and a change at the level of heading is more restrictive than a change at the level of subheading (CS). Second, values content (VC) and technological requirement (TECH) attached to a given change in tariff classification make ROO requirements more restrictive.

In addition to these main rules, Estevadeordal uses the following classification rules in the case of ROO requirements for which no change in tariff classification is specified. ROO requirements based on the import content (MC) are equated to a change in heading (CH, index value 4) if the content requirement allows up to 50 percent of non-originating inputs of the ex-works price of the product, i.e. MC(50).[24] When the permitted share of non-originating inputs is below 50 percent, he assigns index value 5 to such a product. When the import content criterion is combined with a technical requirement, he also assigns index value 5. The highest index value 7 is assigned to the case of the wholly-obtained criterion.

Largely conforming to the classification method of Estevadeordal (2000) described above, ROO index fine-tunes it as follows. First, in addition to a required change in tariff classification, some ROO requirement specifies the value of parts (VP: a requirement for using specific local parts), specific technical process (TECH), or regional value content (RVC), as an additional condition to meet. For a ROO requirement that specifies such an additional condition, we assign a higher ROO index value. Second, some ROO requirements specify exceptions, such as excluding heading XXXX or sub-heading XXXXXX for preferential treatments under a FTA. ROO index classifies a ROO requirement with such an exception as a more restrictive one than the one without any exception, assigning a higher index value. Third, if a ROO requirement specifies an option, such as selecting either CS

[24] The ex-works price of a product denotes the price of a product at the factory warehouse (thus, not including any tax or transportation costs).

or CS+RVC for a ROO requirement to satisfy, then the assigned ROO index value will be the lowest one among the options. The following table shows the classification method of ROO index and Estevadeordal's index.

[Table A-1] Classification Methods of ROO Index and Estevadeordal Index

ROO Requirements	ROO Index	Estevadeordal's Index
Wholly obtained	8	
CCE + TECH		
CCE + VP		
CCE	7	if CC < y* ≤ Wholly obtained
CC + TECH		
CC + RVC		
CC + VP		
CC	6	if CH + RVC < y* ≤ CC
CC or CH + RVC		
CC or CH + VP		
CHE + RVC		
CHE	5	if CH < y* ≤ CH + RVC
CHE or CH + RVC		
CHE or CS + RVC		
CH + VP		
CC or CS + RVC		
CH	4	if CS + RVC < y* ≤ CH
CH or CS + RVC		
CSE + RVC		
CSE	3	if CS < y* ≤ CS + RVC
CSE or CS + RVC		
CS + VP		
CS	2	if CI < y* ≤ CS
CS or CS + RVC		
RVC	1	if y* ≤ CI

Note: Restrictiveness of a ROO requirement (y*), A Change in Chapter (CC), CC with some exemptive clauses (CCE), Change in Heading (CH), Change in Sub-heading (CS), Change in Item (CI), Value of Parts (VP), Technical Requirement (TECH), and Regional Value Content (RVC).

We also construct Local Content index by using import inducement coefficients of the input-output table published by the Bank of Korea for the year of 2007. An import inducement coefficient of a sector (or equivalently a product in that sector) represents the value of imports required directly or indirectly for producing one unit value of a product in that sector, telling how much percentage of value added of a product in that sector is created through imported materials. As well-known in the literature of analyzing input-output tables, the import inducement coefficient matrix is obtained by multiplying the input coefficient matrix for import with the production inducement coefficient matrix. Then, the import inducement coefficient of a sector i is obtained by summation of elements of *ith* column of the import inducement coefficient matrix.

To have import inducement coefficients from the input-output table of Korea that correctly represent the percentage values of "non-originating" materials in the context of KORUS FTA, we go through the following procedure of reclassifying imported intermediate goods from the US as a part of "originating" (thus, not "imported") materials. For this reclassification, we need to extract the imports of the US products away from the total import transaction reported by the Bank of Korea. To do this, we first need to calculate the ratio of the value of import from the US to the one from the world for each good (or equivalently, for each sector of the input-output table). Because the input-output table of the Bank of Korea does not provide such a country-based information of imports, for each sector of the input-output table, we obtain the ratio of Korean import value from the US to Korean import value from the world using the UN Comtrade data.[25]

Denote the diagonal matrix of which diagonal element is equal to the ratio of Korean import value from the US to Korean import value from the world for the corresponding sector by R^{US}. Among different types of input-output table, we use the "non-competitive import type" model which reports the input coefficient matrix for domestic intermediate goods (denoted by A^d) and the input coefficient matrix for import (denoted by A^m), separately. We define (and calculate) $A^{m-US} \equiv A^m - A^m R^{US}$ and $A^{d+US} \equiv A^d + A^m R^{US}$. Then, we obtain the production inducement coefficient matrix by $(I - A^{d+US})^{-1}$ and the import inducement coefficient matrix by $A^{m-US}(I - A^{d+US})^{-1}$. As mentioned above, we obtain the import inducement coefficient of a sector i by summing up all elements of *ith* column of the import inducement coefficient matrix, $A^{m-US}(I - A^{d+US})^{-1}$.

Table 1 in Section 2.1 shows how we convert an import inducement coefficient that we obtain through the method explained above into an index value of Local Content index. In assigning an import inducement coefficient value to a corresponding index value of Local Content index, we take the following facts into consideration. If the import content (MC) requirement allows up to 50 percent of non-originating inputs, recall that Estevadeordal's index assigns index value 4 for such a ROO requirement, the index value for the case of a change in tariff heading (CH). In comparison with the NAFTA system that largely focuses on changes in tariff classification in specifying ROO requirements, the EU has developed a system that specifies ROO requirements both in terms of required changes in tariff

[25] First, we create the table that matches the HS classification of products (5051 items) to that of the input-output table of Korea (403 items) for the year of 2007. After mapping 5051 products of HS classification into 403 sectors of the input-output table (I-O table), we can obtain Korean import values from the US and from the world, and their ratio for each sector of the I-O table, from the UN Comtrade data based on the HS classification.

classification and in terms of local content requirements, namely PANEURO system.[26]

Because the NAFTA system of KORUS FTA provides only a partial and incomplete mapping between local content requirements and required changes in tariff classification, on which the classification of our ROO index is based as shown in Table 1, we examine the ROO requirements in Korea-EU FTA and Korea-EFTA FTA that follow the PANEURO system. According to this examination, for example, the import content requirements that set the maximum percentage of non-originating inputs from 30 to 50 percentage correspond to required changes in tariff classification associated with ROO index values from 4 to 5. Reflecting such a relationship, we convert an import inducement coefficient that belongs to the range of [30, 50] into a Local Content index value of 4.5, the average of ROO index values of 4 and 5. In assigning Local Content index value 1 to products with an import inducement coefficient being greater than 65, we take the following facts into consideration. In specifying local content requirements, KORUS FTA uses what is known as Regional Value Content (RVC). In satisfying a RVC requirement, KORUS FTA allows a product to use either one of two methods in calculating RVC, Build-down or Build-up methods: Build-down method = ((Adjusted Total Value − Adjusted value of Non-Originating Materials) / Adjusted Total Value) × 100; Build-up method = (Value of Originating Materials / Adjusted Total Value) × 100. Since it is the Build-down method that uses the value of non-originating materials, we utilizes this method in finding the critical level of import inducement coefficient, above which we assign the lowest Local Content index value 1. Based on the fact that the minimum required percentage of RVC to meet any ROO requirement is 35 percent in terms of the Build-down method, we assign the lowest Local Content index value 1 to a product that uses non-originating materials that are more than 65 percent of the total value of the product. Finally, we assign Local Content index value 2.5, the average of 2 and 3 of ROO index values, to the products of which import inducement coefficient values belonging to the range of (50, 65), and similarly we assign Local Context index value 6.5 to the products of which import inducement coefficient values belonging to the range of (0, 30).

[26] In term of specifying ROO requirements, FTAs that Korea has signed mostly follow either one of these two systems of classification. For example, Korea-EU FTA, Korea-EFTA FTA, and Korea-Turkey FTA follow the PAENURO system, and Korea-Chile FTA, Korea-US FTA, and Korea-Peru FTA follow the NAFTA system.