Generalized Third-Country Effects on the Formation of Free Trade Agreements (Very Preliminary and Not for Circulation)

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1 Introduction

Regional Trade Agreements (RTAs) have spread widely since the early 1990s. As of January 2019, 291 RTAs out of 467 notifications (counting goods, services and accessions separately) are in force, according to the WTO.

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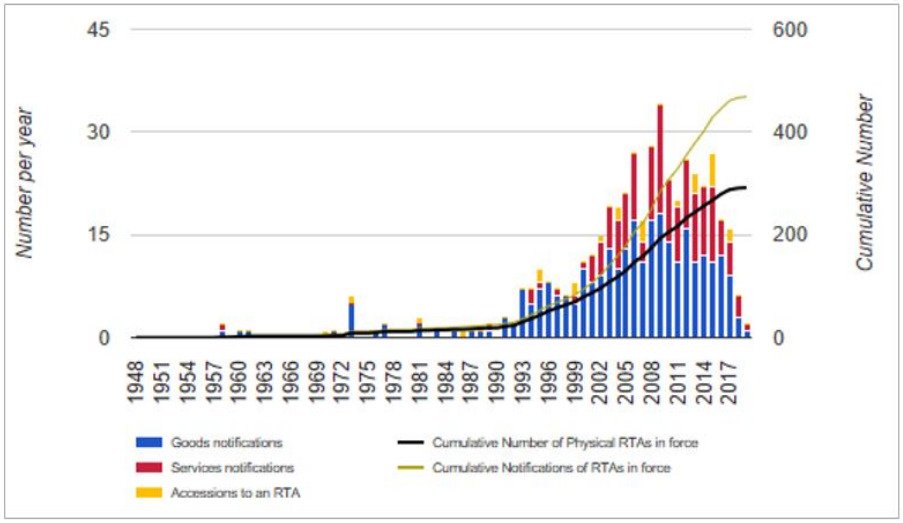
[Figure 1.1] RTAs currently in force, 1948-2019



Source: WTO Homepage

According to a summary of statistics on 189 countries, 164 out of 189 countries joined one or more Free Trade Agreements (FTAs) as of 2013, and the country with the most FTAs had up to 76 FTA partners. Each country had on average 3 FTA partners in 1993 but the number had risen to 27 in 2013. In the case of countries with more than one FTA, it is shown that the average number of FTAs had risen from 11 in 1993 to 31 in 2013. These trends imply that countries participating in FTAs have become more interdependent with each other in complex and continuously evolving FTA networks.

[Table 1.1] Summary statistics for the trends of FTAs

	1993	1997	2001	2005	2009	2013
# of countries with FTAs out of 189 countries	73	103	139	160	164	164
Max # of FTA partners	25	31	36	44	63	76
Median(mean) # of FTA partners of all countries	0 (4)	2 (7)	6 (11)	10 (15)	12 (22)	15 (27)
Median(mean) # of FTA partners of countries with FTAs	11 (11)	6 (12)	13 (14)	14 (18)	15 (25)	19 (31)
Median(mean) diff. of FTA partner # between all pairs of countries	3 (7)	5 (9)	9 9(12)	10 (16)	17 (23)	24 (27)
Median(mean) diff. of FTA partner # between any two parties with a FTA	1 (3)	1 (4)	4 (5)	2 (6)	14 (14)	27 (21)

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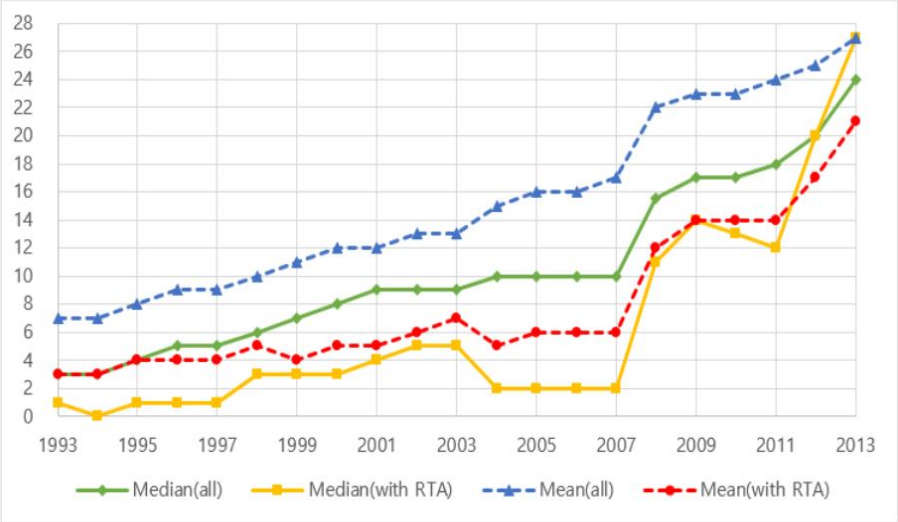
The median and mean of the differences in the number of FTA partners between two parties with a FTA are smaller than those of all pairs of countries, as one should expect. The median of the difference in the number of FTA partners between two parties with a FTAs had been floating between 0 to 5

during 1993-2007. Given the fact that the numbers of both FTA participating countries and FTA partners have been increasing, it is noteworthy that the difference in the number of FTA partners between any two parties with a FTA was not so large. This is is probably due to the tendency that countries who do not have a significant difference in the number of existing FTA partners are more likely to form a new FTA with each other than those countries with a significant difference in the number of existing FTA partners.

While this trend sharply changes in 2008, our study provides a possible theoretical explanation and theory-based empirical evidences for why countries who have a similar number of existing FTA partners may have a stronger incentive to form a new FTA with each other than others. This effect of pre-existing FTA partners (or having no FTA partner) on the incentive of any pair of countries to form a new FTA is known as a *third-country effect* in the sense that their existing FTA partners or their trading partners with no FTA are *third parties* who are not directly involved in their signing a new FTA.

[Figure 1.2] Median(mean) difference of FTA partner numbers between all pairs of counties or any two parties with FTA



Despite the possible third-country effect on formation of new FTAs, the existing studies have largely focused on the directly participating countries' economic characteristics (Baier and Bergstrand, 2004 & 2007), political characteristics (Mansfield, Milner and Rosendorff, 2002), and multilateral issues related to GATT/WTO (Mansfield and Reinhardt, 2003), as the determinants of FTA formation[1]. Manger (2006) is the first empirical study that have paid a special attention on the possible third-country effect on FTA formation. The existing research on the third-country effect can be classified into two groups, one that emphasizes so called "*concession-erosion*" versus "*loss-sharing*" *effects*

[1] Nuno Limão (2016) provide a survey of the literature on PTAs(Preferential Trade Agreements).

of the existing FTA partners, and the other ones that stress what is known as a "*domino*" *effect* of the existing FTAs.

With regard to the first group, Chen and Joshi (2010) show how pre-existing FTA relationship with a third country affects a country's incentive to establish an FTA, based on the three-country trade model. They identify two kinds of third-country effect that influences on formation of a new FTA. First, if a home country has a pre-existing FTA with the third country, a home firm's profit loss in the home market that results from a new FTA can be smaller than the expected loss with no pre-existing FTA because the pre-existing FTA partner's exporting firm will share a part of the home market profit loss caused by a surge of imports from the new FTA partner. This effect is called "*a loss sharing effect*." Now, consider the home firm's export side: The home exporting firm expects to earn a greater profit in the new FTA partner's market with help of the new preferential market access. But the exporting firm's profit gain will get smaller if the new FTA partner already has an FTA with the third country. This is because the third-country firm's pre-existing preferential market into the new FTA partner's market dilutes the home exporting firm's potential profit gain from the new preferential market access. This effect is called "*a concession erosion effect*." Comparing with the benchmark case of no pre-existing FTA, when only one country in the pair has a pre-existing FTA, Chen and Joshi (2010) show that the country with a (no) pre-existing FTA has a stronger (weaker) incentive to sign a FTA with the other country. As a result of these counteracting third-country effects, "the country pair will jointly support an FTA only if the country with a pre-existing FTA offers a sufficiently attractive export market, which requires the country to have a relatively large market size, a high-cost domestic firm, and low transport costs." If both countries have pre-existing FTAs with the third country, then the loss-sharing effect dominates the concession-erosion effect, providing a stronger incentive for the country pair to form a FTA than the benchmark case with no pre-existing FTA.

For the second group, several studies have empirically estimated a "*domino effect*," the likelihood that a pair of countries signs an FTA will increase with the threat of trade diversion that results from either already having other FTAs: Manger (2006), Egger and Larch (2008), Bergstrand et al. (2011), Baldwin and Jaimovich (2012), and Baier et. al. (2014). Egger and Larch (2008) empirically show that pre-existing PTAs raise the possibility to form a new bilateral agreement but this effect can be reduced with the distance. Baldwin and Jaimovich (2012) extend the domino effect model by developing a theory-based measure and defining a "contagion index" with asymmetries in the dyads based on the political economic approach. Baier et. al. (2014) also show that the utility gain of a pair of countries forming a new FTA is likely to get bigger with either having other FTAs (an "*Own-FTA*" or a *domino* effect) and also with other FTAs existing in the rest of the world (a "*Cross FTA*" or a "*competitive liberalization*" effect). In addition, they empirically confirms their theoretical conjecture that a *Own-FTA* effect is likely to have a greater impact on the formation of a new FTA than a *Cross FTA* effect does. These previous studies use spatial econometrics to test whether forming a new FTA between a pair of countries can be

affected by the pre-existing FTAs of other country-pairs.

By extending the three-country trade model of Chen and Joshi (2010) to a-N-country model with different industrialization levels and tariff rates, developed by Furusawa and Konish (2007), our study derives the testable empirical model that can distinguish a loss sharing effect and a concession erosion effect in a bilateral FTA formation. A pre-existing FTA of a country who considers to form a new FTA with another country would have a loss-sharing effect (thus, a positive effect) on her incentive to sign that new FTA, but the same pre-existing FTA would also have a concession-erosion effect (thus, a negative effect) on her partner country's incentive to sign that new FTA, creating the issue of empirically identifying these counter-acting effects of a pre-existing FTA. The N-country trade model of Furusawa and Konish enables us to derive two related but distinctive measures for these two effects of a pre-existing FTA.

To empirically test a loss sharing effect and a concession erosion effect, Chen and Joshi (2010) use an indicator variable based on a pre-existing FTA relationship among three countries. In contrast, our study uses an empirical method developed to deal with "*spatial dependence with dyadic data*,": *Spatial dependence with dyadic data* describes the situation where the decision of a pair of country can be influenced by those of other pairs of countries. We uses the spatial econometric analysis that is similar to that of Egger and Larch (2008), but our analysis differs from theirs by utilizing the weighting matrix constructed from the theory-based measures of pre-existing FTA effects.

This paper consists of following sections. Based on the N-country trade model of Furusawa and Konish (2007), Section 2 analyzes the net welfare changes caused by a new FTA, considering pre-existing FTA effects. Section 3 provides the empirical analysis of our model's prediction regarding the determinants of FTAs. Finally, section 4 shows how well our theoretical model predicts the formation of a new FTA through calibration exercises. Section 5 concludes.

2 The Theoretical Model

2.1 The Basic Set-up

This study is based on the basic set-up of Furusawa and Konishi (2007) to develop the theoretical model[2]. It is assumed that the world consists of n countries, which is populated by a continuum of identical consumers who consume a numeraire good and a continuum of differentiated commodity.

All of produced goods are aggregated competitively into one good, named as the numeraire good[3]. Each consumer is endowed with l unit of labor, which

[2]This study examines the pair-wise effect rather than N's order effect of pre-existing FTA network on the formation of new FTAs in the myopic perspective. So, it is assumed that each negotiating party myopically decides whether to sign a new FTA or not.

[3]In this model, since substitutability among differentiated goods is critical parameter to determine the effect of trade policy, it is needed to assume all differentiated goods belong to a single industry and other competitively produced goods are aggregated into one good, to clarify impacts of trade policy on the welfare. Such an assumption is based on the Dixit and Stiglitz (1977). So,

is used for production of the industrial and numeraire goods. Each unit of labor produces one unit of the numeraire good, so that the wage rate equals 1. It is also assumed that industrial commodities normalize the unit labor requirement to be equal to 0 for each industrial commodity[4].

A continuum commodity is horizontally differentiated in a representative industry. A differentiated commodity can be considered as a variety of an industrial goods that are indexed by $\omega \in [0,1]$. The differentiated industrial commodity, ω, is produced by one firm that belongs to one of n countries, which is also indexed by the same, ω, which engages in price competition with other firms in individual segmented countries. Industrial commodities are produced with a CRS technology without any further entry of firms into this industry.

Under an asymmetry n-county model, each country may have different size of total population and market share of the industrial good. In country $i \in N$, measure μ^i of consumers and measure s^i of firms that produce industrial commodities. Country i produces s^i industrial commodities, which are consumed in every country in the world. The markets are segmented so that firms can perfectly discriminate the price among different countries. Both the size of total population and the market share of the industrial goods are normalized so that$\sum_{k=1}^{n} \mu^k = 1$ and $\sum_{k=1}^{n} s^k = 1$. The ratio $\theta^i = s^i/\mu^i$ measured country i's industrialization level. The higher the ratio, the higher the country's industrialization level. Finally, zero cost of production is assumed in differentiated goods, which means that all countries are identical in their capacities of production in differentiated goods. Because of this assumption, gain from trade comes from expending variety. And, the mass of firms, s^k, exogenously given by model, determines the potential market share of each country in the global differentiated product market.

Country i imposes a specific tariff at a rate of t_j^i on the imports of the industrial commodities that are produced in country j. For simplicity, it is assumed that there is no commodity tax such as $t_i^i = 0$. In addition, each country does not impose tariffs on the numeraire good which may be traded internationally to balance the trade. Tariff revenue is redistributed equally to domestic consumers. Regarding the pre-existing FTAs, $C_i = \{k \in N \mid t_k^i = 0\}$ represents the set of countries that produce commodities on which country i does not impose tariffs, including country i itself. In addition to C_i, $\widehat{C_i}$ is also defined as the set of countries that produce commodities on which country i does not impose tariffs except country i itself. This model considers the situation where country i has signed FTAs with all other countries in $\widehat{C_i}$ rather than CUs. $t(\gamma)$ is the bilateral tariff reform schedule between countries i and j, which satisfies $t_j^i(\gamma) = (1-\gamma)t^i$ and $t_i^j(\gamma) = (1-\gamma)t^j$ for $\gamma \in [0,1]$. The existence of an FTA between i and j is denoted by $\gamma = 1$ and hence $t_j^i(0) = t^i$ and $t_j^i(1) = 0$.

intra-industry elasticity of substitution is only considered . However, the basic set-up is different from Dixit and Stiglitz (1977) and Krugman (1980), which are based on the C.E.S. utility function with a constant elasticity of substitution between varieties.

[4]Alternatively, it can be interpreted that the model such that each consumer is endowed with l units of the numeraire good, which can be transformed by a linear technology into industrial commodities.

The average tariff rate is denoted by $\bar{t}^i(\gamma) = \sum_{k \notin C_i \cup \{j\}} s^k t^i + s^j(1-\gamma)t^i = (1 - s^{C_i} - \gamma s^j)t^i = (1 - s^i - s^{\widehat{C_i}} - \gamma s^j)t^i$. Lastly, the third countries could be classified as two different kinds of groups: one is the third countries (k) which already belong to $\widehat{C_i}$ and the other is the third countries (h) which do not belong to $\widehat{C_i}$ yet, i.e. $k \in \widehat{C_i}$ and $h \notin \widehat{C_i}$.

2.2 Equilibrium in country i

Furusawa and Konishi (2007) uses the way of a welfare decomposition in quasi-linear economies proposed by Furusawa and Konishi (2003). According to Furusawa and Konishi (2003), social welfare can be decomposed into the gross utilities and trade surplus under two certain conditions: consumers have quasi-linear utility function and all countries share the same CRS production technology for each commodity. To adopt the way of a welfare decomposition, it is assumed that consumers in all countries share a common quasi-linear utility function in which substitutability of industrial commodities is parameterized in addition to the zero cost of production in differentiated goods.

A representative consumer's utility is given by the quasi-linear utility function with a quadratic substitutability.

$$U(q, q_0) = \int_0^1 q(\omega)d\omega - \frac{1-\sigma}{2}\int_0^1 q(\omega)^2 d\omega - \frac{\sigma}{2}\left[\int_0^1 q(\omega)d\omega\right]^2 + q_0$$

where $q : [0,1] \to \mathrm{R}_+$ is an integrable consumption function, and q_0 denotes the consumption level of the numeraire good.

$q(\omega)$ is the quantity of variety $\omega \in [0,1]$, and q_0 the quantity of the numeraire. The parameter, σ, expresses the substitutability between varieties: the higher σ, the higher substitutability among differentiated commodities in a representative industry. In other word, the industrial commodities are independent from one another if $\sigma = 0$, while they are perfect substitutes (homogeneous products) if $\sigma = 1$.

Letting y denote the consumer's income, the budget constraint is written as

$$y = \int_0^1 \widetilde{p}(\omega)q(\omega)d\omega + q_0$$

where $\widetilde{p}(\omega) : [0,1] \to \mathrm{R}_+$ denotes the consumer price function.

The first order condition for the consumer's maximization problem derives the inverse demand function for each good ω.

$$q(\omega) = \frac{1}{1-\sigma}[1 - \widetilde{p}(\omega) - \sigma(1 - \widetilde{P})]$$

where $\widetilde{P} = \int_0^1 \widetilde{p}(\omega)d\omega$, denotes the average consumer price in country i.

On the other hand, the firm ω in country k chooses $\{p^i(\omega)\}_{i=1}^n$ to maximize its profits:

$$\pi(\omega) = \sum_{i=1}^{n} \mu^i p^i(\omega) q^i(\omega)$$

where $q^i(\omega) = \frac{1}{1-\sigma}[1 - p^i(\omega) - t_k^i - \sigma\{1 - \widetilde{P}(\omega)\}]$, letting $p^i(\omega)$ denote the producer price for commodity ω, which is a representative consumer's demands in country i for commodity ω produced in country k.

The first order condition for the firm's maximization derives the producer price for commodity.

$$p^i(\omega) = \frac{1}{2}[1 - t_k^i - \sigma\{1 - \widetilde{P}(\omega)\}] \text{ for any } i$$

In the equilibrium of maximizing the profit of the firm ω, prices charged by firms depend only on the import country's tariff policies. Since the argument ω is suppressed since $P^i(\omega)$ does not vary with ω, country i's average consumer price is rewritten as $\widetilde{P^i} = \sum_{k=1}^{n} s^k(p^i + t_k^i) = \frac{1}{2}\{1 + \overline{t}^i - \sigma(1 - \widetilde{P^i})\}$ where $\overline{t}^i = \sum_{k=1}^{n} s^k t_k^i$.

$$\widetilde{P^i} = \frac{1-\sigma+\overline{t}^i}{2-\sigma}$$

Finally, the equilibrium producer price, p_k^i that each firm in country k charges for the market of country i, as a function of country i's tariff vector, $t^i = (t_1^i, ...t_n^i)$ can be written as $\frac{1}{2}[1 - t_k^i - \sigma(1 - \frac{1-\sigma+\overline{t}^i}{2-\sigma})]$ and p_k^i can be derived as following.

$$p_k^i(t^i) = \frac{1-\sigma}{2-\sigma} - \frac{1}{2}t_k^i + \frac{\sigma}{2(2-\sigma)}\overline{t}^i$$

On the other hand, since $q(\omega) = \frac{1}{1-\sigma}[1 - p^i(\omega) - t_k^i - \sigma(1 - \widetilde{P(\omega)}]$, a representative consumer's demand in country i for a commodity produced in country k, denoted by $q_k^i(t^i)$ can be written as $\frac{1}{1-\sigma}[1 - p_k^i(t^i) - t_k^i - \sigma(1 - \frac{1-\sigma+\overline{t}^i}{2-\sigma})]$ and $q_k^i(t^i)$ can be derived as following.

$$q_k^i(t^i) = \frac{1}{2-\sigma} - \frac{1}{2(1-\sigma)}t_k^i + \frac{\sigma}{2(1-\sigma)(2-\sigma)}\overline{t}^i$$

where $\overline{t}^i = \sum_{k=1}^{n} s^k t_k^i$.

Thus, a representative consumer's demand in country i is a function of the tariff rate (t_k^i) imposed on the commodity and the average tariff rate $(\overline{t}^i)$ in the equilibrium.

2.3 A Representative Consumer's Utility

Furusawa and Konishi (2007) supposes that there is only one consumer in every country to simplify the model. A representative consumer's income in country i is the sum of labor income, redistributed tariff revenue, and profit shares of the firms in country i :

$$y = l + T^i(t^i) + \frac{s^i \pi_i(t)}{\mu^i}$$

Under the world tariff vector $t = (t^1, ...t^n)$, each firm in country i earns the profits:

$$\pi_i(t) = \sum_{k=1}^{n} \mu^k p_i^k(t^k) q_i^k(t^k) = \sum_{k=1}^{n} \mu^k (1-\sigma) q_i^k(t^k)^2$$

Country i's per-capital tariff revenue is

$$T^i(t^i) = \sum_{k=1}^{n} t_k^i s^k q_k^i(t^i)$$

Then, the budget constraint can be written as

$$y = \sum_{k=1}^{n} s^k [p_k^i(t^i) + t_k^i] q_k^i(t_k^i) + q_0 = l + T^i(t^i) + \frac{s^i \pi_i(t)}{\mu^i}$$

$$\begin{aligned}
\therefore q_0 &= l + T^i(t^i) + \frac{s^i \pi_i(t)}{\mu^i} - \sum_{k=1}^{n} s^k [p_k^i(t^i) + t_k^i] q_k^i(t_k^i) \\
&= l + \sum_{k=1}^{n} t_k^i s^k q_k^i(t^i) + \frac{s^i}{\mu^i} \sum_{k=1}^{n} \mu^k p_i^k(t^k) q_i^k(t^k) - \sum_{k=1}^{n} s^k [p_k^i(t^i) + t_k^i] q_k^i(t_k^i) \\
&= l - \sum_{k \neq i} s^k p_k^i(t^i) q_k^i(t^i) + \frac{s^i}{\mu^i} \sum_{k \neq i} \mu^k p_i^k(t^k) q_i^k(t^k)
\end{aligned}$$

where $q^i(\omega) = q_k^i(t^i)$ if ω is produced in country k.

Finally, solving for q_0 and substituting q_0 into quasi-linear utility function, Furusawa and Konishi (2007) can have a representative consumer's utility as a function of the world tariff vector, which can be considered as country i's per capital social welfare[5]:

$$W^i(t) \equiv U(q_k^i(t^i)_{k \in N}, q_0^i(t^i)) = V^i(t^i) + \left[X^i(t^{-i}) - M^i(t^i)\right]$$

$$\begin{aligned}
\text{where } V^i(t^i) &= \sum_{k=1}^{n} s^k q_k^i(t^i) - \frac{(1-\sigma)}{2} \sum_{k=1}^{n} s^k q_k^i(t^i)^2 - \frac{\sigma}{2} \left[\sum_{k=1}^{n} s^k q_k^i(t^i) \right]^2 + l \\
M^i(t^i) &= \sum_{k \neq i} s^k p_k^i(t^i) q_k^i(t^i) = \sum_{k \neq i} (1-\sigma) s^k q_k^i(t^i)^2 \\
X^i(t^{-i}) &= \frac{s^i}{\mu^i} \sum_{k \neq i} \mu^k p_i^k(t^k) q_i^k(t^k) = \frac{s^i}{\mu^i} \sum_{k \neq i} (1-\sigma) \mu^k q_i^k(t^k)^2
\end{aligned}$$

2.4 Incentive to Sign an FTA

An FTA between countries i and j reduces or eliminates tariffs imposed on commodities imported from each other while keeping all other tariffs at their original level. The welfare change due to the FTA between countries i and j can be expressed as following;

$$W^i(t_j^i, t_{-j}^i; t_i^j, t_{-i}^j; t^{-\{i,j\}}) \leq W^i(0, t_{-j}^i; 0, t_{-i}^j; t^{-\{i,j\}})$$

[5]Note that one unit of numeraire good is produced with one unit of labor (l), which is linear. And, q_0 does not mean that export is good but import is bad. Increased imports improve the consumer utility but it also increase the import payment for differentiated goods, which lead to less consumption of numeraire goods($q_0 - l = X - M$). For this reason, a new FTA between country i and j causes the increase in imports without any change in exports, which leads to less import payment. Less import payment make it possible for a representative consumer to earn more income and consume more numeraire goods.

Country i is willing to sign an FTA with country j only if it can benefit from the agreement such as positive sum of welfare change in a consumer gross utility and trade surplus. A tariff elimination (or reduction) is likely to increase a consumer gross utility unless the industrial commodities are highly substitutable while it also leads to the opposite result otherwise. However, the impact on the trade surplus might be ambiguous. This is because since the FTA increases export profit margins and import payment as well, mutual trade liberalization might not change the direct trade surplus between newly negotiating parties. It will be more likely to happen if two countries have similar economic sizes. On the other hand, the decreases of imports from the RoW positively affect the trade surplus without any change in exports to the RoW[6]. Therefore, the change of trade surplus is crucial to determine whether an FTA improves the welfare given that mutual trade liberalization increases consumer's gross utilities.

2.4.1 Gross Utility Effect

Because of tariff elimination (or reduction) after a new FTA, each consumer in country i will increase the consumption of country j's commodities, which cause the domestic consumer's gross utility to increase. However, each consumer gets to consume other commodities less than before as well. If the latter effect may outweigh the former, a decrease in tariffs might decrease the domestic consumer's gross utility. It is more likely to happen if the industrial commodities are highly substitutable among themselves. Regarding the deriving process of the welfare change after forming an FTA can be found in Furusawa and Konishi (2007). The welfare change of country i in consumer gross utility after signing an FTA between i and j can be defined as following.

$$\triangle V^i(t) = \int_0^1 \frac{dV^i}{d\gamma} d\gamma = \int_0^1 s^j t^i \left[\frac{1-\sigma}{(2-\sigma)^2} - \frac{\sigma^2}{4(1-\sigma)(2-\sigma)^2} \bar{t}^i + \frac{(1-\gamma)}{4(1-\sigma)} t^i \right] d\gamma$$

$$= \frac{s^j t^i}{8(1-\sigma)(2-\sigma)^2} [8(1-\sigma)^2 + \{-(1-2s^i-s^j)\sigma^2 + 4(1-\sigma)\} t^i] + s^{\widehat{C_i}} \frac{s^j \sigma^2 (t^i)^2}{4(1-\sigma)(2-\sigma)^2}$$

The change in gross utility of country i due to a new FTA, $\triangle V^i(t)$, consists of two parts. One is the change in gross utility which is not affected by the effects of pre-existing FTAs and the other is derived from the pre-existing FTAs ($s^{\widehat{C_i}}$). The second part explains that country i already enjoys love of variety thanks to the goods imported from i's pre-existing FTAs ($s^{\widehat{C_i}}$) with preferential tariffs.

2.4.2 Trade Surplus Effect

The welfare change of country i in trade surplus (direct surplus + third country effect) after forming an FTA between i and j can be defined as following.

[6]Note that given that both i and j already have FTAs with the third countries, a representative consumer's demands for the goods of a new FTA partner, q_j^i, are increased but a representative consumer's demands for the goods of Row, q_k^i and q_h^i, are decreased after forming a new FTA between country i and j.

$$\Delta\left[X^i(t^{-i}) - M^i(t^i)\right] = \int_0^1 \frac{dX_j^i(t(\gamma))}{d\gamma} - \frac{dM_j^i(t(\gamma))}{d\gamma}$$
$$+ \sum_{k\in\widehat{C_i}} \frac{dX_k^i(t(\gamma))}{d\gamma} - \frac{dM_k^i(t(\gamma))}{d\gamma} + \sum_{h\notin\widehat{C_i}\cup\{i,j\}} \frac{dX_h^i(t(\gamma))}{d\gamma} - \frac{dM_h^i(t(\gamma))}{d\gamma} d\gamma$$
$$= (1-\sigma)\int_0^1 2\frac{s^i}{\mu^i}\mu^j q_i^j \frac{dq_i^j}{d\gamma} - 2s^j q_j^i \frac{dq_j^i}{d\gamma} - 2s^k q_k^i \frac{dq_k^i}{d\gamma} - \textstyle\sum_{h\notin\widehat{C_i}\cup\{i,j\}} s^h q_h^i \frac{dq_h^i}{d\gamma} d\gamma$$
$$= \frac{s^i}{\mu^i}\mu^j\{\tfrac{1}{2-\sigma} - \tfrac{t^j}{4(1-\sigma)} + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}(1 - s^j - \tfrac{s^i}{2})t^j\}(1 - \tfrac{s^i\sigma}{2-\sigma})t^j$$
$$-\mu^j s^i s^{\widehat{C_j}} \tfrac{\sigma(t^j)^2}{2(1-\sigma)(2-\sigma)}(1 - \tfrac{s^i\sigma}{2-\sigma})$$
$$-s^j\{\tfrac{1}{2-\sigma} - \tfrac{t^i}{4(1-\sigma)} + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}(1 - s^i - \tfrac{s^j}{2})t^i\}(1 - \tfrac{s^j\sigma}{2-\sigma})t^i$$
$$+s^j s^{\widehat{C_i}} \tfrac{\sigma(t^i)^2}{2(1-\sigma)(2-\sigma)}(1 - \tfrac{s^j\sigma}{2-\sigma})$$
$$+\left(1 - s^i - s^j\right)\{\tfrac{1}{2-\sigma} - \tfrac{t^i}{2(1-\sigma)} + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}(1 - s^i - \tfrac{s^j}{2})t^i\}\tfrac{s^j\sigma t^i}{(2-\sigma)}$$
$$+s^{\widehat{C_i}} \tfrac{t^i}{2(1-\sigma)} \tfrac{s\sigma t^i}{(2-\sigma)} - (1 - s^i - s^j)s^{\widehat{C_i}} \tfrac{\sigma t^i}{2(1-\sigma)(2-\sigma)} \tfrac{s^j\sigma t^i}{(2-\sigma)}$$

The change in trade surplus due to a new FTA, $\Delta\left[X^i(t^{-i}) - M^i(t^i)\right]$, also consists of two parts. One is the change in trade surplus which is not affected by the effects of pre-existing FTAs and the other is derived from the pre-existing FTAs, $s^{\widehat{C_i}}$ and $s^{\widehat{C_i}}$. In this result, the effect of pre-existing FTAs on the incentive for country i to sign an FTA with country j can be explained in four different ways. The first is a concession erosion effect, which is smaller profit gain from exports to a new FTA partner than expected if a new FTA partner already has FTAs with other third countries. This is because pre-existing preferential market access of other third countries to the partner country dilutes the potential gain that the exporting firms of country i expect to achieve. The second is a loss sharing effect, which is smaller loss in the firms' home market profit than expected if country i already has FTAs with other third countries. The exporting firms in other third countries that already form pre-existing FTAs with the country i will absorb larger share of the domestic profit loss. First two effects are derived from the change in direct trade surplus between two parties while the last two effects are derived from the change in third country effect. The forth are derived by more decrease in imports from member countries compared to non-member countries as much as $s^{\widehat{C_i}}(q_k^i - q_h^i)\frac{s^j\sigma t}{(2-\sigma)}$ due to i's pre-existing FTAs. This is because the member countries that have already exported with preferential margins get to face more severe competition than non-member countries when country i and j form a new FTA. Finally, the last is caused by the fact that total imports of country i from all third countries are less decreased because of the reduction in average tariff due to i' pre-existing FTAs.

2.4.3 Total Welfare Effect

The overall welfare change of country i after forming a new FTA between i and j can can be summed up with two main welfare changes: without and with the

consideration of pre-existing FTA effects. Specially, pre-existing FTAs affect the welfare change of country i in five different ways as mentioned earlier. After rearranging the pre-existing FTAs, two different kinds of pre-existing FTAs work in the opposite ways on the incentive to sign an FTA for the country i. The own pre-existing FTA effect measured with $s^{\widehat{C_i}}$ affect positively but, the partner's pre-existing FTA effect measured with $s^{\widehat{C_j}}$ negatively affects the incentive to sign an FTA for the country i when $\sigma \in (0,1)$.

$$
\begin{aligned}
\triangle W^i_{w/FTA} &= \tfrac{s^j t^i}{8(1-\sigma)(2-\sigma)^2}[8(1-\sigma)^2 + \{-(1-2s^i-s^j)\sigma^2 + 4(1-\sigma)\}t^i] \\
&+ \tfrac{s^i}{\mu^i}\mu^j\{\tfrac{1}{2-\sigma} - \tfrac{t^j}{4(1-\sigma)} + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^j-\tfrac{s^i}{2})t^j\}(1-\tfrac{s^i\sigma}{2-\sigma})t^j \\
&- s^j\{\tfrac{1}{2-\sigma} - \tfrac{t^i}{4(1-\sigma)} + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^i-\tfrac{s^j}{2})t^i\}(1-\tfrac{s^j\sigma}{2-\sigma})t^i \\
&+ \left(1-s^i-s^j\right)\{\tfrac{1}{2-\sigma} - \tfrac{t^i}{2(1-\sigma)} + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^i-\tfrac{s^j}{2})t^i\}\tfrac{s^j\sigma t^i}{(2-\sigma)} \\
&\quad + s^j s^{\widehat{C_i}}\tfrac{\sigma^2(t^i)^2}{4(1-\sigma)(2-\sigma)^2} - \tfrac{\mu^j}{\mu^i}s^i s^{\widehat{C_j}}\tfrac{\sigma(t^j)^2}{2(1-\sigma)(2-\sigma)}(1-\tfrac{s^i\sigma}{2-\sigma}) \\
&\quad + s^j s^{\widehat{C_i}}\tfrac{\sigma(t^i)^2}{2(1-\sigma)(2-\sigma)}(1-\tfrac{s^j\sigma}{2-\sigma}) + s^{\widehat{C_i}}\tfrac{t^i}{2(1-\sigma)}\tfrac{s^j\sigma t^i}{(2-\sigma)} \\
&\quad - \left(1-s^i-s^j\right)\tfrac{s^{\widehat{C_i}}\sigma t^i}{2(1-\sigma)(2-\sigma)}\tfrac{s^j\sigma t^i}{(2-\sigma)} \\
&= \triangle W^i_{w/oFTA} + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}[s^{\widehat{C_i}}s^j(2-\tfrac{(1-2s^i)\sigma}{2(2-\sigma)})(t^i)^2 - \tfrac{\mu^j}{\mu^i}s^i s^{\widehat{C_j}}(1-\tfrac{s^i\sigma}{(2-\sigma)})(t^j)^2]
\end{aligned}
$$

On the one hand, the own pre-existing FTA effect comes from the welfare changes in gross utility and in imports. The incentive to sign a FTA with country j increases with $s^{\widehat{C_i}}$ for a country i. This is because as $s^{\widehat{C_i}}$ is bigger, variety consumption is less reduced and the decreasing magnitude of imports from the RoW will be larger as well. On the other hand, the partner's pre-existing FTA effects comes from the welfare change in exports to partner country j. The partner's pre-existing FTA effect is composed of only a concession erosion effect. This effect can be measured with $s^{\widehat{C_j}}$ which is represented by total market shares of the countries already having formed the FTAs with country j. The incentive to sign a FTA with country j will decrease with $s^{\widehat{C_j}}$ for a country i.

As for the partner's pre-existing FTA effect, this result seems to be opposite to those of researches related to "domino theory". Baldwin (2007) shows that trade diversion has a more powerful impact on membership than trade creation, which seems that the defensive motive for joining a bloc is particularly strong. Baldwin and Jaimovich (2012) also show that much of the spread of regionalism is driven by "defensive" FTAs to reduce the discrimination created by FTAs signed among their trade partners. This result, theoretically derived based on the political economic model under some special conditions, show that the new FTAs are signed due to the political reasons rather than economical reasons. Baldwin and Jaimovich (2012) agrees that trade diversion due to partners' FTAs with other countries affects negatively own welfare. If country i does not find it politically optimal to sign an FTA with country j, an FTA between country j and k will make country i less interested in signing an FTA with country j.

In this case, no contagion will happen. Contagion means that a government, which initially opposes a particular trade agreement, changes its mind due to a trade agreement signed by other countries. However, asymmetric entry and negative-profits cause FTA contagion based on the "loser's paradox," the fact that special interest groups tend to fight harder to avoid losing a dollar than they do to win a dollar. This can explain why a government finds it optimal to sign an FTA that it shunned before the shock.

3 Empirical Analysis of Determinants of FTAs

3.1 Testable Hypothesis of Theoretical model

Furusawa and Konishi (2007) shows what makes pairs of countries agree on the FTAs in force based on the change in trade surplus due to an FTA between country i and j. With exogenously givens^i, s^j, μ^i, and μ^j, $[\Delta X^i(t^{-i}) - \Delta M^i(t^i)]$ increases with μ^j but decreases with μ^i for given s^i and s^j. It is also said that the higher $\theta^i (= \frac{s^i}{\mu^i})$ and the lower $\theta^j (= \frac{s^j}{\mu^j})$, the larger $[\Delta X^i(t^{-i}) - \Delta M^i(t^i)]$ for given s^i and s^j. Thus, Furusawa and Konishi (2007) mentions that the direct surplus effect is unbalanced in favor of the relatively more industrialized country. The more industrialized country derives a large benefit from the opening of the partner's relative large market. Based on the proposition 3 of Furusawa and Konishi (2007), the bilateral incentives to sign an FTA could be derived regarding to MFN tariff level and industrialization level.

$$\begin{aligned}&\Delta X^i(t^{-i}) - \Delta M^i(t^i)\\ &= \mu^j[\theta^i q_i^j(\tfrac{\partial q_i^j}{\partial \gamma}) - \theta^j q_j^i(\tfrac{\partial q_j^i}{\partial \gamma})] - \left(1 - s^i - s - s^{\widehat{C_i}}\right) q_h^i(\tfrac{\partial q_h^i}{\partial \gamma}) - s^{\widehat{C_i}} q_k^i(\tfrac{\partial q_k^i}{\partial \gamma})\end{aligned}$$

The proposition 3 of Furusawa and Konishi (2007) states that given that $\sigma = 0$ and that countries would impose the common MFN tariff rate t such that $t^i = t^j = t$, countries i and j sign an FTA if their industrialization levels are similar *i.e.* $\frac{2-3t}{4-2t} \leq \frac{\theta^j}{\theta^i} \leq \frac{4-2t}{2-3t}$ is satisfied. It means that even though the industrialization level of each party affects the welfare change of each party in opposite direction, if relative ratios of industrialization level of two participating parties are in some range, then they are willing to form an FTA. In other word, if industrialization levels of two participating countries are similar each other given that they have the similar MFN tariff level, then they have incentives to form an FTA. This is based on the facts that (i) each country wants to sign an FTA with a country whose industrialization level is not too different compared with its own and (ii) an FTA is put into force only if it is signed by both parties.

Hypothesis 1) Given that tariff levels of two participating countries of a new FTA are similar enough, as two participating countries of a new FTA have similar industrialization levels, a new FTA is more likely to be signed.

The similarity of the industrialization levels can be defined as log[1-{gdpcap$_{it}$ /(gdpcap$_{it}$+gdpcap$_{jt}$)}^{2}-{gdpcap$_{jt}$/(gdpcap$_{it}$+gdpcap$_{jt}$)}^{2}and the similarity of MFN tariff levels as log[1-{t$_{it}$/{t$_{it}$+t$_{jt}$}^{2}-{t$_{it}$/{t$_{it}$+t$_{jt}$}^{2}].

On the other hand, hypothesis regarding the pre-existing FTA effects can be derived based on total welfare change of both parties such that 'own FTAs' positively but 'partner's FTAs' negatively affect the formation of a new FTA.

$$\triangle W^i + \triangle W^j = \frac{s^j t^i}{8(1-\sigma)(2-\sigma)^2}[8(1-\sigma)^2 + \{-(1-2s^i-s^j)\sigma^2 + 4(1-\sigma)\}t^i]$$
$$+\frac{st^j}{8(1-\sigma)(2-\sigma)^2}[8(1-\sigma)^2 + \{-(1-2s^j-s^i)\sigma^2 + 4(1-\sigma)\}t^j]$$
$$+(\mu^j-\mu^i)[\frac{s^i}{\mu^i}(q_i^{j*})(1-\frac{s^i\sigma}{(2-\sigma)})t^j - \frac{s^j}{\mu^j}(q_j^{i*})(1-\frac{s^j\sigma}{(2-\sigma)})t^i]$$
$$+\left(1-s^i-s^j\right)\left(s^j q_h^{i*} t^i + s^i q_h^{j*} t^j\right)\frac{\sigma}{(2-\sigma)}$$
$$+\frac{\sigma}{2(1-\sigma)(2-\sigma)}[s^j s^{\widehat{C_i}}\{2-\left(1-2s^i\right)\frac{\sigma}{2(2-\sigma)}\}(t^i)^2 - \frac{\mu^j}{\mu^i}s^i s^{\widehat{C_j}}(1-\frac{s^i\sigma}{(2-\sigma)})(t^j)^2]$$
$$+\frac{\sigma}{2(1-\sigma)(2-\sigma)}[s^i s^{\widehat{C_j}}\{2-\left(1-2s^j\right)\frac{\sigma}{2(2-\sigma)}\}(t^j)^2 - \frac{\mu^i}{\mu^j}s^j s^{\widehat{C_i}}(1-\frac{s^j\sigma}{(2-\sigma)})(t^i)^2]$$

Hypothesis 2) The likelihood to form an FTA between country i and j increases with own FTA effects and decreases with partner's FTA effects.

The pre-existing FTA effects should be properly estimated in each country perspective because pre-existing FTAs of country i acts as own FTAs for country i and partner's FTAs for country j as well. Fortunately, since pre-existing FTAs of country i affect the welfare change through the imports and gross utility for country i but through the exports for country j, the weighting matrix can be differently defined each other. Based on the theory based results, 'own FTA effects' is measured by $s^j s^{\widehat{C_i}}$ while 'partner's FTA effects' is meausred by $\frac{\mu^j}{\mu^i}s^i s^{\widehat{C_j}}$ for the pre-existing FTAs of country i. Therefore, four different theory-base constructed variables to represent pre-existing FTA effects of each party are used in the empirical estimations.

- Own FTA effect$_{i,t}$ $= \sum_{k\in C_i}(\frac{\text{Bilateral Import}_{ij}}{\text{Total Import}_i})(\frac{\text{Import}_{ik}}{\text{Total Import}_i})FTA_{ik,t-1}$

- Partner's FTA effect$_{i,t}$ $= \sum_{m\in C_j}(\frac{POP_j}{POP_i})_{t-1}(\frac{\text{Bilateral Imxport}_{ji}}{\text{Total Import}_j})(\frac{\text{Import}_{jm}}{\text{Total Import}_j})FTA_{jm,t-1}$

- Own FTA effect$_{j,t}$ $= \sum_{k\in C_j}(\frac{\text{Bilateral Import}_{ji}}{\text{Total Import}_j})(\frac{\text{Import}_{jk}}{\text{Total Import}_j})FTA_{jk,t-1}$

- Partner's FTA effect$_{j,t}$ $= \sum_{m\in C_i}(\frac{POP_i}{POP_j})_{t-1}(\frac{\text{Bilateral Import}_{ij}}{\text{Total Import}_i})(\frac{\text{Import}_{im}}{\text{Total Importi}})FTA_{im,t-1}$

Importantly note that the weights to be used for generating pre-existing FTA variable should be time-invariant because FTA signature can be correlated with import share of partner, member and non-member countries, which leads to

simultaneity problems. To avoid this problem, the predicted shares of the first observation are also used for the whole period estimated by a gravity equation with fixed effects and multilateral resistance based on Baier and Bergstrand (2007)[7].

3.2 Empirical Estimation Results

3.2.1 Data

Baier et al. (2014) says that the notions such as FTA domino effects, competitive liberalization, contagion and interdependence have existed since 1993. In fact, the number of bilateral and regional FTAs has spread since 1990. Therefore, data will be limited to the period to 1993-2012 with taking this trend into consideration. FTA data is updated from 2006 to 2013 based on the Economic Integration Agreement Data (May 2013)[8]. Other tariff and trade data are from the World Integrated Trade Solution (WITS) and the GDP and population data are from the World Bank Indicator Database. The undirected dyadic data of 355,320 observations with 17,766 country-pair of 189 countries from 1993 to 2012 are technically generated for the empirical estimations. Unfortunately, some observations are omitted due to the missing data in each variable.

3.2.2 Main result

To test the determinants of FTAs, the dependent variable is usually used as $\text{FTA}^{*}_{ij,t}$, which is defined as 1 if two countries form an FTA between themselves , and 0 otherwise. Since the dependent variable is binary, probit is used with year dummy in the empirical estimation. In the first column of table 3.1, all explanatory variables have the significant results as expected. Since FTA_{ij} might not be independent across observations, standard errors are adjusted with clustering in the second and third columns. Finally, to solve the possible unobserved heterogeneity problem at country-pair level, conditional logit is also used. Since the observations that switch FTA status are used for estimation, only 11,795 observations are used in the estimation with conditional logit. Even though all results estimated by conditional logit are not statistically significant, all variables have expected signs.

$$\text{FTA}_{ij,t} = \beta_0 + \beta_1 \text{MFN sim}_{ij,t-1} + \beta_2 \text{Industry sim}_{ij,t-1} + \rho_1 + \text{My FTAs}_{i,t-1}$$

$$+ \rho_2 \text{Partner's FTAs}_{i,t-1} + \rho_3 \text{My FTAs}_{j,t-1} + \rho_4 \text{Partner's FTAs}_{j,t-1}$$

[7] Baldwin and Jaimovich (2012) use predicted values of the first-year observation for all periods based on the estimation results of a simple gravity equation with fixed effects and the log GDP in the dyads. Egger and Larch (2008) also use "natural" trade flows predicted by a bilateral gravity model as developed by Anderson and van Wincoop (2003).

[8] Source for dependent variable: the Economic Integration Agreement Data set indexes the amount of trade openness on a scale 1 to 6 between every country pair between 1950 and 2005 (updated by author until 2013).

[Table 3.1] Estimation results with one year lagged variables

FTA		Probit	Probit	OLS	Conditional logit
MFN sim	+	0.52***	0.52***	0.09***	0.24
Industry sim	+	0.39***	0.39***	0.06***	4.45
Own FTA effect$_i$	+	1.00***	1.00***	0.20***	1.11
Partner's FTA effect$_i$	-	-0.57***	-0.57***	-0.06***	-16.99
Own FTA effect$_j$	+	1.03***	1.03***	0.21***	0.23
Partner's FTA effect$_j$	-	-0.70***	-0.70***	-0.09***	-16.36
Year dummy		Yes	Yes	No	Yes
Clusters		No	county pair	county pair, year	No
Obs.		91,211	91,211	91,211	11,795
(Pseudo) R^2		0.37	0.37	0.31	

Note: *, **, and *** denote significance at 10%, 5%, and 1% respectively

Predicting the FTAs It is also examined how well post-estimated probabilities to form an FTA based on our empirical model can explain the real FTA status. Following Baier and Bergstrand (2004) and Chen and Joshi (2010), it is defined that any country pairs of which predicted probabilities exceed 50 percent, agree on forming an FTA. Based on the predicted probability of the first estimation in Table 3.1, this study can examine countries' probabilities to form an FTA between 1993 and 2012.

[Table 3.2] Predicting FTAs

	Predicted FTAs	
Real FTA	0	1
0	0.93	0.09
1	0.07	0.91
Total	1.00	1.00

	Real FTAs	
Predicted FTA	0	1
0	0.99	0.43
1	0.01	0.57
Total	1.00	1.00

The probability of real FTA=1 is 91% given that predicted FTA=1 and the probability of real FTA=0 is 93% given that predicted FTA=0. The same result can be stated with the opposite way, followed by the way of Chen and Joshi (2010). The probability of predicted FTA=1 is 57% given that real FTA=1 and the probability of predicted FTA=0 is 99% given that real FTA=0. In either way, the empirical model seems to explain real FTA status pretty well.

3.2.3 Sensitivity analysis

Robustness check with different time lags In the spatial dependence with dyadic data, Endogeneity problem can be caused. Other units k spatially influence on unit i while unit i also affects other units k ($y_i \rightarrow y_k \rightarrow y_i$: simultaneity problems). However, if each unit does not affect each other in turn, endogeneity is not a problem. Baldwin and Jaimovich (2012) uses temporally one-period lagged spatial dependent variable to solve this endogeneity problem. This is based on the assumption that pre-existing FTAs cannot be affected by new FTAs retroactively. For this reason, one-year lagged variables are used

under the assumption that pre-existing FTAs cannot be affected by new FTAs retroactively. As a sensitivity analysis, it is also estimated with five-year lagged variables.[9].

$$\text{FTA}_{ij,t} = \beta_0 + \beta_1 \text{MFN sim}_{ij,t-5} + \beta_2 \text{Industry sim}_{ij,t-5} + \rho_1 + \text{My FTAs}_{i,t-5}$$

$$+\rho_2 \text{Partner's FTAs}_{i,t-5} + \rho_3 \text{My FTAs}_{j,t-5} + \rho_4 \text{Partner's FTAs}_{j,t-5}$$

[Table 3.3] Estimation results with five-year lagged variables

FTA		Probit	Probit	OLS	Conditional logit
MFN sim	+	0.40***	0.42***	0.09***	0.62
Industry sim	+	0.35***	0.37***	0.07***	-0.06
Own FTA effect$_i$	+	1.06***	0.92***	0.23***	2.55
Partner's FTA effect$_i$	-	-0.27***	-0.36***	-0.07*	-15.75
Own FTA effect$_j$	+	1.07***	0.94***	0.24***	1.75
Partner's FTA effect$_j$	-	-0.37***	-0.45***	-0.09*	-8.34
Year dummy		Yes	Yes	No	Yes
Clusters		No	county pair	county pair, year	No
Obs.		75,092	75,092	75,092	11,105
(Pseudo) R^2		0.32	0.28	0.31	

Note: *, **, and *** denote significance at 10%, 5%, and 1% respectively

Robustness check with other control variables This study can infer some facts based on the empirical estimation results with other control variables based on Baier and Bergstrand (2004). First, by comparing R^2 between first and second column in Table 3.4, it can be shown that the own FTA effect and the partner's FTAs effect improve the goodness of fit of a model, which implies the pre-existing FTA significantly affect the formation of a new FTA. Second, MFN similarity has opposite signs when regressed with the same continent. Namely, after controlled with the same continent, MFN similarity seems to represent the tendency to form an FTA between countries with dissimilar MFN tariff level. Lastly, in the estimation results regressed with both Diff. K/L and GDPcap sim, GDPcap sim shows insignificant result. Generally, the former is considered to induce the trade diversion while the latter induce trade creation. Nevertheless, Diff. K/L seems to have more significant impact on the formation of a new FTA. In fact, FTAs seem to be formed due to factors that cause trade diversion rather than trade creation based on the second and the last results.

[9]Chen and Josh (2010), and Baldwin and Jaimovich (2012) use one-year lagged explanatory variables while Egger and Larch (2008) and Baier et. al. (2014) use five-year lagged explanatory variables.

[Table 3.4] Estimation results with other control variables

	Probit	Probit	Probit
GDP Sum (+)	0.15***	-0.12***	-0.21***
GDP Sim (+)	0.22***	0.19***	0.06***
Inverse Distance (+)	0.78***	0.87***	0.98***
Distance from RoW (+)	-0.65***	3.71***	5.35***
Same Continent (+)	0.57***	0.78***	0.83***
Diff. K/L (+)	0.35***	0.32***	0.51***
sq_Diff. K/L (-)	-0.45***	-0.34***	-0.26***
Diff. K/L from RoW (-)	0.94***	0.16***	0.13***
MFN sim (+)			-0.132***
GDPcap sim (+)			0.20
Own FTA effect$_i$(+)		1.24***	1.36***
Partner's FTA effect$_i$(-)		0.06	-0.17*
Own FTA effect$_j$(+)		1.22***	1.33***
Partner's FTA effect$_j$(-)		-0.18***	-0.30***
Year Dummy	Yes	Yes	Yes
obs.	312,280	292,090	90,984
(Pseudo) R^2	0.460	0.594	0.634

Note: *, **, and *** denote significance at 10%, 5%, and 1% respectively

4 Calibration Analysis

The choice whether to sign an FTA can depend on the net welfare change due to a new FTA. If $\triangle W^i$ is greater than zero, country i must be willing to sign a new FTA with country j. But, in some cases, even though $\triangle W^i$ is negative, country i would sign a new FTA with country j, or vice versa. Each country may have different critical value that makes itself willing to sign a new FTA. By using this critical value, it would be confirmed how well "Real FTA Status" can be matched up with "Predicted FTA Status" based on the following theory-based welfare changes.

$$\triangle W^i = \frac{s^j t^i}{8(1-\sigma)(2-\sigma)^2}[8(1-\sigma)^2 + \{-(1-2s^i-s^j)\sigma^2 + 4(1-\sigma)\}t]$$
$$+\frac{s^i}{\mu^i}\mu^j\{\frac{1}{2-\sigma} - \frac{t^j}{4(1-\sigma)} + \frac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^j-\frac{s^i}{2})t^j\}(1-\frac{s^i\sigma}{2-\sigma})t^j$$
$$-s^j\{\frac{1}{2-\sigma} - \frac{t^i}{4(1-\sigma)} + \frac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^i-\frac{s^j}{2})t^i\}(1-\frac{s^j\sigma}{2-\sigma})t^i$$
$$+\left(1-s^i-s^j\right)\{\frac{1}{2-\sigma} - \frac{t^i}{2(1-\sigma)} + \frac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^i-\frac{s^j}{2})t^i\}\frac{s^j\sigma t^i}{2-\sigma}$$
$$+\frac{\sigma}{2(1-\sigma)(2-\sigma)}[s^{\widehat{C_i}}s^j\{2-\left(1-2s^i\right)\frac{\sigma}{2(2-\sigma)}\}(t^i)^2 - \frac{\mu^j}{\mu^i}s^i s^{\widehat{C_j}}\{1-s^i\frac{\sigma}{(2-\sigma)}\}(t^j)^2]$$

To verify the conformity between "Real FTA Status" and "Predicted FTA Status", the best substitutability (σ) among differentiated goods is needed to be estimated because the magnitude of $\triangle W^i$ depends on the degree of substitutability that is an only unobservable parameter in $\triangle W^i$. By substituting given real data such as s^i, s^j, μ^i, μ^j, t^i, t^j, $s^{\widehat{C_i}}$, and $s^{\widehat{C_j}}$ into $\triangle W^i$ and $\triangle W^j$

and changing σ as much as 0.01 ranging from 0 to 1, the best $\sigma = 0.72$ was calculated, which have the highest correlation between "Real FTA Status" and "Predicted FTA Status". The latter is regarded as FTA existence only if both $\triangle W^i$ and $\triangle W^j$ are greater than 0.

Then, starting from $\triangle W^j \geq 0$ for $\sigma = 0.72$, by changing critical value in the range of minimum and maximum values of $\triangle W^i$ that make country i actually sign FTAs, the best critical value (cv_i) could be selected for each country that match "Real FTA Status" and "Predicted FTA Status" the most in the perspective of country i. Every country can be both country i (exporter) and country j (importer). the same jobs were iterated from the position of country i and country j in turn until each critical value of each country is merged with one value. With one merged critical value for each country, "Predicted FTA Status" is defined as 1 if both of each $\triangle W$ are over critical value of each country *i.e.* $\triangle W^i \geq cv_i$ and $\triangle W^j \geq cv_j$ and 0 if either or neither of each $\triangle W$ are over the critical value of each country. Finally, it could be shown how well whether to form a new FTA can be predicted by the welfare changes and critical values.

[Table 4.1] Comparison of Real and Predicted FTA Status when cv_i & $cv_j = 0$

	Predicted FTA Status		
Real FTA Status	0	1	Total
0	85,576	70,879	156,455
1	4,709	21,838	26,547
Total	90,285	92,717	183,002

In the case that critical values for all countries are equal to zero, the numbers of (Predicted_FTA Status =0) are almost same with (Predicted FTA Status =1) as 90,285 compared to 92,717. In the case that the individual critical values for each country are used, the numbers of (Predicted FTA Status = 0) are 7 times larger than (Predicted FTA Status =1) as 160,872 compared to 22,130. It is a similar result that the numbers of (Real_FTA Status = 0) are 6 times larger than (Real FTA Status=1) as 156,455 compared to 26,547.

[Table 4.2] Comparison of Real and Predicted FTA Status with cv_i & cv_j

	Predicted FTA Status		
Real FTA Status	0	1	Total
0	150,281	6,174	156,455
1	10,591	15,956	26,547
Total	160,872	22,130	183,002

In the case that critical values for all countries are equal to zero, 85,576 cases of (Real FTA Status=0) are matched up among 90,285 cases of (Predicted FTA Status = 0) and 21,838 cases of (Real FTA Status =1) are matched up among 92,717 cases of (Predicted FTA Status = 1) . These results show a predictive success rate of 95% for not-signing FTA cases and a predictive success rate of 23% for signing FTA cases. On the other hand, in the case that the individual critical values for each country are used, 150,281 cases of (Real FTA Status=0) are matched up among 160,872 cases of (Predicted FTA Status = 0) and 15,956

cases of (Real FTA Status=1) are matched up among 22,130 cases of (Predicted FTA Status = 1) . These results show a predictive success rate of 93.4% for not-signing FTA cases and a predictive success rate of 72% for signing FTA cases. A predictive success rate signing FTA cases is much higher when individual critical value for each country is used than when identical critical value is used for all countries.

5 Conclusion

This study contributes to using the theory-base constructed variables in terms of industrialization level, tariff rate, and pre-existing FTAs to empirically test the bilateral incentives to form as new FTA while Furusawa and Konishi (2007) focus on whether complete FTA network is stable or not.

We would derive bilateral incentives agreed by both parties. Based on the proposition 3 of Furusawa and Konishi (2007), it is also shown that given that tariff level between two participating countries is similar enough, a new FTA is more likely to be signed as two participating countries of a new FTA have similar industrialization level. In addition, we also examine the determinants of FTAs regarding third country effects of pre-existing FTAs, which conclude that a country's own pre-existing FTAs positively and partner's pre-existing FTAs negatively affect the formation of a new FTA. This finding is consistent with the conclusions of Chen and Joshi (2010) in terms of a loss sharing effect and a concession erosion effect. However, we can show how pre-existing FTAs with numerous asymmetric third countries affect the formation of a new FTA. To test the pre-existing FTA effects with numerous asymmetric third countries, "spatial dependence with dyadic data" is used. There exist some researches related to this issue and applied with the same methods. However, we approach to this issue through the theory-based method compared to Egger and Larch (2008) and analyze partner's pre-existing FTA effects in the traditional economic incentives compared to the political economic approach of Baldwin and Jaimovich (2012).

We also derives the overall welfare change caused by a new FTA. Then, the substitutability that has the highest correlation between "Real FTA Status" and "Predicted FTA Status", and the best critical value for each country that matches "Real FTA Status" and "Predicted FTA Status" the most are estimated through the calibration by substituting given real trade and economic data into the derived welfare change. Eventually, we can show how well whether to sign a new FTA can be predicted depending on the net welfare change caused by a new FTA and the critical value that makes each country sign a new FTA. These results show a predictive success rate of 93.4% for not-signing FTA cases and a predictive success rate of 72% for signing FTA cases.

Although FTAs have expanded rapidly over the past two decades, the number of new FTAs has been declining with the proliferation of protectionism. In this situation, it is very meaningful to establish a new FTA that will increase the economic welfare. The study is expected to be very useful for selecting new FTA partners who are expected to increase own economic welfare greatly by

signing a new FTA.

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