경제학박사학위논문

The Effect of Pre-existing FTAs with Asymmetric Third Countries on the Formation of a New FTA

비대칭적인 제 3국들과 맺고 있는 기존의 FTA가 새로운 FTA를 맺는데 미치는 영향에 대한 연구

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노 재 연

Abstract

The Effect of Pre-existing FTAs with Asymmetric Third Countries on the Formation of a New FTA

Jaeyoun Roh
Department of Economics
The Graduate School of
Seoul National University

Based on the theoretical model of 'Free Trade Network (2007)', this thesis defines the net welfare change caused by a new FTA derived under the condition that both parties do not have concluded any FTAs with other parties and under the condition that they have the pre-existing FTAs with asymmetric third countries. By substituting the real trade and economic data of 189 countries from 1993 to 2012 into the derived welfare change, this thesis can predict whether a new FTA is formed or not. To show how well it can be predicted, the substitutability, which is used for defining the welfare change but unobservable, and the best critical value of each country that matches 'Real FTA Status' and 'Predicted FTA Status' the most are estimated through the calibration. Then, this thesis can show that 'Real FTA Status' corresponds to 90 percent of 'Predicted FTA Status' which can be predicted by the welfare change caused by a new FTA and the critical value of each country that makes itself willing to sign a new FTA.

This thesis predicts how pre-existing FTAs with other asymmetric third countries, the industrialization level, and MFN tariff level of each country that participates in a new FTA affect the formation of a new FTA based on the aforementioned theoretical results, which has not been noted in the previous literatures. Those predictions are verified with the way of 'Spatial Dependence with Dyadic Data'. Specially, in this thesis, whether to sign a new FTA or not, which is predicted according to the critical value of each country estimated through the calibration, is used as a dependent variable to empirically test the unilateral incentives rather than 'Real FTA Status' that represents the bilateral decisions agreed by both parties.

Finally, this thesis attempts to identify the most important issues that each country considers in signing a new FTA by selecting substantially influential variables through the Big Data Analysis. For this, I first generate the dataset that

reflects the directly participating countries' economic characteristics, political characteristics, multilateral issues related to GATT/WTO, and the interdependence of preferential trading relationships as mentioned in the previous literatures. Then, I can get the different subset of variables for each individual country by applying the glmnet package and 10-fold cross validation method into R programming for 'Lasso' and 'Lasso' logit regression. Finally, I regress one year lagged variables selected in each 'Lasso' and 'Lasso' logit regression on 'Real FTA Status' with each OLS and probit. The coefficients are very similar to each other in 'Lasso' and OLS and 'Lasso' logit and probit method. R^2 of each estimation result regressed with selected variables for the observations of each individual country is much higher than with the same selected variables for observations of all countries. In fact, the variables selected through the 'Lasso' regression are powerful to explain what kinds of issues truly affect the willingness to sign a new FTA. The results seem to reflect each economical, geographical, or geopolitical tendency toward forming new FTAs, which is supported by the high R^2 regardless of the numbers of predictors.

This thesis contributes to using the theory-based calibration to empirically test the determinants of FTAs, empirically analyzing unilateral and bilateral incentives based on the generalized theory model of Furusawa and Konish (2007), which can explain that the effects of pre-existing FTA on the formation of a new FTA can be determined by the parameters such as the industrialization level, MFN tariff level, and economic size of each participating country, and lastly analyzing the determinants of FTAs for each individual country by selecting the relevant variables that substantially affect the formation of FTAs among the variables mentioned in the previous literatures by using Big Data Analysis.

Key words: FTA, Interdependence, Free Trade Network, Spatial Dependence with Dyadic Data, Big Data Analysis, Lasso

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1 Introduction

Regional Trade Agreements (RTAs) have spread widely since the early 1990s according to the WTO. As of 7 April 2015, 406 RTAs out of 612 notifications (counting goods, services and accessions separately) are in force. There are two important traits in this trend: increasing numbers of countries are taking part in RTAs and they are integrating with increasing numbers of partners. Egger and Larch (2008) shows that each country has on average 3.6 preferential trade partners in 1990 but the number has risen to 20.5 in 2005. This means that countries participating in RTAs have become more interdependent directly with each other or indirectly through third countries in complex and continuously evolving FTA networks. This thesis could confirm those trends from summary statistics in the table 1.1. In 2013, 164 countries out of 189 are participating in RTAs and the number of partner countries on average rose up to 27 from 4 in 1993.

[Table 1.1] Summary statistics for the trends of RTAs

out of 189 countries	1993	1997	2001	2005	2009	2013
# of Avr. RTA partners	4.25	6.61	10.63	15.46	22.04	26.72
Min of RTA partners	0	0	0	0	0	0
Max of RTA partners	25	31	36	44	63	76
# of countries with RTAs	73	103	139	160	164	164
# of countries without RTAs	116	86	50	29	25	25

Note: estimated by author and Source: the EIAD indexes (updated by author up to 2013[1]).

Despite the two clear traits in the trend, most of previous literatures have generally focused on the determinants of FTAs regarding the directly participating countries' economic characteristics (Baier and Bergstrand, 2004 & 2007), political characteristics (Milner an Drosendorff, 2002), and multilateral issues related to GATT/WTO (Mansfield and Reinhardt, 2003). However, the recent researches have noted the interdependence of preferential trading relationships. There are two somewhat different approaches regarding the interdependence of preferential trading relationships.

Some studies have examined the theory of 'domino effect', empirically testing it in the context of growing interdependence incurred by bilateral agreements, that the likelihood that a pair of countries signs an FTA will increase with the threat of

[1]Sourced from the Economic Integration Agreement Dataset indexes the amount of trade openness on a scale 1 to 6 between every country pair between 1950 and 2005 and updated by author up to 2013.

trade diversion (Manger (2006), Egger and Larch (2008), Baldwin and Jaimovich (2012), Bergstrand et al. (2011), and Baier et. al. (2014)). Manger (2006), which is one of the earliest studies for this issue, tests the interdependence among bilateral FTAs by building a weighting matrix with the average geographical distance of the involved dyads. Egger and Larch (2008) extends the spatial econometric analysis to show the dynamic formation and enlargement of PTAs. Egger and Larch (2008) shows that pre-existing PTAs raise the possibility to reach a bilateral agreement but this effect can be reduced with the distance. Baldwin and Jaimovich (2012) extends the domino theory model by developing a theory-based measure for contagion and has defined 'contagion index' with asymmetries in the dyads. They showed that FTAs are contagious and the degree of contagion is related to the importance of the partners' markets. Baier et. al. (2014) also proves that the utility gain from a new FTA increases with an "Own-FTA" and a "Cross FTA" and that "Own-FTA" has a greater impact on the formation of a new FTA than "Cross FTA" does.

On the other hand, Chen and Joshi (2010) shows how the existing FTA relationship with the third country affects a country's incentive to establish an FTA. The magnitude of the net welfare change depends on whether both or either of negotiating countries already have an FTA with the third country[2]. They introduce two kinds of third-country effects that determine the net welfare change resulted by formation of a new FTA. First, if a home country already has an FTA with the third country, the profit loss due to a new FTA in the home market can be smaller than expected because existing FTA partners will share the part of the domestic profit loss due to a surge of imports from a new FTA partner. They call this effect 'a loss sharing effect'. On the other hand, exporting firms in the home market can expect to earn greater profits in the market of a new FTA partner with help of the new preferential market access. But the profit gain of exporting firms could be smaller than expected if a new FTA partner already has an FTA with other third country. This is because pre-existing preferential market access of other third country dilutes the potential profit gain of preferential market access for exporting firms in the home market. They call this effect 'a concession erosion effect'.

This thesis will take both the pre-existing FTA relationship with the third country and cross-country interdependence between bilateral agreements into considerations. This thesis not only explains the third country effect of pre-existing FTAs in terms of 'a loss sharing effect' and 'a concession erosion effect', but also generalizes

[2]Note that in general, when a country pair establishes an FTA, both countries experience gains in export profit and consumer surplus as well as reductions in home profit and tariff revenue.

the pre-existing FTA effects with numerous asymmetric third countries compared to the three-country trade model of Chen and Joshi (2010). To test the effects of pre-existing FTAs with the third country, they use the indicator variable based on pre-existing FTA relationship among three countries while this study use the way of "Spatial Dependence with Dyadic Data". It is generally used to examine wether forming a new FTA can be affected by the pre-existing FTAs of other country-pairs in previous literature. This study also uses the similar spatial econometric analysis but the weighting matrix is based on the theory-based measure of pre-existing FTA effects compared to Egger and Larch (2008). In addition, Baier et. al. (2014) shows own-FTA effects with the numbers of own-FTAs while this study shows the effect of own-FTAs with asymmetric countries by using spatial weighting matrix. Finally, this study also shows how partner's FTA with asymmetric countries affect the formation of an FTA in the traditional economic incentives compared to the political economic approach of Baldwin and Jaimovich (2012).

This thesis consists of four main sections. The section 2 reviews theoretical development background and equilibrium results of Furusawa and Konishi (2007). It also shows that the net welfare change caused by a new FTA can be decomposed into two parts: the welfare change derived under the condition that both parties do not have concluded any FTAs with other third countries and under the condition that they have the pre-existing FTAs with other third countries. By scrutinizing the pre-existing FTA effects, this study explains pre-existing FTA effects in five different ways: concession erosion effect, less change in variety consumption, loss sharing effect, relatively more decrease in demands of member countries compared to non-members, and less decrease in imports from the ROW caused by the reduction in average tariff. The first effect is resulted from partner's pre-existing FTAs and the other four effects originate from own pre-existing FTAs. Depending on its own pre-existing FTAs or partner's pre-existing FTAs, two different kinds of pre-existing FTAs work in the opposite ways on the incentive to sign an FTA. 'Own pre-existing FTAs' positively but 'partner's pre-existing FTAs' negatively affect the formation of a new FTA. This is the main findings of this thesis.

In the section 3, based on the derived net welfare change due to a new FTA, this study shows how well whether to form a new FTA can be predicted according to the welfare change and the critical value that makes each country willing to sign a new FTA. For this, the best substitutability, which is used for defining the net welfare change but unobservable, is estimated through the calibration by substituting given real trade and economic data into the derived welfare change. Then, the best critical

value of each country that matches 'Real FTA Status' and 'Predicted FTA Status' the most is also estimated through the calibration. Finally, this study can show that 72 percent of cases predicted as FTAs in force (FTA=1) and 93 percent of cases predicted as no FTAs (FTA=0) are matched up with 'Real FTA Status'.

In the section 4, this study explains unilateral incentives for each party to sign an FTA by showing the comparative statics of the welfare change after forming a new FTA with respect to tariff levels, industrialization levels and pre-existing FTAs. Through those unilateral incentives, this study can find that tariff level, industrialization level, and pre-existing FTAs give conflicting effects toward the welfare change of each party, which makes one party relatively more beneficial. For this reason, this study would derive bilateral incentives agreed by both parties based on the proposition 3 of Frusawa and Konishi (2007). To test the unilateral determinants of FTAs, it is necessary to apply a suitable dependent variable instead of 'Real FTA Status' that represents the bilateral decisions agreed by both parties. 'Real FTA Status' corresponds to 90 percent of 'Predicted FTA Status' which can be predicted by the total welfare change and the critical values as shown in section 3. Therefore, $I(\triangle W^i_{ij,t} > cv_i)$ is used as a dependent variable, which is defined as 1 if the net welfare change is greater than critical value that makes country i willing to sign an FTA, and 0 otherwise. This method can contribute to enlarging a scope of the researches relating to the determinants of FTAs from the perspective of unilateral incentive. So far, there have been no ways to empirically test the unilateral incentives except 'Real FTA Status'.

In the section 5, this thesis attempts to identify the most important issues that each country considers in signing a new FTA by using a Big Data Analysis. For the purpose, the basic concept of 'Lasso' regression is found to be most useful in terms of prediction accuracy and the model interpretability thanks to the variable selection process. Specially, the variables dealt with in this thesis are selected for all countries while the different subset of variables is selected for each individual country as the relevant determinants of FTAs. The result turns out to be remarkable because regression results with selected variables have relatively higher R^2 regardless of the numbers of predictors. In some cases, despite being regressed with a couple of selected variables, R^2 is pretty high. It means that 'Big Data Analysis' provides a powerful instrument for finding out what kinds of issues truly affect the willingness to sign a new FTA. In fact, selected variables seem to reflect the economic, geographical, or geopolitical tendency of each individual country toward forming FTAs.

2 The Theoretical Model

2.1 The Basic Set-up

[3]I adopt the basic set-up of Furusawa and Konishi (2007) to develop the theoretical model[4]. Furusawa and Konishi (2007) assume 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.

They aggregate all of goods produced competitively into one good, named as the numeraire good[5]. Each consumer is endowed with l unit of labor, which 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. They also assume that industrial commodities normalize the unit labor requirement to be equal to 0 for each industrial commodity[6].

They consider a continuum of horizontally differentiated commodity in a representative industry[7]. 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[8] with other firms in individual segmented countries. Assume that industrial commodities are produced with a CRS technology and that there is no entry of firms into this industry.

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, they assume that there

[3]This section seems like the review or summary mostly based on Furusawa and Konishi (2007) and Furusawa and Konishi (2003). I would add some specific details and paraphrase their sentence.

[4]I examine 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, I assume each negotiating party myopically decides whether to sign a new FTA or not.

[5]In this model, since substitutability among differentiated goods is critical parameter to determine the effect of trade policy, I need 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, I only consider intra-industry elasticity of substitution. However, my 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.

[6]Alternatively, I can interpret 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.

[7]Greenaway et al. (1995) define that horizontally differentiated goods are differentiated by attributes while vertically differentiated goods are differentiated by quality.

[8]Note that price competition and quantity competition yield the same equilibrium outcomes in this set-up of continuous commodities since a firm's choice of either price or production quantity has only a negligible impact on the demands for other firms' products. Therefore, the analysis based on this model would not be affected by the choice of strategic variables.

is no commodity tax, so that $t_i^i = 0$. They also assume that the countries do not impose tariffs on the numeraire good which may be traded internationally to balance the trade. Tariff revenue is redistributed equally to domestic consumers.

They consider asymmetry n-county model. Countries may be different in the market size (population size) and the size of the industrial good industry. In country $i \in N$, measure μ^i of consumers and measure s^i of firms that produce industrial commodities are located. Country i produces s^i industrial commodities, which are consumed in every country in the world. They assume that the markets are segmented so that firms can perfectly price discriminate among different countries. They normalize the size of total population 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.

They assume zero cost of production in differentiated goods such 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 country in differentiated product market under global market.

Regarding the pre-existing FTAs, they assume that $C_i = \{k \in N \mid t_k^i = 0\}$ 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, I also define $\widehat{C}_i$ as the set of countries that produce commodities on which country i does not impose tariffs except country i itself. I also consider the situation where country i has signed FTAs with all other countries in $\widehat{C}_i$ rather than CUs.

They denote $t(\gamma)$ as 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 $t_j^i(1) = 0$. The average tariff rate is denoted by $\overline{t}^i(\gamma) = \sum_{k \notin C_i \cup \{j\}} s^k t^i + s^j(1-\gamma)t^i = (1 - s^{C_i} - \gamma s^j)t^i$ $= (1 - s^i - s^{\widehat{C_i}} - \gamma s^j)t^i$.

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)[9]. According to Furusawa and Konishi (2003), social welfare can be decomposed into the gross utilities and trade surplus of non-numerarie commodities 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, Furusawa and Konishi (2007) assumes that consumers in all countries share a common quasi-linear utility function in which substitutability of industrial commodities is parameterized[10].

A representative consumer's utility is given by the following quasi-linear utility function[11] with a quadratic substitutability.

$$U(q, q_0) = \int_0^1 q(\omega)d\omega - \underbrace{\frac{1-\sigma}{2}\int_0^1 q(\omega)^2 d\omega}_{\text{love of variety}} - \underbrace{\frac{\sigma}{2}\left[\int_0^1 q(\omega)d\omega\right]^2}_{\text{substitutability}} + q_0$$

where $q : [0,1] \rightarrow \mathbb{R}_+$ 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. The industrial commodities are independent from one another if $\sigma = 0$, while they are perfect substitutes (homogeneous products) if $\sigma = 1$. The last first term, $\frac{\sigma}{2}\left[\int_0^1 q(\omega)d\omega\right]^2$ represents the substitutability among differentiated commodities, which may become clearer if we notice $\left[\int_0^1 q(\omega)d\omega\right]^2 = \int_0^1\int_0^1 q(\omega)q(\omega')d\omega' d\omega$. In the last second term, as long as $\sigma < 1$, the quadratic utility function exhibits love of variety, which means that consumers are biased toward a dispersed consumption of varieties. Therefore, for given any consumption such as $\int_0^1 q(\omega)d\omega$, consumers enjoy higher utility as the consumption bundle is composed with more balanced and various goods[12].

[9] Furusawa and Konishi (2003) provide all details of deriving processes.

[10] The set-up of continuous commodities is based on the model developed by Ottaviano et al. (2002), "Agglomeration and trade revisited," International Economic Review, 43(2)

[11] With the quasi-linear utility function, every consumer's marginal utility of income always equals unity as long as she consumes a positive amount of the numeraire good, which linearly contributes to the utilities, and hence it is possible to proceed with a partial equilibrium analysis regarding non-numeraire commodities, which contribute to consumer's utilities non-linearly.

[12] Sang-Seung Yi (2000) noted two gains from trade: trade increase the variety of goods available and trade restrains the domestic firm's market power.

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

The first order condition for the consumer's maximization problem gives us 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[13]:

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

where $q(\omega) = \frac{1}{1-\sigma}[1 - p^i(\omega) - t_k^i - \sigma\{1 - \widetilde{P}(\omega)\}]$[14], 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 this maximization gives us the following result.

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

In the equilibrium of maximizing the profit of the firm ω, prices charged by firms depend only on the import country's tariff policies. They suppress the argument ω since $P^i(\omega)$ does not vary with ω. For this, 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 after arranging it, they have

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

[13] Refer to Furusawa and Konishi (2007) for more details to derive equilibrium in country i.

[14] This outcome is from the first order condition for the consumer's maximization problem.

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 after arranging it, they have

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

where $\overline{t}^i = \sum_{k=1}^{n} s^k t_k^i$.Notice that $p_k^i(t^i) = (1-\sigma)q_k^i(t^i)$ for tariff vector t^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[15]. 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

$$y = \underbrace{\sum_{k=1}^{n} s^k [p_k^i(t^i) + t_k^i] q_k^i(t_k^i) + q_0}_{\text{A representative consumer's expenditure}} = \underbrace{l + T^i(t^i) + \frac{s^i\pi_i(t)}{\mu^i}}_{\text{A representative consumer's income}}$$

[15]The following analysis remains valid even in the case where every country is populated by many consumers with different tastes as long as every consumer's preferences are represented by a quasi-linear utility function and a country's well-being is measured by a utilitarian social welfare function, i.e. the sum of all consumers' utilities.

$$\therefore q_0 = l + T^i(t^i) + \frac{s^i \pi_i(t)}{\mu^i} - \sum_{k=1}^{n} s^k [p_k^i(t^i) + t_k^i] q_k^i(t_k^i)$$
$$= l + \sum_{k=1}^{n} t_k^i s^k q_k^i(t^i) + \frac{s^i}{\mu^i} \sum_{k=1}^{n} \mu^k p_i^k(t^k) q_i^k(t^k) - \sum_{k=1}^{n} s^k [p_k^i(t^i) + t_k^i] q_k^i(t_k^i)$$
$$= l - \underbrace{\sum_{k \neq i} s^k p_k^i(t^i) q_k^i(t^i)}_{\text{Import Payment = 'M'}} + \underbrace{\frac{s^i}{\mu^i} \sum_{k \neq i} \mu^k p_i^k(t^k) q_i^k(t^k)}_{\text{Export Payment='X'}}$$

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

$$\Rightarrow \underbrace{q_0 + M}_{\text{Consumption}} = \underbrace{l + X}_{\text{Production}} \Rightarrow \underbrace{q_0 - l}_{\text{Net import of numeraire goods}} = \underbrace{X - M}_{\text{Net export of numeraire goods}}$$

Note that one unit of numeraire good is produced with one unit of labor (l), which is linear. And, I also would make sure that the last equation of 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 numerarie goods. 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.

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:

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

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

The functions $V^i(t^i)$, $M^i(t^i)$, and $X^i(t^{-i})$ represent a consumer's gross utility, import payments, and export value of industrial commodities, respectively. Country i's social welfare consists of a consumer's gross utility and the industrial trade surplus $X^i(t^{-i}) - M^i(t^i)$. Country i's tariffs affect social welfare through the effects on $V^i(t^i)$ and $M^i(t^i)$ while other countries' tariffs affect country i's social welfare through the effects on $X^i(t^{-i})$. The change of tariff rate affects social welfare only through the changes in consumption of industrial commodities since the consumption of an industrial commodity depends on the tariff rate imposed on the commodity and the

average tariff rate, i.e. $q_k^i(t^i) = \widetilde{q_k^i}(t_k^i, \overline{t}^i)$. The change of country i's tariff rate due to a new FTA affect country i's import from a new FTA partner directly as well as country i's import from all of the countries through the change of the average tariffs indirectly, for all $k = 1, 2, ..., n$.

2.4 Incentive to Sign an FTA

[16]An FTA between countries i and j reduce or eliminate tariffs imposed on commodities imported from each other while they keep all other tariffs at their original level. The welfare change due to the FTA between countries i and j can be expressed as following;

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

This condition can be written as

$$\triangle V^i(t^i) + [\triangle X^i(t^{-i}) - \triangle M^i(t^i)] \geq 0,$$

where $\triangle V^i(t^i) \equiv V^i(0, t_{-j}^i) - V^i(t^i)$,
$\triangle X^i(t^{-i}) \equiv X^i(0, t_{-i}^j; t^{-\{i,j\}}) - X^i(t^j; t^{-\{i,j\}})$ and $\triangle M^i(t^i) \equiv M^i(0, t_{-j}^i) - M^i(t^i)$

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 (= direct surplus effect + third country effect).

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 countries. It will be more likely to happen if two countries have similar economic sizes. In addition, the decreases of imports from the ROW positively affect the trade surplus without any change in exports to the ROW. Therefore, the change of trade surplus is crucial to determine whether an FTA improves the welfare or not given that mutual trade liberalization increases consumer's gross utilities. For more details, I will examine the effects of FTA between

[16]This section is based on the basis set-up of Furusawa and Konishi (2007). I review their main findings and paraphrase their sentence. On the top of that, I add some specific details.

country i and j on three components of social welfare, $V^i(t^i)$ and $M^i(t^i)$ and $X^i(t^{-i})$ and what makes country i agree on the formation of an FTA.

As a first step to examine the welfare effect, I will show how a representative consumer's demand is changed after forming a new FTA. 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 those for both members or non-members of country i's pre-existing FTAs, q_k^i and q_h^i, are decreased after forming a new FTA between country i and j.

$$\frac{dq_j^i}{d\gamma} = \underbrace{\frac{t^i}{2(1-\sigma)}}_{(1):+} - \underbrace{\frac{s^j\sigma t^i}{2(1-\sigma)(2-\sigma)}}_{(2):-} = \underbrace{\frac{t^i}{2(1-\sigma)}(1-\frac{s^j\sigma}{(2-\sigma)})}_{(3):+} > 0$$

The first term is direct effect from reduction in tariff on the demand for the goods of a new FTA partner, q_j^i and the second term is indirect effect from reduction in average tariff, which comes from the competition within the country j. Overall net change of q_j^i is positive.

$\frac{dq_k^i}{d\gamma} = -\frac{s^j\sigma t^i}{2(1-\sigma)(2-\sigma)} < 0$ and $\frac{dq_h^i}{d\gamma} = -\frac{s^j\sigma t^i}{2(1-\sigma)(2-\sigma)} < 0$

There is only negative indirect effects from reduction in average tariff on a representative consumer's demands for the goods of both members or non-members of country i's pre-existing.

A representative consumer's demand for the goods of country i in country j, q_i^j, is increased but those in country k, and h, q_i^j and q_i^h, are not changed after forming a new FTA between country i and j.

$\frac{dq_i^j}{d\gamma} = \frac{t^j}{2(1-\sigma)} - \frac{s^i\sigma t^j}{2(1-\sigma)(2-\sigma)} = \frac{t^j}{2(1-\sigma)}(1 - \frac{s^i\sigma}{(2-\sigma)})t^j > 0$

$q_i^k(t^k) = \frac{1}{2-\sigma} + \frac{\sigma}{2(1-\sigma)(2-\sigma)}(1 - s^{C_k})t^k \rightarrow \frac{dq_i^k}{d\gamma} = 0$

$q_i^h(t^h) = \frac{1}{2-\sigma} - \frac{1}{2(1-\sigma)}t + \frac{\sigma}{2(1-\sigma)(2-\sigma)}(1 - s^{C_h})t^h \rightarrow \frac{dq_i^h}{d\gamma} = 0$

Note that there is no third or higher order effect of pre-existing FTAs since tariff reduction leads to only trade creation without any trade diversion of diverting from more efficient countries to less efficient ones. This is because each country has the same capacity to produce differentiated goods at zero cost by assumptions.

Examples of N's order effect of pre-existing FTAs

1. First order effect: due to a new FTA between Korean and USA, both direct imports and exports between themselves are increases but imports from the ROW such as both Chile (members) and Mexico (non-members) are decreased.

$$\begin{array}{lcll} \text{Korea} & \Leftrightarrow & \text{USA (new FTA)} & \Delta\text{Import, } \Delta\text{export} \\ & \Leftrightarrow & \text{Chile (pre-existing FTA)} & \nabla\text{Import} \\ & & \text{Mexico (No FTA)} & \nabla\text{Import} \end{array}$$

2. Second order effect: since both Korea and USA already have FTAs with Chile, pre-existing FTAs with Chile cuase 'loss sharing effect' and 'concession erosion effect' to both Korea and USA.

$$\underleftarrow{Korea \Leftrightarrow \underleftarrow{USA \Leftrightarrow \textbf{Chile}}_{\text{Loss sharing effect}}}_{\text{Concession erosion effect}}$$

3. Third order effect: the pre-existing FTAs of Chile can possibly affect the USA's export to Chile such as $q_{USA}^{Chile}(t) = \frac{1}{2-\sigma} + \frac{\sigma}{2(1-\sigma)(2-\sigma)}(1 - s^{C_{chile}})t^{chile}$. But, demands for USA's goods in Chile are not changed by a new FTA between Korea and USA such as $\frac{\partial q_{USA}^{Chile}(t)}{\partial \gamma} = 0$. Therefore, we do not need to consider third or higher order effect of pre-existing FTAs in this model.

$$\underleftarrow{Korea \Leftrightarrow \underleftarrow{USA \Leftrightarrow Chile \Leftrightarrow \textbf{Mexico}}_{\text{No effect}}}_{\text{No effect}}$$

2.4.1 Gross Utility Effect

The welfare change of country i in consumer gross utility after forming an FTA between i and j is calculated by the following ways.

First, $V^i(t^i(\gamma))$ can be rewritten as following[17]:

$$\begin{aligned} V^i(t^i(\gamma)) &= \textstyle\sum_{k=1}^n s^k q_k^i(t^i) - \frac{(1-\sigma)}{2}\sum_{k=1}^n s^k q_k^i(t^i)^2 - \frac{\sigma}{2}[\sum_{k=1}^n s^k q_k^i(t^i)]^2 + l \\ &= \tfrac{(1-\bar{t}^i)}{2-\sigma} - \tfrac{(1-\sigma)}{2}\sum_{m=1}^n s^m[\tfrac{1}{2-\sigma} - \tfrac{1}{2(1-\sigma)}t_m^i + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}\bar{t}^i]^2 - \tfrac{\sigma}{2}[\tfrac{(1-\bar{t}^i)}{2-\sigma}]^2 + l \end{aligned}$$

Then, $V^i(t^i(\gamma))$ is differentiated with respect to γ, which is a continuous variable denoting the degree of an FTA between i and $j, i.e. \gamma \in [0,1]$ and $\gamma = 1$ if there exists an FTA between i and j[18].

[17] Since $q_k^i(t^i) = \frac{1}{2-\sigma} - \frac{1}{2(1-\sigma)}t_k^i + \frac{\sigma}{2(1-\sigma)(2-\sigma)}\bar{t}^i$ and $\sum_{k=1}^n s^k = 1$,note $\sum_{k=1}^n s^k q_k^i(t^i) = \frac{\sum_{k=1}^n s^k}{2-\sigma} - \frac{\sum_{k=1}^n s^k t_k^i}{2(1-\sigma)} + \frac{\sigma\sum_{k=1}^n s^k}{2(1-\sigma)(2-\sigma)}\bar{t}^i = \frac{1}{2-\sigma} - \frac{\bar{t}^i}{2(1-\sigma)} + \frac{\sigma}{2(1-\sigma)(2-\sigma)}\bar{t}^i = \frac{(1-\bar{t}^i)}{2-\sigma}$.

[18] As the same with the lemma 1 of Furusawa and Konishi (2007), $\frac{\partial V^i}{\partial t_j^i} = \sum_{k=1}^n \frac{\partial \widetilde{V^i}}{\partial \widetilde{q_k^i}}(\frac{\partial \widetilde{q_k^i}}{\partial t_j^i} + \frac{\partial \widetilde{q_k^i}}{\partial \bar{t}^i}\frac{\partial \bar{t}^i}{\partial t_j^i}) = s^j[-\frac{1-\sigma}{(2-\sigma)^2} + \frac{\sigma^2}{4(1-\sigma)(2-\sigma)^2}\bar{t}^i - \frac{1}{4(1-\sigma)}t_j^i]$. By substituting $t_j^i(\gamma)$ and $\bar{t}^i(\gamma)$ for t_j^i and $\bar{t}^i$, I can ob-

$$\frac{dV^i(t^i(\gamma))}{d\gamma} = \frac{s^j t^i}{2-\sigma} - \frac{1-\sigma}{2} s^j 2q_j^i(t^i)\frac{t^i}{2(1-\sigma)} - \frac{1-\sigma}{2}\sum_{k=1}^{n} s^k 2q_k^i(t^i)\frac{\sigma\left(-s^j t^i\right)}{2(1-\sigma)(2-\sigma)} - \frac{\sigma}{2}2\frac{(1-\bar{t}^i)}{2-\sigma}\frac{s^j t^i}{2-\sigma}$$

$$= s^j t^i[\frac{1}{2-\sigma} - \underbrace{\frac{q_j^i(t^i)}{2} + \frac{(1-\bar{t}^i)}{2-\sigma}\frac{\sigma}{2(2-\sigma)}}_{\Delta[\text{Love of variety}]} - \frac{\sigma}{(2-\sigma)^2}(1-\bar{t}^i)]$$

$$= s^j t^i[\frac{1}{2-\sigma} - \frac{q_j^i(t^i)}{2} - \frac{\sigma}{2(2-\sigma)^2}(1-\bar{t}^i)]$$

$$= s^j t^i[\frac{1}{2-\sigma} - \frac{1}{2}\{\frac{1}{2-\sigma} - \frac{(1-\gamma)}{2(1-\sigma)}t^i + \frac{\sigma}{2(1-\sigma)(2-\sigma)}\bar{t}^i\} - \frac{\sigma}{2(2-\sigma)^2}(1-\bar{t}^i)]$$

$$= s^j t^i[\underbrace{\frac{1-\sigma}{(2-\sigma)^2}}_{(1)} - \underbrace{\frac{\sigma^2}{4(1-\sigma)(2-\sigma)^2}\bar{t}^i}_{(2)} + \underbrace{\frac{(1-\gamma)}{4(1-\sigma)}t^i}_{(3)}]$$

$\frac{dV^i(t^i(\gamma)}{d\gamma}$ is composed of three parts. First, (1) means that the increase of consumer surplus after FTA with country j is offset by the decrease of gross utility in love of variety and substitutability. Then (2) seems to be the indirect effect caused by the trade diversion from other trading partners to the country j. Lastly, (3) means that the increase in gross utility seems to be due to the trade liberalization (zero-tariffs) after FTA with country j.

Thus, thanks to tariff elimination 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 indirect 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.

By integrating over γ, finally, the welfare change of country i in consumer gross utility after signing an FTA between i and j becomes as following.

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

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

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

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

---

tain $\frac{dV^i(t^i(\gamma)}{d\gamma}$ with the following way, $\frac{\partial V^i(t^i(\gamma)}{\partial t_j^i(\gamma)}\frac{\partial t_j^i(\gamma)}{\partial \gamma} = -t^i\frac{\partial V^i(t^i(\gamma)}{\partial t_j^i(\gamma)}$ since $\frac{dt_j^i(\gamma)}{d\gamma} = -t^i$. Finally, $\frac{dV^i(t^i(\gamma)}{d\gamma} = s^j t^i[\frac{1-\sigma}{(2-\sigma)^2} - \frac{\sigma^2}{4(1-\sigma)(2-\sigma)^2}\bar{t}^i + \frac{(1-\gamma)}{4(1-\sigma)}t^i]$, which is the change of the gross utility with respect to γ. $\int_0^1 \frac{dV^i(t^i(\gamma))}{d\gamma}d\gamma$ can be regarded as the overall expected change of gross utility according to before/after FTA between i and j.

$$= A^i + \underbrace{s^{\widehat{C_i}} \frac{s^j \sigma^2 (t^i)^2}{4(1-\sigma)(2-\sigma)^2}}_{\text{From pre-existing FTAs}}$$

$\triangle V^i(t)$ consists of two parts. One part is the exactly same as $\triangle V^i(t)$ of no pre-existing FTAs case and the other part is derived from the pre-existing FTAs ($s^{\widehat{C_i}}$), which makes a consumer's gross increased. This is because country i can still enjoy love of variety thanks to the goods imported from i's pre-existing FTAs ($s^{\widehat{C_i}}$) with preferential tariffs even after signing a new FTA between country i and j. This explanation can be plausible since $s^{\widehat{C_i}} \frac{s^j \sigma^2 (t^i)^2}{4(1-\sigma)(2-\sigma)^2}$ is derived from the part of $-\frac{\sigma^2}{4(1-\sigma)(2-\sigma)^2}(1 - s^{C_i} - \frac{s^j}{2})t^i$ in $\triangle V^i(t)$, which implies the loss caused by the decrease in variety of goods, but $s^{C_i} \frac{s^j \sigma^2 (t^i)^2}{4(1-\sigma)(2-\sigma)^2}$ makes loss of $\triangle V^i(t)$ smaller. In sum, in the case that both country i and j have pre-existing FTAs, $\triangle V^i(t)$ is bigger than $\triangle V^i(t)$ of no pre-existing FTA case thanks to the pre-existing FTA effect. In addition, $\triangle V^i(t)$ can be always positive if $s^{C_i} + \frac{s^j}{2} \geq \frac{1}{2}$, which is the lemma 2 of Furusawa and Konishi (2007).

2.4.2 Trade Surplus Effect

The welfare change of country i in $\Delta[X^i(t^{-i}) - M^i(t^i)]$ after singing an FTA between i and j consists of two parts: direct surplus effect and third country effect.

$$\Delta[X^i(t^{-i}) - M^i(t^i)]$$

$$= \text{Direct surplus (direct + indirect effect) + Third country effect}$$

$$= \int_0^1 \underbrace{\frac{dX_j^i(t(\gamma))}{d\gamma} - \frac{dM_j^i(t(\gamma))}{d\gamma}}_{\text{Direct surplus}}$$

$$+ \underbrace{\underbrace{\sum_{k \in \widehat{C_i}} \frac{dX_k^i(t(\gamma))}{d\gamma} - \frac{dM_k^i(t(\gamma))}{d\gamma}}_{\text{From member countries}} + \underbrace{\sum_{h \notin \widehat{C_i} \cup \{i,j\}} \frac{dX_h^i(t(\gamma))}{d\gamma} - \frac{dM_h^i(t(\gamma))}{d\gamma}}_{\text{From non-member countries}} d\gamma}_{\text{Third country effect}}$$

$$= (1-\sigma) \int_0^1 2\tfrac{s^i}{\mu^i} \mu^j q_i^j \tfrac{dq_i^j}{d\gamma} - 2s^j q_j^i \tfrac{dq_j^i}{d\gamma} - \textstyle\sum_{k \in \widehat{C_i}} 2s^k q_k^i \tfrac{dq_k^i}{d\gamma} - \sum_{h \notin \widehat{C_i} \cup \{i,j\}} 2s^h q_h^i \tfrac{dq_h^i}{d\gamma} d\gamma$$

$$= \tfrac{s^i}{\mu^i} \mu^j \{\tfrac{1}{2-\sigma} - \tfrac{t^j}{4(1-\sigma)} + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}(1 - s^j - s^{\widehat{C_j}} - \tfrac{s^i}{2})t^j\}\{1 - s^i \tfrac{\sigma}{(2-\sigma)}\}t^j$$
$$- s^j \{\tfrac{1}{2-\sigma} - \tfrac{t^i}{4(1-\sigma)} + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}(1 - s^i - s^{\widehat{C_i}} - \tfrac{s^j}{2})t^i\}\{1 - s^j \tfrac{\sigma}{(2-\sigma)}\}t^i$$
$$+ s^{\widehat{C_i}} \{\tfrac{1}{2-\sigma} + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}(1 - s^i - s^{\widehat{C_i}} - \tfrac{s^j}{2})t^i\} \tfrac{s^j \sigma t^i}{(2-\sigma)}$$
$$+ \left(1 - s^i - s^j - s^{\widehat{C_i}}\right) \{\tfrac{1}{2-\sigma} - \tfrac{t^i}{2(1-\sigma)} + \tfrac{\sigma}{2(1-\sigma)(2-\sigma)}(1 - s^i - s^{\widehat{C_i}} - \tfrac{s^j}{2})t^i\} \tfrac{s^j \sigma t^i}{(2-\sigma)}$$

$$
\begin{aligned}
&= \underbrace{\frac{s^i}{\mu^i}\mu^j\{\frac{1}{2-\sigma}-\frac{t^j}{4(1-\sigma)}+\frac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^j-\frac{s^i}{2})t^j\}(1-\frac{s^i\sigma}{2-\sigma})t^j}_{\text{Net change in } i\text{'s exports to country } j\ (b_1)} \\
&\quad \underbrace{-\frac{\mu^j}{\mu^i}s^i s^{\widehat{C_j}}\frac{\sigma(t^j)^2}{2(1-\sigma)(2-\sigma)}(1-\frac{s^i\sigma}{2-\sigma})}_{\text{(1) Concession erosion effect}} \\
&\quad \underbrace{-s^j\{\frac{1}{2-\sigma}-\frac{t^i}{4(1-\sigma)}+\frac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^i-\frac{s^j}{2})t^i\}(1-\frac{s^j\sigma}{2-\sigma})t^i}_{\text{Net change in } i\text{'s imports from country } j\ (b_2)} \\
&\quad \underbrace{+s^j s^{\widehat{C_i}}\frac{\sigma(t^i)^2}{2(1-\sigma)(2-\sigma)}(1-\frac{s^j\sigma}{2-\sigma})}_{\text{(2) Loss sharing effect}} \\
&\quad \underbrace{+\left(1-s^i-s^j\right)\{\frac{1}{2-\sigma}-\frac{t^i}{2(1-\sigma)}+\frac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^i-\frac{s^j}{2})t^i\}\frac{s^j\sigma t^i}{(2-\sigma)}}_{\text{Net change in imports from the ROW } (b_3)} \\
&\quad \underbrace{+s^{\widehat{C_i}}\frac{t^i}{2(1-\sigma)}\frac{s^j\sigma t^i}{(2-\sigma)}}_{(3)} \underbrace{-(1-s^i-s^j)s^{\widehat{C_i}}\frac{\sigma t^i}{2(1-\sigma)(2-\sigma)}\frac{s^j\sigma t^i}{(2-\sigma)}}_{(4)} \\
&= \underbrace{b_1-\frac{s^i}{\mu^i}\mu^j s^{\widehat{C_j}}\frac{\sigma(t^j)^2}{2(1-\sigma)(2-\sigma)}(1-\frac{s^i\sigma}{2-\sigma})+b_2+s^j s^{\widehat{C_i}}\frac{\sigma(t^i)^2}{2(1-\sigma)(2-\sigma)}(1-\frac{s^j\sigma}{2-\sigma})}_{\text{Direct trade surplus}} \\
&\quad \underbrace{+b_3+s^{\widehat{C_i}}\frac{s^j\sigma(t^i)^2}{2(1-\sigma)(2-\sigma)}\{1-\left(1-s^i-s^j+\right)\frac{\sigma}{(2-\sigma)}\}}_{\text{Third country effect}}
\end{aligned}
$$

Pre-existing FTAs of each participating member can affect the incentive for country i to sign an FTA with country j with four ways. The first is 'concession erosion effect', which is mentioned by Joshi and Chen (2010). The profit gain from exports to a new FTA partner might be smaller 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 'loss sharing effect', which is also mentioned by Joshi and Chen (2010). The loss in the firms' home market profit due to a new FTA will be smaller 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. Those are derived from the direct trade surplus effects between member countries while the last two effects are derived from the third country effect. The first third country effect comes from 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' 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 effect is due to the fact that total imports from the third countries of country i 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 is composed of two parts: the changes in gross utility and trade surplus given that both i and j have no FTAs with other third countries and those derived from the pre-existing FTAs. By digging deeper into main results of Furusawa and Konishi (2007), I could show that pre-existing FTAs affect the welfare change of country i in five different ways. After rearranging the pre-existing FTAs, I can find that two different kinds of pre-existing FTAs work in the opposite ways on the incentive to sign an FTA for the country i. 'Own pre-existing FTA effects' measured with $s^{\widehat{C_i}}$ positively but, 'Partner's pre-existing FTA effects' measured with $s^{\widehat{C_j}}$ negatively affects the incentive to sign an FTA for the country i when $\sigma \in (0,1)$. The total welfare change of country i after singing an FTA between i and j becomes as following and each pre-existing FTA effect can be explained with each label.

$$\triangle W^i = \triangle V^i(t) + [\triangle X^i(t^{-i}) - \triangle M^i(t^t)]$$

$$\begin{aligned}
\triangle W^i_{w/FTA} &= \triangle W^i_{w/oFTA}\ (= A^i + b_1 + b_2 + b_3) \\
&+ \underbrace{s^j s^{\widehat{C_i}} \frac{\sigma^2 (t^i)^2}{4(1-\sigma)(2-\sigma)^2}}_{(1)} - \underbrace{\frac{\mu^j}{\mu^i} s^i s^{\widehat{C_j}} \frac{\sigma (t^j)^2}{2(1-\sigma)(2-\sigma)} \left(1 - \frac{s^i \sigma}{2-\sigma}\right)}_{(2)} \\
&+ \underbrace{s^j s^{\widehat{C_i}} \frac{\sigma (t^i)^2}{2(1-\sigma)(2-\sigma)} \left(1 - \frac{s^j \sigma}{2-\sigma}\right)}_{(3)} + \underbrace{s^{\widehat{C_i}} \frac{t^i}{2(1-\sigma)} \frac{s^j \sigma t^i}{(2-\sigma)}}_{(4):\ s^{\widehat{C_i}}(q_k^i - q_h^i)\frac{s^j \sigma t}{(2-\sigma)}} \\
&- \underbrace{\left(1 - s^i - s^j\right) \frac{s^{\widehat{C_i}} \sigma t^i}{2(1-\sigma)(2-\sigma)} \frac{s^j \sigma t^i}{(2-\sigma)}}_{(5)} \\
&= \triangle W^i_{w/oFTA} + \frac{\sigma}{2(1-\sigma)(2-\sigma)} [\underbrace{s^{\widehat{C_i}} s^j \left(2 - \frac{(1-2s^i)\,\sigma}{2(2-\sigma)}\right)(t^i)^2}_{(1)+(3)+(4)+(5)} - \underbrace{\frac{\mu^j}{\mu^i} s^i s^{\widehat{C_j}} \left(1 - \frac{s^i \sigma}{(2-\sigma)}\right)(t^j)^2}_{(2)}]
\end{aligned}$$

(1) Less change in variety consumption due to i' pre-existing FTAs

(2) Concession erosion effect in exports to a new FTA member due to j' pre-existing FTAs effect

(3) Loss sharing effect in imports from a new FTA member due to i' pre-existing FTAs effect

(4) Relatively more decrease in demands of the member countries of i' pre-existing FTAs compared to the non-members

(5) Less decrease in total imports from the ROW caused by the reduction in average tariff due to i' pre-existing FTAs

$$\triangle W^{i}_{w/FTA} \text{ is increased in } s^{\widehat{C_i}} \text{ and decreased in } s^{\widehat{C_j}}.$$

'Own pre-existing FTA effects' comes from the welfare changes in imports from the partner and the third countries, and in gross utility. The incentive to sign a FTA with country j increases with $s^{\widehat{C_i}}$ for a country i. This is because as $s^{\widehat{C_i}}(= s^{i}_{\widehat{C_i}})$ 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, 'Partner's pre-existing FTA effects' comes from the welfare change in exports to partner country j. 'Partner's pre-existing FTA effects' is composed of only '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 'Partner's pre-existing FTA effects', 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[19]. 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.

My empirical work will show that partner's pre-existing FTAs negatively affect the likelihood to form a new FTA with partner country j in the traditional economic incentives. In addition, I also show that country i is willing to sign a new FTA with country j if country i find it politically optimal to sign an FTA with country j based on the political economic approach of Baldwin and Jaimovich (2012). In appendix, I add some estimation results regressed with all variables related to the pre-existing FTA effects to compare which pre-existing FTA effects affect the formation of a new FTA the most.

Lastly, the total welfare changes of both country i and j can be written as following.

$$\begin{aligned}
&\triangle W^i + \triangle W^j = \triangle V^i + \triangle V^j + [\Delta X^i - \Delta M^i] + [\Delta X^j - \Delta M^j] \\
&= A^i + A^j + \underbrace{(\mu^j - \mu^i)[\theta^i(q_i^j)(1 - s^i\frac{\sigma}{(2-\sigma)})t^j - \theta^j(q_j^i)(1 - s^j\frac{\sigma}{(2-\sigma)})t^i]}_{\text{direct surplus effect}} \\
&+\underbrace{(s^j s^{\widehat{C_i}}(t^i)^2 + s^i s^{\widehat{C_j}}(t^j)^2)\frac{\sigma}{2(1-\sigma)(2-\sigma)}}_{\text{Pre-existing FTAs effect}} + \underbrace{\left(1 - s^i - s^j\right)\left\{s^j(q_h^i)t^i + s^i(q_h^j)t^j\right\}\frac{\sigma}{(2-\sigma)}}_{\text{Third country effect}}
\end{aligned}$$

[19] Holding the number of firms constant, the change in profits of a firm in a nation with and without an FTA is $(\frac{\mu}{\sigma n})(\frac{(1-\phi)((1+\phi(N-1))^2-(1-\phi)^2F_j)}{((1+(1-\phi)F_2+\phi(N-1))(2+\phi(N-2))(1+\phi(N-1)}$), which is decreasing in F_j, which confirms that contagion does not happen for FTAs when the number of firms is fixed. F_j is denoted as the number of FTAs that the country j (the hub) has with others (the spokes), assuming there are no other FTAs.

3 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. I expect that each country has different critical value that makes itself willing to sign a new FTA. By using this critical value, I would like to confirm how well 'Real FTA Status' can be matched up with 'Predicted FTA Status' based on the following theory-based welfare changes.

$$\triangle W^i = \underbrace{\frac{s^j t^i}{8(1-\sigma)(2-\sigma)^2}[8(1-\sigma)^2 + \{-(1-2s^i-s^j)\sigma^2 + 4(1-\sigma)\}t]}_{\text{Change in gross utility}}$$

$$+\underbrace{\frac{s^i}{\mu^i}\mu^j\{\frac{1}{2-\sigma} - \frac{t^j}{4(1-\sigma)} + \frac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^j-\frac{s^i}{2})t^j\}(1-\frac{s^i\sigma}{2-\sigma})t^j}_{\text{Change in exports to a new FTA partner}}$$

$$\underbrace{-s^j\{\frac{1}{2-\sigma} - \frac{t^i}{4(1-\sigma)} + \frac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^i-\frac{s^j}{2})t^i\}(1-\frac{s^j\sigma}{2-\sigma})t^i}_{\text{Change in imports from a new FTA partner}}$$

$$+\underbrace{\left(1-s^i-s^j\right)\{\frac{1}{2-\sigma} - \frac{t^i}{2(1-\sigma)} + \frac{\sigma}{2(1-\sigma)(2-\sigma)}(1-s^i-\frac{s^j}{2})t^i\}\frac{s^j\sigma t^i}{2-\sigma}}_{\text{Change in the imports from the ROW}}$$

$$+\frac{\sigma}{2(1-\sigma)(2-\sigma)}[\underbrace{s^{\widehat{C_i}}s^j\{2-\left(1-2s^i\right)\frac{\sigma}{2(2-\sigma)}\}(t^i)^2}_{\text{Change in own pre-existing FTA effects}} - \underbrace{\frac{\mu^j}{\mu^i}s^i s^{\widehat{C_j}}\{1-s^i\frac{\sigma}{(2-\sigma)}\}(t^j)^2}_{\text{Change in partner's pre-existing FTA effects}}]$$

To verify the conformity between 'Real FTA Status' and 'Predicted FTA Status', I first need to find the best substitutability (σ) among differentiated goods 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 $s^{\widehat{C_j}}$[20] into $\triangle W^i$ and $\triangle W^j$ and changing σ as much as 0.01 ranging from 0 to 1, I could find the best $\sigma = 0.72$ that 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 as much as (max_$\triangle W^i$ - min_$\triangle W^i$)/400 in the range of minimum and maximum values of $\triangle W^i$ that make country i actually sign FTAs, I could select the best critical value

[20] s^i is the market share of country i in the industrial goods. I define s^i as the ratio of country i's GDP out of World GDP in industry. In the World Bank indicator data, industry is defined to correspond to ISIC divisions 10-45 and includes manufacturing (ISIC divisions 15-37).

(cv_i) 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). I iterate the same job 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, I define 'Predicted FTA Status' 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, I could show how well whether to form a new FTA can be predicted by the welfare changes and critical values.

[Table 3.1] 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 3.2] 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, 21,838 cases of (Real FTA Status =1) are matched up among 92,717 cases of (Predicted FTA Status = 1) and 85,576 cases of (Real FTA Status=0) are matched up among 90,285 cases of (Predicted FTA Status = 0). 23 percent of cases predicted as FTA=0 and 95 percent of cases predicted as FTA=1 are matched up with 'Real FTA Status'. On the other hand, in the case that the individual critical values for each country are

used, 15,956 cases of (Real FTA Status=1) are matched up among 22,130 cases of (Predicted FTA Status = 1) and 150,281 cases of (Real FTA Status=0) are matched up among 160,872 cases of (Predicted FTA Status = 0). 72 percent of cases predicted as FTA=0 and 93 percent of cases predicted as FTA=1 are matched up with 'Real FTA Status'. The probability of (Real FTA Status = 1) given Predicted FTA Status = 1 is higher when individual critical value for each country is used than when identical critical value is used for all countries.

To find out the crucial components in the net welfare change due to a new FTA that truly affect the decision to reach agreements, I first examine the summary statics of given real data such as s^i, μ^i, t^i, and $s^{\widehat{C_i}}$. In the case 1 that both 'Real FTA Status' and 'Predicted FTA Status' = 1 at t, mean values of s^i and $s^{\widehat{C_i}}$ are not only bigger but also more increased between t-1 and t compared to the case 2 of all observations. Interestingly, mean value of MFN^i is increased in case 1 rather than decreased, which represents the 'Stumbling Bloc Effect'. It is contrary to the result that mean value of MFN^i is even more decreased than case 2 in the case 3 that Real FTA Status = 1 at t. 'Stumbling Bloc Effect' in case 1 can be explained with the fact that the European countries mostly belong to the observations of case 1. Limao (2016) says that there could be a stronger 'Stumbling Bloc Effect' for countries and goods with lower initial multilateral tariffs. This statement is supported by two empirical studies. Limao (2006) shows that MFN tariffs for PTA goods are relatively increased compared to non-PTA goods in US. Karacaovali and Limao (2008) find the 'Stumbling Bloc Effect' for EU but no 'Stumbling Bloc Effect' in goods with positive tariffs and for customs unions.

[Table 3.3] Case 1: Both real and predicted FTA status = 1 at t

t-1	obs.	Means	t	obs.	Means	Change rate
s^i	1,296	0.011	s^i	1,688	0.012	0.06
$s^{\widehat{C_i}}$	1,535	0.304	$s^{\widehat{C_i}}$	1,688	0.342	0.13
MFN^i	1,046	0.072	MFN^i	1,688	0.084	0.17
Population^i	1,535	1.81e+07	Population^i	1,688	1.89e+07	0.04

[Table 3.4] Case 2: All observations

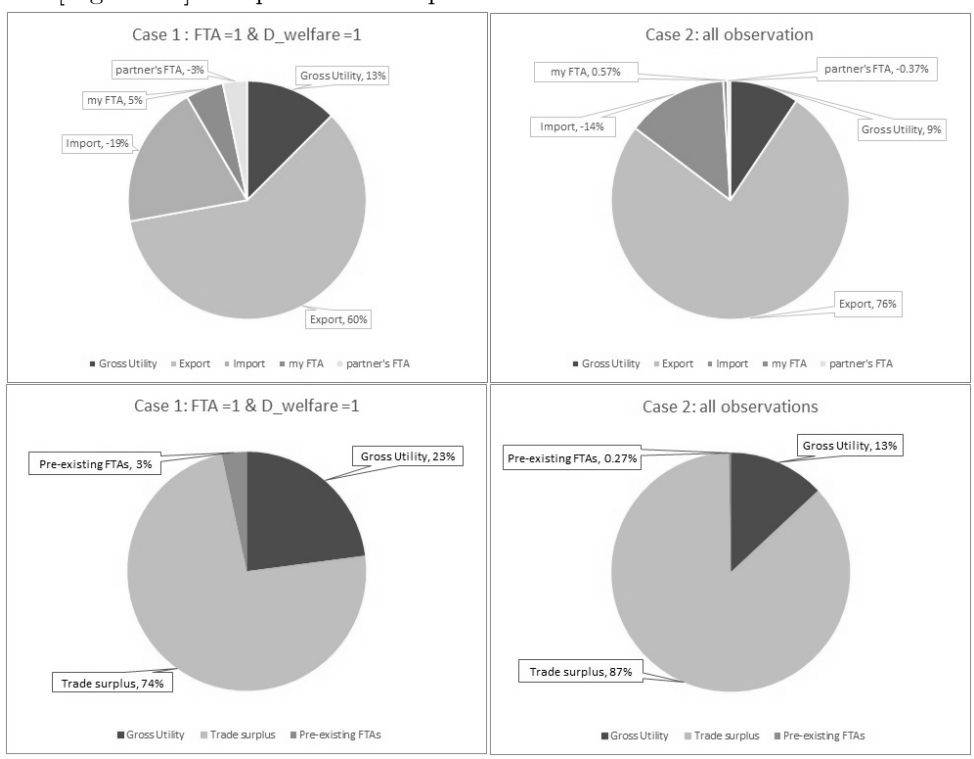
t-1	obs.	Means	t	obs.	Means	Change rate
s^i	578,852	0.006	s^i	607,804	0.006	0.02
$s^{\widehat{C_i}}$	675,108	0.089	$s^{\widehat{C_i}}$	710,640	0.092	0.03
MFN^i	352,500	0.10	MFN^i	373,180	0.098	-0.015
Population^i	674,732	3.24e+07	Population^i	710,264	3.26e+07	0.006

[Table 3.5] Case 3: Real FTA status=1 at t

t-1	obs.	Means	t	obs.	Means	Change rate
s^i	43,427	0.0079	s^i	44,033	0.0078	-0.004
$s^{\widehat{C_i}}$	48,357	0.089	$s^{\widehat{C_i}}$	49,160	0.238	0.035
MFN^i	37,061	0.078	MFN^i	36,692	0.076	-0.026
Population^i	48,347	2.23e+07	Population^i	49,150	2.24e+07	0.004

Among the components of the net welfare change due to a new FTA, gross utility and pre-existing FTA have relatively higher ratio in the case 1 compared to case 2, which means that the change in gross utility and pre-existing FTA might be influential to make each party agree on forming an FTA.

[Figure 3.1] Comparison of component ratios between case 1 and case 2[21]



[21] The components ratios of upper figure are bases on the sum of absolute values of each component while those of lower figure are based on the net value of all components in Figure 3.1.

4 Empirical Analysis of Determinants of FTAs

Diverse empirical researches have showed what makes pairs of countries agree on the FTAs in force. As a economic determinants of FTA, Baier and Bergstrand (2004) affirms that the larger the likelihood to form a new FTA is, the closer each other but the more remote from the ROW, the larger and more similar economic sizes of two participating countries are, more different capital-labor endowment ratios between each party and less different capital-labor endowment ratios of the participating countries relative to those of the ROW. In the perspective of trading partners, Magee (2003) proves that if two countries are already natural trading partner each other, they are more likely to sign an FTA, treating FTA formation as endogenous. Holmes (2005) shows that a new FTA is more likely to be implemented as mercantile interest, which is the desire for access to partner's market as a exporter, is strong enough with each other. Mercantile interest is measured by the share of exports to partner's country out of own total exports. In addition to those economical approaches, Mansfield and Reinhardt (2003) shows how GATT/ WTO affects the formation of Regionalism. Especially, Mansfield and Reinhardt (2003) proves that a preferential trade agreement is more likely to be formed when more countries take part in GATT/WTO, a multilateral negotiating round is taking place, one of parties participates in a GATT/WTO dispute settlement with a third party as a complainant or defendant, and one of parties loses a dispute with a third party. In the perspective of political determinants, Mansfield et. al. (2002) shows that democratic countries are more likely to conclude the trade agreement. Besides, in the case of both democratic countries, RTAs are two times more likely to be formed than either democratic country case and four times more than neither democratic country case. Lastly, Marquez-Ramos et. al. (2011) concludes that socio-political factors such as democracy, common language, and the level of economic freedom are less influential than any other economic and geographical factors used in Baier and Bergstrand (2004) on the different levels of integration by using ordered logit model. Those mentioned above and more variables used as the determinants of FTAs in previous literatures are listed in the appendix.

Furusawa and Konishi (2007) also mentions some determinants to form an FTA based on the change in trade surplus due to an FTA between country i and j.

$$\Delta X^i(t^{-i}) - \Delta M^i(t^i)$$
$$= \mu^j[\theta^i q_i^j(\underbrace{\frac{\partial q_i^j}{\partial \gamma}}_{+}) - \theta^j q_j^i(\underbrace{\frac{\partial q_j^i}{\partial \gamma}}_{+})] - \left(1 - s^i - s^j - s^{\widehat{C_i}}\right) q_h^i(\underbrace{\frac{\partial q_h^i}{\partial \gamma}}_{-}) - s^{\widehat{C_i}} q_k^i(\underbrace{\frac{\partial q_k^i}{\partial \gamma}}_{-})$$

s^i, s^j, μ^i, and μ^j are exogenously given by a model. $[\Delta X^i(t^{-i}) - \Delta M^i(t^i)]$ 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) also mention 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. On the top of some implications of Furusawa and Konishi (2007), I try to examine unilateral incentives and bilateral incentives to sign an FTA in this section.

4.1 Unilateral Incentives to Sign an FTA

4.1.1 Testable Hypothesis of Theoretical model

Based on the comparative statics of the welfare change after forming a new FTA with respect to tariff levels, industrialization levels and pre-existing FTAs, I can make three hypotheses and find that tariff levels, industrialization levels and pre-existing FTAs of each party make one party relatively more beneficial.

Tariff levels Furusawa and Konish (2007) shows that if $t^i \geq t^j$, it is likely that $\Delta q_j^i(t^i) \geq \Delta q_i^j(t^i)$, which means that country j's export to country i increases more than its import from country i if partner's MFN tariff level is higher than own MFN tariff level. Hence, the FTA between i and j tends to be more beneficial to country j if $t^i \geq t^j$. According to the result of comparative statics, $\triangle W^i$ is increased as t^j is higher but whether $\triangle W^i$ increases or decreases is not decided as t^i is higher. Due to own tariff elimination after forming an FTA, consumer surplus increases but it also leads to decrease in profit and tariff revenue as well, which makes the effect of t^i on $\triangle W^i$ unclear. However, tariff elimination causes exports to a new FTA partner to increase and the change in exports to a new FTA partner will be larger as partner's tariff level is higher. Based on the latter result, I make the first hypothesis.

Hypothesis 1) Unilateral incentive to sign an FTA with the partner country is increased as partner country is high-tariff country.

$$\frac{\partial \triangle W^i_{w/FTA}}{\partial t^i} = \underbrace{\begin{array}{c} -s^j[\frac{1}{2-\sigma} - \frac{t^i}{2(1-\sigma)} + \frac{\sigma(1-s^{C_i}-s^j)t^i}{(1-\sigma)(2-\sigma)}] \\ +(1-s^i)\,[\frac{1}{2-\sigma} - \frac{t^i}{(1-\sigma)} + \frac{\sigma}{(1-\sigma)(2-\sigma)}(1-s^{C_i}-\frac{s^j}{2})t^i]\frac{s^j\sigma}{(2-\sigma)} \end{array}}_{-:\text{ decrease in profit and tariff revenue}}$$

$$\frac{\partial \triangle W^i_{w/FTA}}{\partial t^j} = s^i\frac{\mu^j}{\mu^i}[\frac{1}{2-\sigma} - \frac{t^j}{2(1-\sigma)} + \frac{\sigma}{(1-\sigma)(2-\sigma)}(1-s^{C_i}-\frac{s^i}{2})t^j](1-s^i\frac{\sigma}{(2-\sigma)}) \geq 0$$

Hur and Qiu (2015) shows how the tariff levels of two FTA partner countries influence on the unilateral incentive to form an FTA. First, if a country has a relatively lower tariff, the profit and tariff revenue reduction from completely opening up the domestic market is smaller (market concession effect). They also show that the country's exporters will gain more benefits in the partner's market as its partner is a high-tariff county, which raises domestic country's incentive to sign an FTA with a higher tariff level country (market expansion effect).

Industrialization levels Furusawa and Konish (2007) shows that the direct surplus effect can be unbalanced in favor of the relatively more industrialized country. The more industrialized country derives a relatively larger benefit from the opening of the partner's market.

Hypothesis 2) Unilateral incentive to sign an FTA with the partner country increases with own industrialization level and decreases with partner's industrialization level.

$$\begin{aligned} \triangle W^i_{w/FTA} &= \triangle V^i(t^i) + [\triangle X^i(t^{-i}) - \triangle M^i(t^i)] \\ &= \underbrace{\mu^j\{\theta^i(q^j_i)(1-s^i\frac{\sigma}{(2-\sigma)})t^j - \theta^j(q^i_j)(1-s^j\frac{\sigma}{(2-\sigma)})t^i\}}_{\text{Direct surplus effect}} \\ &\quad \underbrace{+s^{c_i}(q^i_k)\frac{s^j\sigma t^i}{(2-\sigma)} + \left(1-s^j-s^{c_i}\right)(q^i_h)\frac{s^j\sigma t^i}{(2-\sigma)}}_{\text{Third country effect}} \end{aligned}$$

where $\theta^i = \frac{s^i}{\mu^i}$. The higher θ^i and the lower θ^j, the larger an increase in country i's industrial trade surplus.

$$\frac{\partial \triangle W^i_{w/FTA}}{\partial \theta^i} = \mu^j(q^j_i)(1-s^i\frac{\sigma}{(2-\sigma)})t^j \geq 0$$

$$\frac{\partial \triangle W^i_{w/FTA}}{\partial \theta^j} = -\mu^j(q^i_j)(1-s^j\frac{\sigma}{(2-\sigma)})t^i \leq 0$$

The effects of pre-existing FTAs Furusawa and Konish (2007) shows that country i's incentive to sign an FTA with country j increases with the numbers of own pre-existing FTAs but decrease with those of partner's pre-existing FTAs

given that the world consists of n symmetric countries with common tariff set (t). However, the similar results can be derived even under the assumption of asymmetric countries: the incentive to sign an FTA increases with own pre-existing FTA effects and decreases with partner's pre-existing FTA effects. In the asymmetric case, the pre-existing FTA effect can be measured by spatial weighting matrix rather than by the number of pre-existing FTAs.

Hypothesis 3) Own pre-existing FTAs with asymmetric countries positively but partner's pre-existing FTAs with asymmetric countries negatively affect own incentive to sign an FTA with the a new FTA partner.

$$\triangle W^i_{w/FTA} = \triangle W^i_{w/oFTA} + \frac{\sigma}{2(1-\sigma)(2-\sigma)}[s^{\widehat{Ci}} s^j \{2-(1-2s^i)\frac{\sigma}{2(2-\sigma)}\}(t^i)^2 - \frac{\mu^j}{\mu^i} s^i s^{\widehat{Cj}} \{1-s^i \frac{\sigma}{(2-\sigma)}\}(t^j)^2]$$

$$\frac{\partial \triangle W^i_{w/FTA}}{\partial s^{\widehat{Ci}}} = \frac{\sigma}{2(1-\sigma)(2-\sigma)} s^j \{2-(1-2s^i)\frac{\sigma}{2(2-\sigma)}\}(t^i)^2 \geq 0$$

$$\frac{\partial \triangle W^i_{w/FTA}}{\partial s^{\widehat{Cj}}} = -\frac{\sigma}{2(1-\sigma)(2-\sigma)} \frac{\mu^j}{\mu^i} s^i \{1-s^i \frac{\sigma}{(2-\sigma)}\}(t^j)^2 \leq 0$$

The effect of own pre-existing FTA with asymmetric countries $s^{\widehat{Ci}}$ is derived from exports while the effect of partner's pre-existing FTAs with asymmetric countries $s^{\widehat{Cj}}$ is derived from imports and gross utility. The effect of pre-existing FTAs with asymmetric countries needs to be weighted by the market shares of countries that have already formed pre-existing FTAs. To properly measure pre-existing FTA effect, I first explain the empirical methodology such as "Spatial Dependence with Dyadic Data" and show how to define a spatial weighting matrix based on my theoretical results.

4.1.2 Empirical Methodology for Testing Hypothesis

To properly verify the theoretical results of the pre-existing FTA effects, I apply "Spatial Dependence with Dyadic Data" into our empirical model. The spatial effects in dyadic data include two main terminologies: 'Spatial Dependence' and 'Dyadic Data'. First, 'Spatial Dependence' or 'Spatial Contagion' describes the situation where the decision of one economical or political unit is influenced by those of other units, which is said to spatially depend on each other[22]. In other words,

[22] There are generally three ways to model spatial effects: spatial lag, Spatial-x and spatial error models. Spatial lag models regress the dependent variable on the weighted values of the same dependent variable in all other units, which could be the temporally lagged dependent variable in all other units. Spatial-x models regress the dependent variable on the weighted values of more than one of dependent variables in all other units. Finally, Spatial error models regress on the weighted values of error term, which also have an i.i.d. error term, ε.

the marginal utility of one unit depends on the decisions of other units. Most of studies related to 'Spatial dependence' or 'Spatial Contagion' have been based on a monadic data set. The spatial lag in a monadic panel dataset is formally modeled like $y_{i,t} = \rho\sum_{k} w_{ik,t}y_{k,t} + \beta X_{i,t} + \varepsilon_{i,t}$, where $i = 1, 2, ..., N$, $t = 1, 2, ..., T$, $k = 1, 2, ..., N$. The dependent variable $y_{i,t}$ regresses on a spatially lagged dependent variable, $\sum_{k} w_{ik,t}y_{k,t}$ and a set of explanatory variables, $X_{i,t}$, which also includes the temporally lagged dependent variable and unit and period fixed effects if necessary. $\varepsilon_{i,t}$ is an independent and identically distributed error term. The spatial lag $\sum_{k} w_{ik,t}y_{k,t}$ is composed of two parts: the spatial $(y_{k,t})$ and the spatial weighting matrix $(w_{ik,t})$. The spatial $y_{k,t}$, which is an $N \times T$ matrix (N number of units k and T time periods) of the dependent variable, generally can be the same period or lagged value of the dependent variable in all units k. It is multiplied by $N \times N \times T$ block-diagonal spatial weighting matrix, which is a kind of link function to measure the connectivity between N number of units i and N number of units k in T time periods in the off-diagonal cells of the matrix. The diagonal of the weighting matrix is zero for all $i = k$, which means that each unit cannot spatially depend on itself.[23]

In the recent international researches, however, a dyadic framework seems to be more suitable for representing the bilateral relation between two parties such as preferential trade agreement (Manger 2006, Egger and Larch 2008, Baldwin and Jaimovich 2012), bilateral investment treaties (Neumayer and Plumper 2010), and so on. In dyadic data, the unit of observation is a pair so dependent variable is the form of relationship between dyads. According to the classification of spatial effects in dyadic data proposed by Neumayer and Plumper (2010a)[24], there are two kinds of dyadic data such as directed and undirected dyadic data. In directed dyadic data, the interaction between i and j is initiated from i (source) and directed to j (target), while since there is no difference between ij and ji, dyad ij and ji are equivalent each other in undirected dyadic data.

Among five different classifications of directed dyad, 'specific target contagion' $(y_{ij} = \rho\sum_{k\neq j} \omega_{pq}y_{ik} + \varepsilon_{ij})$ describes the situation where decisions of other target countries k with the same source country i affect the decision between country i (source) and j (target). It is applicable to create the weighting matrix for 'own pre-existing FTA effects'.

'Own pre-existing FTA effects' describes the situation where the decision of

[23] This explanation is referenced from Neumayer and Plumper (2010b).

[24] "Spatial Effects in Dyadic Data," International Organization 64, Winter 2010, p 145-166

FTA between country i (source, oneself) and j (target, partner) at t is influenced by the weighted average of FTAs signed by other countries k (other targets, exporters) with the country i (source, importer) up to $t-1$. Its basic form is $y_{ij,t} = \rho \sum_{k \in \widehat{C_i}} \omega_{pq,t-1} y_{ik,t-1} + \varepsilon_{ij,t}$, of which weighting matrix could be $\omega_{pq} = w_{(ik)}$, which shows a link between i and k. This is based on 'own pre-existing FTA effects' measured by $s^{\widehat{C_i}}$. $s^{\widehat{C_i}}$ is the measure of market shares of the countries which belong to $\widehat{C_i}$, which can be defined by weighted sum of the import shares of other exporting countries (k) that have already exported goods to country i with preferential tariffs.

$$\text{(Own pre-existing FTA effects)}_{i,t} = \sum_{k \in \widehat{C_i}} \left(\frac{\text{Import}_{ik}}{\text{Total Import}_i}\right)_{1993} FTA_{ik,t-1}$$

where $\sum_{k \in \widehat{C_i}} \left(\frac{\text{Import}_{ik}}{\text{Total Import}_i}\right)\text{FTA}_{ik,t-1}$ is weighted sum of FTAs signed by the countries i up to $t-1$ weighted by the import share of each member country k (exporter) belonging to $\widehat{C_i}$ in country i (importer).

On the other hand, 'specific source contagion' ($y_{ij} = \rho \sum_{m \neq i} \omega_{pq} y_{mj} + \varepsilon_{ij}$) describes the situation where decisions of other source countries m with the same target country j affect the decision between country i (source) and j (target). It is applicable to create the weighting matrix for 'partner's pre-existing FTA effects'.

'Partner's pre-existing FTA effects' describes the situation where FTAs of other source countries m (exporters) with the same target country j (target, importer) affect the decision of FTA between country i (source, exporter) and j (target, importer). Its basic form is $y_{ij,t} = \rho \sum_{m \in \widehat{C_j}} \omega_{pq,t-1} y_{mj,t-1} + \varepsilon_{ij,t}$ of which the weighting matrix could be $\omega_{pq} = w_{(mj)}$, which shows a link between m and j. This is based on 'partner's pre-existing FTA effects' measured by $s^{\widehat{C_j}}$. $s^{\widehat{C_j}}$ is also the measure of market shares of the countries which belong to $\widehat{C_j}$, which can be defined as weighted sum of the export shares of other exporting countries (m) in the country j that have already exported goods to country j with preferential tariffs.

$$\text{(Partner's pre-existing FTA effects)}_{i,t} = \sum_{m \in \widehat{C_j}} \left(\frac{\text{Export}_{mj}}{\text{Total Import}j}\right)_{1993} FTA_{mj,t-1}$$

where $\sum_{m \in \widehat{C_j}} \left(\frac{\text{Export}_{mj}}{\text{Total Import}j}\right)\text{FTA}_{mj,t-1}$ is weighted sum of FTAs signed by country j up to $t-1$ weighted by the import shares of each member country m (exporters) belonging to $\widehat{C_j}$, in country j (importer). In other words, it is the ratio of each m's export out of j's total import.

Importantly note that $\sum_{k \in \widehat{C_i}} (\frac{\text{Import}_{ik}}{\text{Total Import}_i})$ and $\sum_{k \in C_j} (\frac{\text{Export}_{mj}}{\text{Total Import}j})$ 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. For example, if country i sings an FTA with country k at $t-1$, import share of all other countries except the country k will be reduced. Then, $FTA_{ik,t-1}$ is likely to influence on not only country i's (Own FTAs effects) but also country k's (Own FTA effects) at t. To avoid this problem, 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 dyad. Egger and Larch (2008) also use 'natural' trade flows predicted by a bilateral gravity model as developed by Anderson and van Wincoop (2003).

I also use the predicted shares of the first observation for the whole period estimated by a gravity equation with fixed effects, multirateral resistance, and log based on Baier and Bergstrand (2007) and Baier and Bergstrand (2009).

[Table 4.1] Comparison of the gravity estimation results[25]

	BB (2007)	Author
log GDP_i	0.71	0.86
log GDP_j	0.58	0.33
RTA	0.51	0.12
within R^2	0.20	0.39
obs.	47,081	340,929

Lastly, 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 ($\text{y}_i \rightarrow \text{y}_k \rightarrow \text{y}_i$: 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. Baldwin and Jaimovich (2012) also includes only dyads that do not have an FTA before the beginning of the sample and keep the dyads in the panel until the point where they change their FTA status. But, since the regressions estimated with this method are not converged in these empirical estimations, I use the FTA existence instead of dropping out of the dyads when country pairs change their FTA status.

[25] Note that other fixed variables such as distance, adjacent, common language, and multirateral resistance variables, are omitted.

4.1.3 Data

Baier et al. (2014) says that the notions of 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. In addition, some countries have not existed or had independence (not recognized as a country) until 1992. Therefore, I limit the period to 1993-2012 with taking this trend and fact into consideration because the main goal of my thesis is to examine the effect of pre-existing FTAs. My RTA data is updated from 2006 to 2013 based on the 'Economic Integration Agreement Data (May 2013)' but some other data is available by 2012. The Economic Integration Agreement Dataset indexes the amount of trade openness on a scale 1 to 6, between every country pair between 1950 and 2005[26]. I also exclude the GSP and Preferential Trade Agreement because "Preferential" means only partial liberalization, not "free" trade. Finally, I include 710,640 observations with 189 countries in the unilateral case because the directed dyadic data is used in unilateral case.

4.1.4 Empirical Estimation Results

I would like to test three hypotheses based on unilateral incentive of country i. First, country i is more likely to sign an FTA with country j as country j is high-tariff country. Second, the likelihood for country i to sign an FTA with country j increases own industrialization level and decreases with that of country j. Finally, own pre-existing FTAs with asymmetric countries ($\widehat{S^{C_i}}$) positively but pre-existing FTAs of country j with asymmetric countries ($\widehat{S^{C_j}}$) negatively affect the incentive of country i to sign an FTA with the country j. In the first equation to estimate the three hypotheses, I use $FTA_{ij,t}$ as the dependent variable. $FTA_{ij,t}$ is 1 if country i and j form an FTA at t and 0 otherwise. In the results of the first estimation equation, own industrialization level, and own pre-existing FTA effects have expected sign but partner's industrialization level and partner's pre-existing FTA effects unexpectedly have opposite signs in all estimation methods. The dependent variable of the first equation can not perfectly represent unilateral decision to sign an FTA only for country i. This is because $FTA_{ij,t}$ is the results agreed based on the incentives of both parties rather than the unilateral incentive.

[26] Source for dependent variable: the Economic Integration Agreement Dataset 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).

(1) $\text{FTA}_{ij,t} = \beta_0 + \rho_1 \text{Own FTAs}_{i,t-1} + \rho_2 \text{Partner's FTAs}_{i,t-1}$
$+\beta_1 \text{MFN}_{j,t-1} + \beta_2 \text{ In GDPcap}_{i,t-1} + \beta_3 \text{ In GDPcap}_{j,t-1}$

[Table 4.2] Estimation results of unilateral incentives with Real FTA Status

All		Correlation	probit	probit	Conditional logit	Conditional logit
MFN$_j$	+	-0.11	-0.001	-0.008***	-0.47***	-0.15
In GDPcap$_i$	+	0.18	0.08***	0.02	7.12***	4.22*
In GDPcap$_j$	-	0.18	0.04***	0.02***	7.09***	0.64
$_S\widehat{C_i}$	+	0.32	5.02***	2.87***	70.97***	6.78
$_S\widehat{C_j}$	-	0.32	4.16***	5.24***	151.98***	-13.48*
Obs.			347,838	307,870	41,966	41,966
Country dummy			No	Yes	No	No
Year dummy			No	Yes	No	Yes
(Pseudo) R^2			0.25	0.28		

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

(2) $I(\triangle W^i_{ij,t} > cv_i) = \beta_0 + \rho_1 \text{My FTAs}_{i,t-1} + {}_2\text{Partner's FTAs}_{i,t-1}$
$+\beta_1 \text{MFN}_{j,t-1} + \beta_2 \text{ In GDPcap}_{i,t-1} + \beta_3 \text{ In GDPcap}_{j,t-1}$

[Table 4.3] Estimation results of unilateral incentives with Predicted FTA Decision

All		Correlation	probit	probit	Conditional logit	Conditional logit
MFN$_j$	+	0.18	4.95***	9.18***	32.02***	28.97***
In GDPcap$_i$	+	0.45	0.23***	0.75***	3.81***	5.02***
In GDPcap$_j$	-	-0.17	-0.11***	-0.32***	-3.21***	-2.07***
$_S\widehat{C_i}$	+	0.56	7.29***	1.04***	9.34***	12.16***
$_S\widehat{C_j}$	-	-0.11	-0..76***	-1.14***	-11.92***	-8.14***
Obs.			141,871	132,880	8,503	8,503
Country dummy			No	Yes	No	No
Year dummy			No	Yes	No	Yes
(Pseudo) R^2			0.35	0.71		

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

To represent the unilateral incentive as accurate as possible, I try to use $I(\triangle W^i_{ij,t} > cv_i)$ as a dependent variable based on the theoretical results mentioned in the section 3.3. $I(\triangle W^i_{ij,t} > cv_i)$ which is an indicator variable becomes 1 if overall welfare change of country i due to an FTA between country i and j is greater than critical value that makes country i willing to sign an FTA, and 0 otherwise. In estimation results of the second equation, all variables have the statistically significant results as expected in all estimation methods. Specially, partner's industrialization level

and pre-existing FTA effects negatively affect the unilateral incentives to form an FTA as expected.

However, since MFN_j is used to calculate $\triangle W^i$, I estimate the critical value (cv_i) with half of countries after calculating the best substitutability, $\sigma = 0.73$. Then, I try to test the unilateral decisions of half of the countries used in calculating critical value toward the unused half of the countries. Even in this case, I also have the statistically significant results as expected in all estimation methods.

[Table 4.4] Estimation results of unilateral incentives with Predicted FTA Decision 1

All		Correlation	probit	probit	Conditional logit	Conditional logit
MFN_j	+	0.11	3.24^{***}	10.02^{***}	26.29^{***}	33.34^{***}
$\ln \text{GDPcap}_i$	+	0.24	0.06^{***}	0.64^{***}	2.72^{***}	4.97^{***}
$\ln \text{GDPcap}_j$	-	-0.10	-0.05^{***}	-0.26^{***}	-2.64^{***}	-1.38^{***}
$s^{\widehat{C_i}}$	+	0.37	4.83^{***}	0.87^{**}	10.41^{***}	13.43^{***}
$s^{\widehat{C_j}}$	-	-0.07	$-0..62^{***}$	-1.86^{***}	-20.73^{***}	-18.18^{***}
Obs.			70,536	30,241	2,145	2,145
Country dummy			No	Yes	No	No
Year dummy			No	Yes	No	Yes
(Pseudo) R^2			0.17	0.62		

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

So far, there have been no ways to test the unilateral incentives to sign a new FTA because $\triangle W^i$ is unobservable. However, I could make $\triangle W^i$ observable by theoretically derived welfare change caused by a new FTA defined with given real trade and economic data such as s^i, s^j, μ^i, μ^j, t^i, t^j, $s^{\widehat{C_i}}$, and $s^{\widehat{C_j}}$ through the calibration. This might be a meaningful contribution to the researches related to the determinate of FTAs from the perspective of unilateral incentive.

4.2 Bilateral Incentives to Sign an FTA

4.2.1 Testable Hypothesis of Theoretical model

As mentioned in the unilateral incentives, tariff level, industrialization level and pre-existing FTA of each party give opposite impact on each welfare change caused by a new FTA. Since it makes one party relatively more beneficial, I would like to show bilateral incentives that make each party agree on forming a new FTA. Based on the proposition 3 of Frusawa and Konishi (2007), I could derive the bilateral incentives

to sign an FTA regarding to MFN tariff level and industrialization level, which have rarely been examined in the previous literature.

The proposition 3 of Frusawa 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.

Specifically, since if $\sigma = 0$, $\triangle W^i_{w/FTA} = \frac{\mu^j}{8}\{\theta^j(3t^i - 2)t^i + 2\theta^i(2 - t^j)t^j\}$, the country i has an incentive to sign the FTA with country j if and only if $\frac{\theta^j}{\theta^i} \leq \frac{2(2-t^j)t^j}{(2-3t^i)t^i}$. The counterpart for country j also must be satisfied for agreeing on forming an FTA between countries i and j. Therefore, assuming $t^i = t^j = t$, the FTA is signed if and only if $\frac{2-3t}{4-2t} \leq \frac{\theta^j}{\theta^i} \leq \frac{4-2t}{2-3t}$. In addition, as t increases, since this range of $\frac{\theta^j}{\theta^i}$ is expanded, an FTA can be signed even between asymmetric countries in industrialization level.

In sum, 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. Hur and Qiu (2015) also proves that the incentive for two countries to form an FTA always increases as the gap of their tariff level is reduced. Based on those results, I make a hypothesis and define the industrialization level similarity and MFN similarity as well to test the hypothesis. 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 $log[1 - \{t_{it}/(t_{it} + t_{jt})\}^2 - \{t_{jt}/(t_{it} + t_{jt})\}^2]$.

Hypothesis 4) 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.

On the other hand, I also make a hypothesis regarding the pre-existing FTA effects based on total welfare change of both parties and have same conclusion with unilateral case that 'own pre-existing FTAs' positively but 'partner's pre-existing FTAs' negatively affect the formation of a new FTA.

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

Hypothesis 5) The likelihood to form an FTA between country i and j increases with own pre-existing FTA effects and decreases with partner's pre-existing FTA effects.

However, there is something to be watched out for to test the pre-existing FTA effects properly in each country perspective. This is 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. I will explain more details about the spatial weighting matrix in the next section 4.2.2.

4.2.2 Empirical Methodology for Testing Hypothesis

In the bilateral case, the basic form of 'own FTA effects' is $y_{ij,t} = \rho \sum_{k \in C_i} \omega_{pq,t-1} y_{ik,t-1} + \varepsilon_{ij,t}$, of which weighting matrix could be $\omega_{pq} = w_{(ij)(ik)}$. It shows a link between i and j on the one hand and dyad i and k on the other hand. This is based on 'own FTA effects' measured by $s^j s^{\widehat{C_i}}$.

$$(\text{Own FTA effects})_{i,t} = \sum_{k \in \widehat{C_i}} (\frac{\text{Bilateral Import}_{ij}}{\text{Total Import}_i})_{1993} (\frac{\text{Import}_{ik}}{\text{Total Import}_i})_{1993} FTA_{ik,t-1}$$

where $\sum_{k \in \widehat{C_i}} (\frac{\text{Import}_{ik}}{\text{Total Import}_i})\text{FTA}_{ik,t-1}$ is weighted sum of the import share of each member country k (exporter) belonging to $\widehat{C}_i$ in country i (importer). $(\frac{\text{Bilateral Import}_{ij}}{\text{Total Import}_i})$ is the import share of country j in country i.

On the other hand, the basic form of 'partner's FTA effects' is $y_{ij,t} = \rho \sum_{m \in \widehat{C_j}} \omega_{pq,t-1} y_{mj,t-1} + \varepsilon_{ij,t}$ of which the weighting matrix could be $\omega_{pq} = w_{(ij)(mj)}$. It shows a link

between i and j on the one hand and dyad m and j on the other hand. This is based on 'partner's FTA effects' influenced by $\frac{\mu^j}{\mu^i} s^i s^{\widehat{C_j}}$.

$$\text{(Partner's FTA effects)}_{i,t} = \sum_{m \in \widehat{C_j}} \left(\frac{POP_j}{POP_i}\right)_{t-1} \left(\frac{\text{Bilateral Export}_{ij}}{\text{Total Import}_j}\right) \left(\frac{\text{Export}_{mj}}{\text{Total Import}_j}\right) FTA_{mj,t-1}$$

where $\sum_{m \in \widehat{C_j}} \left(\frac{\text{Export}_{mj}}{\text{Total Import}j}\right) \text{FTA}_{mj,t-1}$ is weighted sum of the import shares of each member country m (exporters) belonging to $\widehat{C_j}$, in country j (importer). $\left(\frac{\text{Bilateral Import}_{ji}}{\text{Total Import}_j}\right)$ is the import share of country i in country j. Lastly, $\left(\frac{POP_j}{POP_i}\right)$ is relative population level of country j to country i.

To reflect 'own FTA effects' and 'partner's FTA effects' in the perspective of both country i and j, four different variables to represent pre-existing FTA effects of each party are used in the empirical estimations.

- Own FTA effect$_{i,t} = \sum_{k \in C_i} \left(\frac{\text{Bilateral Import}_{ij}}{\text{Total Import}_i}\right) \left(\frac{\text{Import}_{ik}}{\text{Total Import}_i}\right) FTA_{ik,t-1}$
- Partner's FTA effect$_{i,t} = \sum_{m \in C_j} \left(\frac{POP_j}{POP_i}\right)_{t-1} \left(\frac{\text{Bilateral Export}_{ij}}{\text{Total Import}_j}\right) \left(\frac{\text{Export}_{mj}}{\text{Total Import}_j}\right) FTA_{mj,t-1}$
- Own FTA effect$_{j,t} = \sum_{k \in C_j} \left(\frac{\text{Bilateral Import}_{ji}}{\text{Total Import}_j}\right) \left(\frac{\text{Import}_{jk}}{\text{Total Import}_j}\right) FTA_{jk,t-1}$
- Partner's FTA effect$_{j,t} = \sum_{m \in C_i} \left(\frac{POP_i}{POP_j}\right)_{t-1} \left(\frac{\text{Bilateral Export}_{ji}}{\text{Total Import}_i}\right) \left(\frac{\text{Export}_{mi}}{\text{Total Import}i}\right) FTA_{mi,t-1}$

4.2.3 Data

Basically, dataset is generated similarly with unilateral case except the observations. I include 355,320 observations with 17,766 country-pair in the bilateral case for 20 years from 1993 to 2012 because the undirected dyadic data is used in bilateral case.

4.2.4 Empirical Estimation Results

Main results In most estimations to test the determinants of FTAs, the dependent variable is usually used as $\text{FTA}^*_{ij,t} = \min(\triangle W^i_{w/}, \triangle W^j_{w/})$, which means a new FTA between country i and j is formed if both negotiating countries could benefit from a new FTA between country i and j. Since $\text{FTA}^*_{ij,t}$ is unobservable, $\text{FTA}^*_{ij,t}$ is defined as 1 if two countries form an FTA between themselves ($FTA^*_{ij,t} \geq 0$), and 0 otherwise ($FTA^*_{ij,t} \leq 0$). Because the dependent variable is binary, I mainly use probit.

$$\text{FTA}_{ij,t} = \beta_0 + \beta_1 \text{MFN sim}_{ij,t-1} + \beta_2 \text{Industry sim}_{ij,t-1}$$
$$+\rho_1 \text{My FTAs}_{i,t-1} + \rho_2 \text{Partner's FTAs}_{i,t-1} + \rho_3 \text{My FTAs}_{j,t-1} + \rho_4 \text{Partner's FTAs}_{j,t-1}$$

[Table 4.5] Estimation results of bilateral incentives with one year lagged variables

FTA		(1) Probit	(2) Probit RE	(3) Probit	(4) OLS: two way cluster	(5) Conditional logit
MFN sim_{t-1}	+	0.52^{***}	0.95^{***}	0.52^{***}	0.09^{***}	0.24
Industry sim_{t-1}	+	0.39^{***}	2.37^{***}	0.39^{***}	0.06^{***}	4.45
Own FTA $\text{effect}_{i,t-1}$	+	1.00^{***}	5.57^{***}	1.00^{***}	0.20^{***}	1.11
Partner's FTA $\text{effect}_{i,t-1}$	-	-0.57^{***}	-2.32^{***}	-0.57^{***}	-0.06^{***}	-16.99
Own FTA $\text{effect}_{j,t-1}$	+	1.03^{***}	5.55^{***}	1.03^{***}	0.21^{***}	0.23
Partner's FTA $\text{effect}_{j,t-1}$	-	-0.70^{***}	-3.52^{***}	-0.70^{***}	-0.09^{***}	-16.36
Year dummy		Yes	Yes	Yes	No	Yes
Clusters		No	No	county pair	county pair and year	No
Obs.		91,211	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

In the first column of table 4.5, all explanatory variables have the significant results as expected. Since FTA_{ij} might not be independent across observations, I try to adjust standard errors with clustering in the third and fourth columns of table 4.5. And, I could check that the inference analysis is basically unchanged, even after adjusting with one-way or two-way clustering. Finally, to solve the possible unobserved heterogeneity problem at country-pair level, I try to use conditional logit and the results are in the fifth column of table 4.5. Since the observations that switch FTA status during the observed period are used for estimation, only 11,795 observations are used in the estimation with conditional logit method. Even though all results estimated by conditional logit are not statistically significant, all variables have expected signs. Fortunately, in other estimation methods, all variables are statistically significant with expected signs.

Predicting the FTAs Following Baier and Bergstrand (2004) and Chen and Joshi (2010), this thesis also examines how well post-estimated probabilities to form an FTA based on our empirical model can explain the real FTA status. This study also defines 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 4.6, this study can examine countries' probabilities to form an FTA between 1993 and 2012.

[Table 4.6] 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.

4.2.5 Sensitivity analysis

Robustness check with different time lags 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.

$$\text{FTA}_{ij,t} = \beta_0 + \beta_1 \text{MFN sim}_{ij,t-5} + \beta_2 \text{Industry sim}_{ij,t-5}$$
$$+\rho_1 \text{My FTAs}_{i,t-5} + \rho_2 \text{Partner's FTAs}_{i,t-5} + \rho_3 \text{My FTAs}_{j,t-5} + \rho_4 \text{Partner's FTAs}_{j,t-5}$$

[Table 4.7] Estimation results of bilateral incentives with five-year lagged variables

FTA	(1) Probit	(1) Probit RE	(1) Conditional logit	(2) Probit	(2) Probit RE	(1) Conditional logit
MFN sim	0.33***	1.06***	9.44	0.40***	1.48***	0.62
Industry sim	0.34***	1.09***	-3.09	0.35***	1.09***	-6.06
Own FTA effect$_i$	1.02***	3.10***	122.80	1.10***	2.67***	2.55
Partner's FTA effect$_i$	-0.11	-0.49	-103.99	-027***	-0.48	-15.75
Own FTA effect$_j$	1.01***	3.03***	55.76	1.07***	2.60***	1.75
Partner's FTA effect$_j$	-0.31**	-1.18**	-314.99	-0.37***	-0.51	-8.34
Year Dummy	Yes	Yes	No	Yes	Yes	Yes
Obs.	16,343	16,343	1.344	75,092	75,092	11,105
(Pseudo) R^2	0.35			0.32		

Note: Regressed (1) with every five year data and (2) with 5-year lagged data from 1993 to 2012.

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

I would mainly use one-year lagged explanatory variables since the observation period from 1993 to 2012 is relatively shorter than other studies. I would limit

to such a shorter period because FTA domino effects, competitive liberalization, contagion and interdependence have existed since 1993 as mentioned in Baier et al. (2014) and the main objective of this research is to examine the pre-existing FTA effects. However, one-year lagged variables perfectly can not be free from the endogeneity problem. To eliminate that problem as much as possible, I also try to estimate with five-year lagged variables in two different ways. I first estimate with every five year data such as 1993, 1998, 2003, 2008, and 2013 and then with 5-year lagged data from 1993 to 2013. Both results are very similar each other. In most estimation methods, MFN similarity, industrialization similarity, and own FTA effects are statistically significant with expected signs but partner's FTA effects are not statistically significant in the some methods. Conditional logit method still have insignificant results for all variables same as the one year lagged variables and industrialization level similarity shows negative sign.

Robustness check with other control variables Before I estimate the effects of our main variables with other control variables, I first check whether our dataset generated by author is available by comparing to summary statistics or estimation results of other previous literatures. This is because this study uses the different periods and numbers of countries. For more details about this comparison, please reference the Appendix. This study would use the following specification to estimate the effects of our main variables with other control variables as EL (2008), BJ (2012), and Baier et. al. (2014) did in their papers. The probability to switch status from non-FTA to FTA is determined by the logistic cumulative distribution function $G(\cdot)$ of a linear vector of lagged explanatory variables X at different levels(country-pair-year, country-year, and year) and the spatial lag.

$$pr(switch) = G(\beta_0+\rho_1 W_{(ij)(ik),t-1}\cdot FTA_{ik,t-1}+\rho_2 W_{(ij)(mj),t-1}\cdot FTA_{mj,t-1}$$
$$\rho_3 W_{(ji)(jk),t-1}\cdot FTA_{jk,t-1}+\rho_4 W_{(ji)(mi),t-1}\cdot FTA_{mi,t-1}+\beta_1 X_{ij,t-1}+\beta_2 X_{i,t-1}+\beta_3 X_{t-1})$$

As a robustness check, this study estimates empirical specifications with other control variables based on Baier and Bergstrand (2004)[27] and Egger and Larch (2008). The key variables related to industrialization similarity and pre-existing FTAs show expected signs in all estimation results but MFN similarity has opposite signs when regressed with the variables related to the bilateral distance and multilateral resistance such as inverse distance, distance from the ROW, and same

[27] Please reference Appendix for the explanation about why difference of K/L and distance from the ROW have opposite signs in some estimations.

continent. Namely, after controlled with other variables related to the trading costs, MFN similarity seems to represent the tendency to form an FTA between countries that have dissimilar MFN tariff level. On the other hand, in the estimation results regressed with both GDP sum and GDPcap sim, GDP sum shows negative sign and GDPcap sim shows insignificant result compared to the estimation results using either one of each variable. In addition. when comparing R^2 between second and third columns and between second and forth columns of table 4.8, including economic determinants such as GDP sum, GDP sim, Diff. K/L, and Diff. K/L from ROW does not improve the goodness of fit of a model while including inverse distance, distance from the ROW, and same continent improves it. This makes me realize that to increase the explanation power through theory-based measure, I need to develop the theoretical model including trading cost such as bilateral distance and multilateral resistance.

[Table 4.8] Estimation results of bilateral incentives with other control variables

EL (2008)	Probit	Probit	Probit	Probit	Probit	Probit
GDP Sum (+)	0.16***		-0.30***		-0.20***	0.14***
GDP Sim (+)	0.23***		0.09***		0.07***	0.21***
Inverse Distance (+)	0.78***			1.00***	1.00***	0.58***
Distance from ROW (+)	-0.65***			5.35***	5.72***	0.88***
Same Continent (+)	0.57***			0.89***	0.87***	0.51***
Diff. K/L (+)	0.35***		-0.06		0.51***	0.24***
aq_Diff. K/L (-)	-0.45***		-0.19***		-0.27***	-0.40***
Diff. K/L from ROW (-)	0.94***		0.06***		0.08***	0.75***
MFN sim (+)		0.52***	0.52***	-0.13***	-0.12***	
GDPcap sim (+)		0.39***	0.12	0.18***	0.17	
Own FTA effect$_i$(+)		1.00***	1.13***	1.36***	1.44***	
Partner's FTA effect$_i$(-)		-0.57***	-0.22***	-0.40***	-0.18*	
Own FTA effect$_j$(+)		1.03***	1.14***	1.36***	1.42***	
Partner's FTA effect$_j$(-)		-0.70***	-0.24***	-0.60***	-0.32***	
Interdependece (+)						0.04***
sq_Interdependence (-)						-0.0004***
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
obs.	312,280	91,211	90,984	91,211	90,984	312,280
(Pseudo) R^2	0.461	0.374	0.391	0.637	0.643	0.473

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

5 Big Data Analysis of Determinants of FTAs

As the numbers of independent variables increase, the regression coefficients could be correlated, which causes the large variance and finally inaccurate prediction. To solve this kind of problem, 'Ridge' regression was generally used by shrinking the coefficients to zero. But, as an improved alternative solution, Tibshirani (1996) introduced the 'Lasso', standing for the least absolute shrinkage and selection operator. In addition to the prediction accuracy, the 'Lasso' regression also improves the model interpretability by performing the variable selection. It is possible when the penalty term force some coefficient estimates to be exactly equal to zero given that the tuning parameter λ is sufficiently large. In other words, the 'Lasso' can create a model that removes the irrelevant variables under the best λ chosen by cross validation. Thus, compared to the 'Ridge' regression which shrinks all coefficients to zero, 'Lasso' regression shrinks some coefficients to be exactly zero which makes the models interpretable keeping the good features of 'Ride' regression such as the prediction accuracy.

Generally, in a standard multivariate regression model, the unbiased coefficients such as $\widehat{\beta}_0$, $\widehat{\beta}_1, ..., \widehat{\beta}_p$ can be estimated by minimizing the residual sum of squares, supposed that standardized predictors have mean zero and variance one.

$$RSS = \sum_{i=1}^{n}(y_i - \widehat{y}_i)^2 = \sum_{i=1}^{n}(y_i - \widehat{\beta}_0 - \widehat{\beta}_1 x_{i1} - \widehat{\beta}_2 x_{i2} - ... - \widehat{\beta}_p x_{ip})^2$$

'Ridge' and 'Lasso' regression also minimize not only RSS but also a penalty term such as $\lambda\sum_{p=1}^{P}[\alpha|\beta_p| + (1-\alpha)(\beta_p)^2]$. The tuning parameter λ serves to control the relative impact of the penalty terms. When $\lambda = 0$, the penalty term has no effect and this is exactly OLS but as λ is close to infinity, the impact of the penalty term increases and finally all coefficient estimates will be exactly equal to zero. Given that the tuning parameter λ is sufficiently large, if $\alpha = 0$, this becomes 'Ridge' regression with only quadratic constraint and if $\alpha = 1$, this becomes 'Lasso' regression with only absolute constraint.

Throughout the process of cross validation, the best tuning parameter λ can be chosen. Normally used 10-fold cross validation method randomly divides the set of observations into 10 groups and defines one group as a validation set and the reminder as a training set, and computes mean squared error (MSE) on the observations in the held-out fold. The same process is repeated ten times in turn and ten resulting MSEs are averaged out over a grid of λ values covering the full range

from the null model and the tuning parameter λ that makes the cross-validation errors smallest is selected. In other words, 10-fold cross validation method selects the best lambda to make averaging mean squared error (MSE) lowest. With this best λ chosen by cross validation method, the irrelevant variables can be removed through the simple 'Lasso' and 'Lasso' logit regression.

To identify the most important issues that each country considers in signing a new FTA, I first make the data set consisted of forty independent variables referring the previous literatures. Then, in order to regress with simple 'Lasso' and 'Lasso' logit, I apply the glmnet package and 10-fold cross validation method into R programming while setting the argument alpha equal to 1 after removing the missing vales from the data. Finally, I could get the subset of variables from simple 'Lasso' and 'Lasso' logit regression for all countries and each individual country.[28]

5.1 Estimation Results with all countries

When I use all possible country pairs as observations, some variables are selected as the determinants of FTAs in the way of simple 'Lasso' and 'Lasso' logit regression. In both methods, similar variables are selected except Interdependence and GDPcap similarity in Lasso and each FTA coverage of both participating countries in Lasso logit. For example, the variables related to bilateral distance and multilateral resistance such as inverse distance, same continent, and distance from ROW are selected in both methods. Military alliance, contiguous, common language, and communist transition are also commonly selected. The variables that represent the ratio of bilateral trade over own GDP for each party are also selected in both methods, which support that FTAs tend to be formed between natural trading partners. Noteworthily, the variables which represent the pre-existing FTA effects are selected such as ROWFTA, own FTA effects and Interdependence. Those selected variables are the main results of the literatures that analyze pre-existing FTA effects. Especially, own FTA effects and GDPcap similarity are chosen, which are mainly discussed as the determinants of FTAs in my thesis.

Then, the variables selected in simple Lasso' method are regressed with OLS and ones selected in 'Lasso' logit method are regressed with probit. The coefficients are very similar each other between 'Lasso' and OLS and between 'Lasso' logit and probit regression, and R^2 of each OLS and probit seems to be pretty high.

[28] I reference the explanation of Lasso and Ridge regression and R codes in "An Introduction to Statistical Learning with applications in R" written by James, Witten, Hastie, and Tibshirani (2014).

[Table 5.1] Estimation results based on Big Data Analysis for all countries

All countries		Lasso	OLS	All countries		Lasso Binary	Probit
ROWFTA	+	-0.00003	-0.00002***	ROWFTA	+	-0.0002	-0.00002***
Own FTA effect$_i$	+	0.13	0.12***	Own FTA effect$_i$	+	1.64	1.36***
Own FTA effect$_j$	+	0.14	0.12***	Own FTA effect$_j$	+	1.78	1.27***
Inverse Distance	+	0.09	0.06***	Inverse Distance	+	1.03	0.74***
Distance from ROW	+	0.26	0.44***	Distance from ROW	+	0.33	2.57***
Same Continent	+	0.14	0.03***	Same Continent	+	1.59	0.78***
Military Alliance	+	0.04	0.11***	Military Alliance	+	0.40	0.34***
Contiguous	+	0.04	0.10***	Contiguous	+	0.42	0.22***
Common Language	+	0.02	0.05***	Common Language	+	0.48	0.68***
Bilateral Trade$_i$	+	0.10	0.34***	Bilateral Trade$_i$	+	3.66	2.69***
Bilateral Trade$_j$	+	0.18	0.22***	Bilateral Trade$_j$	+	1.79	1.10***
D_Communist transition	-	-0.02	-0.01***	D_Communist transition	-	-0.13	-0.05***
Interdependence	+	0.004	0.007***	FTA coverage$_i$	+	0.003	0.002***
GDPcap Sim	+	0.02	0.02***	FTA coverage$_j$	+	0.001	0.003***
obs.		51,215	290,872	obs.		51,215	179,579
(Pseudo) R^2			0.45	(Pseudo) R^2			0.62

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

5.2 Estimation Results with Each Individual Country

Limao (2016) mentions that each country has cooperated more broadly through 'Preferential Trade Agreements' in both economic and non-economic issues beyond the applied tariff reductions. This trend seems to increase the heterogeneity across PTAs. It is natural because each country has different motives to form PTAs each other. When the interest of each party reaches agreement, a new PTA can be signed. Therefore, this thesis attempts to identify what kinds of factors are the most influential to decide whether to sign FTAs for each individual country by utilizing the Big Data Analysis.

First, I find that in each simple 'Lasso' and 'Lasso' logit regression, different kinds of variables are selected for each individual country. Then, I regress one year lagged variables selected in each 'Lasso' and 'Lasso' logit regression on real FTA status with each OLS and probit. The coefficients are very similar each other in 'Lasso' and OLS and 'Lasso' logit and probit method. R^2 of each estimation result regressed with selected variables for the observations of each individual country are much

higher than with the same selected variables for the observations of all countries. Another remarkable fact is that the results regressed with selected variables have relatively higher R^2 regardless of the numbers of predictors. In some country cases, in spite of being regressed with couple of selected predictors, R^2 is pretty high. For example, Interdependence which is pre-existing FTA effects of other countries weighted by inverse distance is selected for most of representative countries except Russia. Specially, in the case of Australia, R^2 is 0.81 in spite of being regressed only with Interdependence compared to 0.29 for all countries. It shows that the selected variables throughout the 'Lasso' method are powerful to explain what kinds of factors truly affect the willingness to sign a new FTA for each country. The selected variables tend to reflect the economical, geographical, or geopolitical background in each country case.

5.2.1 Korea

[Table 5.2] Estimation results based on Big Data Analysis for Korea

FTA	Lasso	Korea:OLS	ALL: OLS	Lasso Binary	Korea:probit	ALL:probit
$MFTA_j$	0.002	0.003***	0.004***	0.06	0.05***	0.02***
Interdependence	0.61	0.68***	0.006***	7.15	7.65***	0.04***
MFN Similarity	-0.05	0.07***	0.06***	-0.19	-0.60	0.33***
GDP Similarity				0.06	0.85**	0.16***
Inverse Distance	-0.01	-0.04***	0.14***			
Ex FTA $coverage_i$	0.01	0.02***	0.002***	0.22	0.21***	0.01***
Relative GDP $growth_i$	0.009	0.04***	-0.0001***			
Relative GDP $growth_j$	0.003	0.004***	0.002***	0.03	0.08***	0.001***
$Democracy_j$	0.01	0.03***	0.04***			
Obs.	669	828	74,492	669	920	83,582
(Pseudo) R^2		0.53	0.52		0.83	0.43

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

As meaningful determinants of FTAs, $MFTA_j$, Interdependence, MFN Similarity, GDP Similarity, Inverse Distance, Export FTA $coverage_i$, Relative GDP $growth_i$, Relative GDP $growth_j$, and $Democracy_j$ are selected in simple 'Lasso' regression and $MFTA_j$, Interdependence, MFN Similarity, Export FTA $coverage_i$, Relative GDP $growth_j$ in 'Lasso' logit regression for Korea. FTAs are generally formed between neighboring countries but Korea tend to form FTAs with countries locating far away from Korea. In addition, a new FTA is inclined to be formed between countries having similar MFN tariff level in general because it may minimize the

trade diversion caused by a new FTA. However, Korea shows the opposite tendency that it prefers new FTA partners with different MFN tariff levels. Finally, Korea is more likely to sign an FTA as partner's relative GDP growth rate is higher and partner country is more democratic.

5.2.2 USA

According to the Big Data Analysis, especially in the simple 'Lasso' regression, USA consider own FTA effect$_i$, partner's FTA effect$_i$, Contagion$_i$, Interdependence, Inverse distance, Military alliance, Contiguous, Export FTA coverage$_j$, Bilateral Trade$_i$, Democracy$_j$, Dummy_Communist Transition as influential factors to decide whether to sign a new FTA. Even though less variables are chosen in the 'Lasso' logit, similarly Interdependence, Inverse distance, Ex FTA coverage$_j$, Democracy$_j$ are also selected as relevant factors. Interestingly, both partner's FTA effect$_i$ and Contagion effect$_i$ negatively affect the formation of an FTA. In other words, partner's pre-existing FTAs, regardless of wether it is in the traditional economic or political economic perspective, give negative effects on the incentives to form an FTA. USA shows some opposite characteristics to general tendency in Inverse distance, military alliance, and partner's democratization level, too.

[Table 5.3] Estimation results based on Big Data Analysis for USA

FTA	Lasso	USA:OLS	ALL: OLS	Lasso Binary	USA:probit	ALL:probit
Own FTA effect$_i$	0.01	0.06***	0.11***			
Partner's FTA effect$_i$	-0.02	-96.15***	-0.001			
Contagion$_i$	-0.002	-0.07***	0.06***			
Interdependence	0.30	0.35***	0.007***	2.72	1.69***	0.02***
Inverse Distance	-0.17	-0.25***	0.04***	-1.90	-0.57***	0.78***
Millitary alliance	-0.004	-0.04***	0.15***			
Contiguous	0.76	0.74***	0.15***			
Ex FTA coverage$_j$	0.001	0.003***	0.0003***	0.02	0.04***	0.01***
Bilateral trade$_i$	1.18	5.50***	0.72***			
Democracy$_j$	-0.05	-0.04***	0.01***	-0.91	-1.07***	-0.03**
D_Communist transition	-0.03	-0.04***	-0.04***			
Distance from ROW				1.73	10.49***	3.39***
Obs.	1,289	2,227	175,597	1,289	2,274	211,722
(Pseudo) R^2		0.60	0.43		0.60	0.43

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

5.2.3 Australia, China, and Japan

Interdependence seems to be the decisive factor to influence on the formation of a new FTA for most of representative countries except Russia. Specially, for Australia, China, and Japan, Interdependence, the pre-existing FTA effects weighted by inverse distance, seems to be the most important factor to decide whether to sign an FTA. In other words, Australia, China, and Japan are inclined to be affected by the FTAs of closely located countries the most. It is supported by very high R^2 in spite of regressed with a couple variables including Interdependence or only Interdependence.

[Table 5.4] Estimation results based on Big Data Analysis for Australia

FTA	Lasso	Australia: OLS	All: OLS	Lasso Binary	Australia: probit	All: probit
Interdependence	0.89	0.93^{***}	0.01^{***}	7.68	5.23^{***}	0.05^{***}
Military alliance	0.007	0.06^{***}	0.24^{***}			
Obs.	1,243	3,572	337,554	1,243	3,572	337,554
R^2		0.84	0.35		0.81	0.29

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

[Table 5.5] Estimation results based on Big Data Analysis for China

FTA	Lasso	China: OLS	All: OLS	Lasso Binary	China: probit	All: probit
Interdependence	0.36	0.51^{***}	0.01^{***}	5.52	3.28^{***}	0.05^{***}
Inverse Distance	-0.04	-0.05^{***}	0.04^{***}			
Distance from ROW	0.03	0.23^{***}	0.21^{***}			
Military alliance	0.03	0.03^{***}	0.19^{***}			
Obs.	1,189	3,572	337,554	1,189	3,572	337,554
R^2		0.52	0.36		0.68	0.29

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

[Table 5.6] Estimation results based on Big Data Analysis for Japan

FTA	Lasso	Japan: OLS	All: OLS	Lasso Binary	Japan: probit	All: probit
Interdependence	0.81	0.81^{***}	0.01^{***}	7.09	6.21^{***}	0.05^{***}
Distance from ROW	0.02	0.08^{***}	0.13^{***}			
Bilateral Trade$_j$				5.29	1.75^{***}	6.33^{***}
Obs.	1,325	3,572	337,554	1,325	3,572	337,554
R^2		0.77	0.30		0.77	0.29

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

5.2.4 Brazil

For Brazil, Partner's FTA effect$_j$, Interdependence, GDP similarity, Contiguous, Bilateral Trade$_i$, and Bilateral Trade$_j$ are selected in the simple 'Lasso' regression and Partner's FTA effect$_j$, Interdependence, Inverse Distance, Contiguous, and Bilateral Trade$_j$ are selected in the 'Lasso' logit regression. Since Brazil tends to have FTAs with neighboring countries, geographical elements such as Inverse Distance, Contiguous seem to be selected. It also tends to form an FTA with natural trading partners that have a similar GDP level.

[Table 5.7] Estimation results based on Big Data Analysis for Brazil

FTA	Brazil: Lasso	Brazil: OLS	ALL: OLS	Lasso Binary	Brazil: Probit	ALL: Probit
Partner's FTA effect$_j$	-0.34	-0.03**	0.06***	-17.58	-135.26***	0.37***
Interdependence	0.39	0.13***	0.01***	3.75	2.88***	0.03***
GDP sim	0.007	0.01***	0.02***			
Inverse Distance				0.001	1.93***	0.54***
Contiguous	0.001	0.19***	0.21***	0.67	0.52***	0.24***
Bilateral Trade$_i$	0.23	2.66***	0.83***			
Bilateral Trade$_j$	1.68	4.16***	0.91***	16.88	34.66***	3.77***
Obs.	1,323	3,322	292,090	1,323	3,322	293,969
R^2		0.67	0.32		0.95	0.36

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

5.2.5 India

Compared to other countries, common colonizer is selected for India. In addition, Interdependence, Difference of factor endowment each other, Inverse Distance, Distance from ROW, Contiguous, Relative GDP growth rate, Bilateral Trade$_j$, Democracy$_j$, and Dummy_Communist transition are selected in the simple 'Lasso' regression and Inverse Distance, Distance from ROW, Common colonizer, Relative GDP growth rate, Bilateral Trade$_j$, and Democracy$_j$ in 'Lasso' logit regression.

[Table 5.8] Estimation results based on Big Data Analysis for India

FTA	India: Lasso	India: OLS	All: OLS	India: Lasso Binary	India: Probit	All: Probit
Interdependence	0.02	0.14***	0.01***			
Diff K/L	-1.38	-0.05***	-0.30***			
Inverse Distance	0.04	0.01*	0.07***	0.69	1.42***	0.91***
Distance from ROW	0.44	0.96***	0.21***	8.11	19.60***	-0.60***
Contiguous	0.01	0.09***	0.13***			
Common Colonizer				0.69	0.41***	-0.07***
Relative GDP growth$_i$	0.002	0.001***	-0.001***	0.06	0.05***	-0.02***
Bilateral Trade$_j$	1.51	0.53***	0.81***	10.20	2.92***	5.22***
Democracy$_j$	0.03	0.03***	0.03***	0.62	0.56***	0.59***
D_Communist Transition	-0.01	-0.05***	-0.05***			
Obs.	558	2,808	246,349	558	2,810	250,709
R^2		0.39	0.37		0.52	0..33

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

5.2.6 Russia

For Russia, interestingly, Same continent, Military alliance, Common Language, and Colony which reflect the geopolitical characteristics, are chosen in addition to ROWFTA, MFN similarity, and Bilateral Trade$_j$ in the simple 'Lasso' regression. In the 'Lasso' logit regression, MFN similarity, Same continent, Common Language, and Bilateral Trade$_j$ are selected, which are commonly selected in both methods.

[Table 5.9] Estimation results based on Big Data Analysis for Russia

FTA	Russia: Lasso	Russia: OLS	All: OLS	Russia: Lasso Binary	Russia: Probit	All: Probit
ROWFTA	0.000003	0.000006**	0.00001***			
MFN sim	-0.001	-0.01	0.002	-0.20	-0.3*	-0.04***
Same Continent	0.02	0.04***	0.34***	1.46	4.77***	1.45***
Military alliance	0.03	0.05***	0.13***			
Common Language	0.55	0.63***	-0.03***	1.60	0.72	0.007
Colony	0.10	0.08***	0.09***			
Bilateral Trade$_j$	0.64	0.67***	1.58***	6.05	19.05***	6.31***
Obs.	810	1,211	96,451	810	1,211	96,451
R^2		0.50	0.25		0.68	0..25

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

This study can also get some meaningful results through the 'Lasso' regression with existing variables, raw data, all possible interactions, and squared terms of all utilized variables. Among various selected variables, MFTA_i:MFTA_j (+), MFTA_i:Ex FTA coverage_j (+), Interdependence:Distance cap (+), MFN_j:Export share_{ij} (+), MFN sim:Export share_{ji} (-), MFN sim:Import share_{ji} (-), Same Continent:Contiguous (+), Military alliance:Common Language (+), Military alliance:Common Colonizer (+), Contiguous:Common Language (+) seem to be remarkable variables and especially, **MFN_j:Export share_{ij} (+), MFN sim:Export share_{ji} (-), MFN sim:Import share_{ji} (-)** can be the most meaningful factors as the determinants of FTAs related to this thesis. MFN similarity is mentioned as a determinant of an FTA and Export or import share are used as weights to make own FTA effects and partner's FTA effects in my thesis. In addition to the single effect of each variable, the cross effect can be interesting issues as further studies. Also, it is a little complicated but also meaningful to perform the same Big Data Analysis for EU in the same ways.

6 Conclusion

This thesis is based on the theoretical model of Furusawa and Konishi (2007). However, the main objective of this thesis is different from theirs mainly in that the analysis of this thesis concentrates on the determinants of FTAs while their study examines what bilateral networks are stable.

This thesis first 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, this thesis 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. 72 percent of the cases predicted as no FTAs (FTA=0) and 93 percent of the cases predicted as FTAs in force (FTA=1) are matched up with 'Real FTA Status'.

This thesis also shows the unilateral incentives to sign an FTA based on the comparative statics of the welfare change caused by a new FTA with respect to tariff levels and industrialization level. First, they are increased as partner country is high-tariff country. Also, they increase with own industrialization level and decreases with partner's industrialization level. As looking into the unilateral incentives, this study finds that tariff level and industrialization level give opposite impacts on each welfare change caused by a new FTA, which makes one party relatively more beneficial. For this reason, this thesis would derive bilateral incentives agreed by both parties. Based on the proposition 3 of Frusawa and Konishi (2007), this thesis also shows 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.

To test the determinants of FTAs, $\text{FTA}^*_{ij,t} = \min(\triangle W^i_{w/}, \triangle W^j_{w/})$ is generally used as a dependent variable. It means a new FTA between country i and j is formed if both negotiating countries could benefit from a new FTA between country i and j. Since $\text{FTA}^*_{ij,t}$ is unobservable, $\text{FTA}^*_{ij,t}$ is generally defined as 1 if two negotiating countries form an FTA between themselves and 0 otherwise. However, since $\text{FTA}^*_{ij,t}$ represents the bilateral decisions agreed by both parties, it is not suitable to test the unilateral incentives to sign an FTA. Therefore, since 'Real FTA Status' are matched up with FTA status predicted by the net welfare change and the critical

values in 90 percent for both FTA=0 and FTA=1 shown in section 3, this study suggests to use $I(\triangle W^i_{ij,t} > cv_i)$ as a dependent variable for testing the unilateral incentives to sign an FTA. $I(\triangle W^i_{ij,t} > cv_i)$ is an indicator variable, which is defined as 1 if overall welfare change of country i due to an FTA between country i and j is greater than critical value that makes country i willing to sign an FTA, and 0 otherwise. So far, as there have been no ways to empirically test the unilateral incentives except $\text{FTA}^*_{ij,t}$, $I(\triangle W^i_{ij,t} > cv_i)$ can open up a new way to examine the determinants of FTAs in the unilateral perspective.

In addition, this thesis also examines the determinants of FTAs regarding "Interdependence" with third countries, which conclues 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, this thesis 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. Generally, '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. Namely, whether to sign an FTA between two negotiating countries can be affected by other pre-existing FTAs of other pairs of countries. There exist some researches related to this issue and applied with the same methods. However, this thesis approaches 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).

Finally, this thesis shows what kinds factors act as the determinants of FTAs the most for each individual country by using Big Data Analysis. Thanks to the model interpretability of 'Lasso' regression through the variable selection, this study can find the meaningful factors to affect the formation of a new FTA for each individual country. The selected variables seem to reflect each economic, geographical, or geopolitical tendency toward forming new FTAs, which is supported by the high R^2 regardless of the numbers of predictors.

As further studies, I first need to develop the theoretical model including bilateral distance and multilateral resistance. This is because including 'Inverse Distance', 'Distance from the ROW', and 'Same Continent' increases the explanation power in the empirical estimation results as well as those variables are selected as the relevant

factors in a Big Data Analysis.

On the other hand, the concept of Big Data Analysis is originally to find the hidden patterns, correlations, trends, and other insights in the huge amounts of data. To apply this concept, I try to use raw data, all kinds of existing variables regarding the determinants of FTAs, all possible interactions, and squared terms of all utilized variables. Among various selected variables, some meaningful factors such as MFN_j:Export share_{ij} (+), MFN sim:Export share_{ji} (-), and MFN sim:Import share_{ji} (-) need to be scrutinized. This is because each single term in those product terms, is dealt with in my thesis. Since MFN similarity is suggested as a determinant of FTAs and Export or import share are used as weights to test My FTA effects and Partner's FTA effects, research about interaction effects of those factors might be meaningful.

Lastly, this thesis does not include EU as the representative countries for Big Data Analysis because generating some variables is complicated for EU which is not a single country. But, some meaningful results can be derived by doing the same analysis for EU in the same methods.

7 Appendix

7.1 List of variables used as the Determinants of FTAs

[29]**Pre-existing FTA effects**

$$s^{\widehat{C_i}} = \sum_{k \in \widehat{C_i}} \left(\frac{\text{Import}_{ik}}{\text{Total Import}_i}\right) FTA_{ik,t-1}$$

$$s^{\widehat{C_j}} = \sum_{k \in \widehat{C_j}} \left(\frac{\text{Export}_{mj}}{\text{Total Import}_j}\right) FTA_{mj,t-1}$$

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

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

Baier et. al. (2014)

$$\textbf{MFTA}_i = \sum_{k \neq j}^{N} FTA_{ik} \text{ and } \textbf{MFTA}_j = \sum_{k \neq i}^{N} FTA_{jk}$$

$$\textbf{ROWFTA}_{ij} = \sum_{k \neq i,j}^{N} \sum_{l \neq i,j}^{N} FTA_{kl}$$

Baldwin and Jaimovich (2012)

$$\textbf{Contagion Index}_{ij,t} = \sum_{k \in \Omega_{j,t}} \left(\frac{\text{Bilateral Export}_{ij}}{\text{Total Export}i}\right)\left(\frac{\text{Bilateral Export}_{kj}}{\text{Total Import}j}\right) FTA_{jk}$$

Egger and Larch (2008)

Interdependence (+): the time lagged spatial lag weighted by the inverse of the geographical distance between the dyad p and q with dyad p formed by country-pair i and j and dyad q by country-pair k and m. $\omega_{pq} = e^{-D_{pq}/500}$ with $D_{pq} = (D_{ik} + D_{im} + D_{jk} + D_{jm})/4$.

MFN Sim (+): similarity of two countries in their tariff levels: $log[1-\{t_{it}/(t_{it}+t_{jt})\}^2 - \{t_{jt}/(t_{it}+t_{jt})\}^2]$

Industrialization level Sim (+): similarity of two countries in their industrialization levels: $log[1 - \{gdpcap_{it}/(gdpcap_{it} + gdpcap_{jt})\}^2 - \{gdpcap_{jt}/(gdpcap_{it} + gdpcap_{jt})\}^2]$

Natural (+): measured by the log of the inverse of the great circle distance between two trade partner's capitals.

DCONT (+): indicating two countries are located at the same continent

[29]The variables listed in this appendix are mostly replicated based on the Egger and Larch (2008), Baldwin and Jaimovich (2012), and Baier et. al. (2014)

Remote (+): remoteness of a pair of partners from the rest of the world; measured by 0.5[log{$\sum_{k\neq j}$_distance$_{ik}$/(n-1)}]+0.5[log{$\sum_{k\neq i}$_distance$_{kj}$/(n-1)}]

MCONT$_{ij}$ **(-)**= $\frac{1}{2N}(\sum_{k=1}^{N} CONT_{ik} + \sum_{k=1}^{N} CONT_{jk})$

RGDP Sum (+): total bilateral market size; RGEP_Sum$_t$=log(RGDP$_{it}$+RGDP$_{jt}$)

RGDP Sim (+): the similarity of two countries in their real GDP; log[1-{RGDP$_{it}$/(RGDP$_{it}$+RGDP$_{jt}$)}^{2} -{RGDP$_{jt}$/(RGDP$_{it}$+RGDP$_{jt}$)}^{2}][30]

DKL (+): the absolute difference in real GDP per capital; |log(RGDP$_{it}$/POP$_{it}$)-log(RGDP$_{jt}$/POP$_{jt}$)|[31]

SQDKL (-): the square of DKL

DROWKL (-): the relative factor endowment difference between the rest of the world and a given country-pair

Bilateral Trade[32] (+): is the sum of exports to and imports from the partner in the dyad over the country's own GDP$_i$

GDP Growth$_i$ (-): crisis and economic downturns can promote trade reforms as a way to improve the performance

Relative GDP Growth$_i$ (-): real GDP growth with respect to the average of the rest of the world in the same year.

Export FTA Coverage (+): the percentage of total export covered by previous FTAs. As a country has fewer barriers and greater expertise in negotiating agreements, the country is more likely to sign new FTAs.

Political Distance (-): the absolute difference in the Polity values. Countries with political regimes that are more similar will be more likely to sign an agreement[33].

[30] BB (2004) uses the absolute value of the difference between the logs of real GDPs of two countries, instead. Consequently, the expected sign for their parameter is negative.

[31] Since capital stock data for a large country sample are not available, I adopt this way as suggested in Egger and Larch (2008). Based on that Kaldor pointed to the high correlation of capital-labor ratios and real GDP per capital, this way is applicable. In fact, Egger and Larch (2008) shows that the correlation coefficient of the capital-labor ratio used in BB (2004) and real GDP per capital data is 0.975.

[32] Data for export and import are from UN COMTRADE database and GDP growth is from WDI.

[33] The data are from Polity IV project (source: http://www.systemicpeace.org/polity/polity4.htm). Polity values range from -10 (hereditary monarchy) to 10 (consolidated democracy).

Military alliance (+): 1 if the countries concerned are in a military alliance[34].

WTO dispute (+): 1 if either one country in the dyad was in a GATT/WTO dispute in t-1, which shows that countries can be more willing to sign FTAs in order to enhance their leverage in the dispute.

Democracy (+): 1 if the country as a positive level in POLITY IV index

Communist Transition (-): 1 if either country is a former communist economy

Dyad-level fixed variables[35]

Contiguous (+): indicating whether the two countries are contiguous

Common Language (+): indicating whether the two countries share a common language

Colony (+): indicating whether the two countries have ever had a colonial link

Common Colonizer (+): indicating whether the two countries have had a common colonizer since 1945

[34] Formal Alliances (v4.1): This data set records all formal alliances among states between 1816 and 2012, including mutual defense pacts, non-aggression treaties, and ententes. This data set is hosted by Douglas Gibler, University of Alabama. (source: http://www.correlatesofwar.org/datasets.htm)

[35] GeoDist database (CEPII) provides several bilateral variables such as common language, frontier or colonizer, and distance. (http://soledad.zignago.pagesperso-orange.fr/data.html)

7.2 Comparing results with BB (2004) and EL (2008) to check the availability of data

I would compare the regression results with those of BB (2004) and EL (2008) to check the availability of my dataset because I use different numbers of countries and periods. For this, I try to show that my results regressed with my dataset are predicted similarly as theirs.

[Table A.1] The replicated regression results based on BB (2004)

RTA existence		probit	probit	probit
GDP Sum	+	0.22^{***}	0.24^{***}	0.22^{***}
GDP Sim	+	0.41^{***}	0.27^{***}	0.26^{***}
DKL	+	-0.01	0.37^{***}	0.28^{***}
Sq DKL	-	-0.32	-0.46^{***}	-0.41^{***}
DROWKL	-	0.78^{***}	0.90^{***}	0.75^{***}
Inverse Distance	+		0.73^{***}	0.60^{***}
Same Continent	+		0.52^{**}	0.44^{**}
Distance from ROW	+		-0.45^{***}	0.68^{***}
Interdependence	+			0.02^{***}
Cons.		-10.75	-4.81	-8.65
Obs.		312280	312280	312280
Pseudo R^2		0.18	0.43	0.44

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

In the comparison of BB(2004), total bilateral market size (GDP Sum) and the similarity of two market size (GDP Sim) are statistically significant with expected signs. But, the signs of DKL representing the difference of capital-labor ratios, change from negative to positive after controlled by other variables related to the distance or location. Without other distance or location variables, DKL seems to represent the tendency that countries locating closely or on the same continent, which generally have similar capital-labor ratios, are more likely to form an FTA instead of the difference of capital-labor ratio. After controlled by other variables related to distance or location, DKL gets to capture how the difference of capital-labor ratios affects the formation of an FTA. The signs of distance from the ROW also change from negative to positive after controlled by interdependence. Without interdependence, distance from the ROW represents the effect of neighboring countries such as interdependence. After controlled by interdependence, distance from ROW purely captures multilateral resistance effect such as distance from the ROW.

Those variables in BB (2004) are mostly used in empirical researches related to the pre-existing FTA effects such as EL (2008), BJ (2012), and Baier et. al. (2014).

[Table A.2] The comparison of regression result with EL (2008)

RTA		(1) EL (2008)	(1) Author	(2) EL (2008)	(2) Author
Period		1955-2005	1993-2012	1955-2005	1993-2012
# of countries		146	189	146	189
RTA		0.057	0.071		
Interdependence	+		3.30	2.509^{***}	0.38^{***}
Natural	+	-8.679	-8.762	0.452^{***}	2.74^{***}
GDP sum	+	11.291	10.836	0.773^{***}	16.87^{***}
GDP sim	+	-1.952	-1.032	-0.040	8.89^{***}
DKL	+	1.242	0.796	-0.583^{***}	0.82^{***}
Sq DKL	-	2.344	0.952	0.130^{***}	-0.39^{***}
Dcont	+	0.237	0.249	0.569^{***}	2.62^{***}
Remote	+	8.855	3.889	15.668^{***}	2.05^{***}
DROWKL	-	0.992	9.459	0.460^{***}	-15.82^{***}

Note: (1) Mean (2) Chamberlain RE probit

*. **, and ***denote significance at 10%, 5%, and 1% respectively

On the other hand, in the comparison of EL (2008), most variables have similar means except DROWKL. I have larger means for DROWKL than EL (2008). This must be due to the fact that newly included 46 countries are mostly small countries. Those small countries must increase the relative factor endowment difference between themselves and ROW. However, I seem to have better results than EL (2008) in terms of both significance and expected signs. I have perfectly significant results with expected sings. Therefore, I believe that my dataset with different period and numbers of countries might have no problem to be used for empirical estimation.

7.3 Comparing pre-existing FTA effects based on BJ(2012)

In the comparison with BJ (2012), I have similar summary statistics except Interdependence, Contagion index and GDP sum. I have smaller means for those variables than BJ (2008). This also must be due to the fact that newly included 76 countries are mostly small countries and locate closely with other neighboring countries.

[Table A.3] Comparing Summary Statistics with BJ (2012)

	(1)_Mean	(1) Min	(1) Max	(2) Mean	(2) Min	(2) Max
RTA	0.007	0	1	0.069	0	1
Pure RTA	0.008	0	1	0.006	0	1
EL Interdependence	33.906	0.001	90.019	3.313	1.50e-07	127.787
Contagion index	13.285	0	76.375	1.48	0.95	62.80
WTO dispute	0.581	0	1	0.316	0	1
GDP sum	49.61	39.572	59.222	10.785	7.687	13.389
Diff GDP	2.465	0	10.150	2.718	0	12.034
GDPPC diff	1.951	0	5.864	0.796	0	2.892
Distance	8.876	4.710	9.892	8.759	4.088	9.899
Remote	0.935	0	9.405	3.889	3.767	4.141
Bilateral trade	0.505	0	76.743	2.25	0	111
GDP growth	3.602	-24.049	20.266	3.929	-50.248	106.280
Relative GDP growth	3.146	1.043	4.643	1.011	-57.218	66.988
FTA coverage	39.255	0	98.193	34.501	0	99.281
Political distance	6.662	0	20	7.247	0	20
Democracy	0.598	0	1	0.669	0	1
Communist transition	0.177	0	1	0.388	0	1
Military alliance	0.07	0	1	0.066	0	1
Common language	0.115	0	1	0.158	0	1
Common colonizer	0.051	0	1	0.109	0	1
Colony	0.029	0	1	0.011	0	1
Contiguous	0.007	0	1	0.015	0	1

Note: (1) BJ(2012): 113 countries from 1948 to 2007 and (2) Author: 189 countries from 1993 to 2012

To compare each pre-existing FTA effects, I estimate with ols, probit, and logit with time and country dummy, Chamberlain random effects, and conditional logit, same as Baldwin and Jaimovich (2012). First, I regress with ols, probit, and logit with time and country dummy, and then conditional logit to control the incidental problem, which happens in a panel data model with a limited dependent variables and the unobserved heterogeneity problem. Then, I regress with Chamberlain random effects to eliminate a possible correlation of time-variant regressors with the time-invariant component of the error term. I have the expected signs for 'Own FTA effects' and 'Partner's FTA effects' in all estimation methods but 'Partner's FTA effects' are statistically insignificant in some methods.

[Table A.4] Regression results with all kinds of pre-existing FTA effects

RTA		(1)	(2)	(3)	(4)	(5)
Own FTA effect$_i$	+	0.15***	0.80***	1.39***	1.63***	8.23***
Partner's FTA effect$_i$	-	-0.01***	-0..36	-0.16	-1.16*	-8.13
Contagion index$_i$	+	0.13***	5.98***	10.46***	3.50***	13.43***
EL Interdependence	+	0.02***	0.22***	0.38***	0.33***	2.49***
GDP sum	+	-0.01***	1.33***	2.59***	7.74***	35.89***
GDP diff	-	-0.004***	-0.39***	-0.82***	-1.25***	-6.54***
GDP pc Diff	+	-0.03***	-1.81***	-3.40***	0.81***	-1.19***
Distance	-	-0.04***	-4.77***	-9.08***	-3.90***	
Remote	+	0.44***	14.765***	22.69***	22.79***	
Bilateral trade	+	0.62***	11.99***	19.14***	1.03	21.68***
GDP growth	-	-0.001***	-0.01*	-0.02**	-0.01***	-0.09***
Relative GDP growth	-	0.0004***	0.02***	0.03***	0.02***	0.10***
WTO dispute	+	0.002**	0.26***	0.46***	0.19***	0.09***
FTA coverage	+	-0.0002***	0.02***	0.02***	0.02***	0.03***
Communist Transition	-	-0.008***	-0.43***	-1.45***	-0.20	
Military alliance	+	0.12***	4.63***	9.13***	1.31***	
Contiguous	+	0.14***	3.34***	3.46***	1.49***	
Common language	+	0.05***	2.81***	4.99***	2.00***	
Common colonizer	+	0.01***	0.83***	2.13***	1.65***	
Colony		-0.04***	-1.44***	-1.58***	-0.99***	
Year dummy		Yes	Yes	Yes	No	No
Country dummy		Yes	Yes	Yes	No	No

Note: (1) OLS (2) probit RE (3) logit RE (4) Chamberlain RE probi and (5) conditional logit.

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

Based on the regression results of table A4, I also compute the standardized coefficients[36] to compare the estimated results and interpret which one among the variables regarding to the pre-existing FTA effects gives the most powerful impact on the formation of FTAs. The estimation results say that 'Interdependence' is the most influential, and then each 'Contagion index' and 'Own FTAs effects' is the second and third and 'Partner's FTAs effect' is the least influential on the formation

[36] Since we know the metric coefficients and the standard deviations of the x's and y*, we compute the standardized coefficients by the way that $b_k^{'} = b_k \frac{s_{x_k}}{s_{y^*}}$. It means that a standard deviation change in x_k causes a standard deviation in y to change as much as $b_k^{'}$, which represents the change in response for a change of one standard deviation in x_k. Therefore, we can say that the higher the beta coefficient the greater the impact of the independent variable on the dependent variable.

of a new FTA in the Conditional logit and Chamberlain RE probit methods. On the other hand, 'Contagion index' is the first and then 'Interdependence' and 'Own FTAs effects' is the second and third, and finally 'Partner's FTAs effect' is the last in order in probit RE and logit RE with time and country dummy. Unfortunately, since I could not derive the consistent orders regardless of estimation methods, I could not conclude which one is the most influential among the diverse pre-existing FTA effects. However, I could say that Interdependence give more significant impact on a formation of a new FTA than pre-existing FTA effects of each participating party while Baier et. al. (2014) shows that an "own-FTA"effect gives stronger impacts on the formation of FTAs than "cross FTA"effect.

[Table A.5] Comparing standardized coefficients

RTA		(1)	(2)	(3)	(4)	(5)
Own FTA effect$_i$	+	0.29	0.05	0.04	0.08	25.79
Partner's FTA effect$_i$	-	-0.004	-0.003	-0.001	-0.01	-4.01
Contagion index	+	0.25	0.34	0.32	0.17	45.31
EL Interdependence	+	0.68	0.29	0.27	0.36	246.23

Note: (1) OLS (2) probit (3) logit (4) Chamberlain RE probit (5) conditional logit

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국문 초록

비대칭적인 제 3국들과 맺고 있는 기존의 FTA가 새로운 FTA를 맺는데 미치는 영향에 대한 연구

이 논문은 'Free Trade Network (2007)'의 이론적 모델을 근거로 하여, 새로운 FTA 체결로 올 수 있는 각국의 후생 변화를 측정 가능한 변수들을 이용하여 정의하였다. 이러한 후생의 변화는 기존의 FTA 효과가 배제된 소비자 후생의 변화와 무역수지의 변화, 그리고 기존의 FTA에서 오는 후생의 변화로 정의된다. 그리고 1993년부터 2012년까지 189개국의 국제무역 및 경제 관련 data를 앞서 언급된 후생변화에 대입하여 각국의 후생변화에 따른 FTA 가입 여부를 예측하였다. 이를 위해 실재 FTA 체결여부를 가장 잘 맞추는 각 국가별 임계값을 계산하는 calibration을 수행하여, 이 calibration으로 예측된 FTA 가입여부와 실제 FTA 가입여부가 90% 정도 일치함을 보여주었다.

이 논문은 또한 선행 실증연구에서 주목하지 않은 각국이 비대칭적인 제3국들과 이미 맺고 있는 기존의 FTA가 새로운 FTA체결에 미치는 영향과, 새로운 FTA 참여국들의 산업화 정도와 MFN tariff level의 차이가 새로운 FTA를 맺는데 미치는 영향을 앞서 언급된 이론에 근거하여 예측하고, 그 예측들을 'Spatial Dependence with Dyadic Data' 기법을 이용하여 검증하였다. 특히, calibration을 통해 얻어진 각 국가별 임계값을 통해 예측된 새로운 FTA의 가입의사를 바탕으로 각 국가별 FTA를 맺게 하는 일방의 동기에 대한 가설을 검증하는 방식을 사용하였다.

마지막으로, Big Data Analysis를 통해, 기존 연구에서 FTA를 맺는 요인으로 언급된 변수들 가운데, 각 국가별로 실질적으로 영향을 주는 유효한 변수들을 선별함으로서 각 국가별로 FTA를 맺게 하는 요인을 분석하였다. 이를 위해 선행연구에서 언급된 경제적, 정치적, 다자주의적 관점

의 변수들과 주변 국가들이 기존에 이미 맺고 있는 FTA의 효과를 분석한 변수들을 정리하였다. 이렇게 정리된 자료를 이용하여 glmnet package와 10-fold cross validation 방법을 R프로그래밍에 적용한 Lasso 회귀분석을 통해 각 국가별 FTA를 맺게 되는 요인을 분석하였다. 개별 국가들을 대상으로 한 결과에서는 국가별로 상이한 변수들이 선택되었는데, 이렇게 선택된 변수를 가지고 OLS 및 Probit 방식으로 회귀 분석한 결과에서 상당히 높은 R^2 값을 나타냈다. 두 세 개의 변수만으로 회귀분석 하여도 높은 R^2 값을 나타내는 점으로 볼 때, Lasso 회귀를 통해 선별된 변수들이 국가별 경제적, 지리적, 정치학적 특징들을 반영한 실질적인 국가별 FTA의 결정요인인 것으로 보인다.

이 논문은 FTA 결정요인을 실증적으로 분석하는데 있어서 이론에 근거한 calibration을 이용한 점, 기존의 FTA가 새로운 FTA 체결에 미치는 영향이 참여국가의 경제발전 수준, 참여국가의 크기, tariff level 등의 변수에 의하여 변화되는 것을 예측할 수 있는 Furusawa and Konish(2007)의 general한 이론 모형에 근거하여 실증분석 한 점, Big Data Analysis를 통해, 기존 연구에서 FTA를 맺는 요인으로 언급된 변수들 가운데, 각 국가별로 실질적으로 영향을 주는 유효한 변수들을 선별하여 각 국가별로 FTAs를 맺는 요인을 분석했다는데 의의가 있다.

주요어: FTA, Interdependence, Free Trade Network, Spatial Dependence with Dyadic Data, Big Data Analysis, Lasso

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