Econometric Approaches to Strategic Interactions in Trade Agreements

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1.1 Introduction

The complex nature of the existing free trade agreements (FTA) shows that various factors enter into an FTA formation decision. In this paper, I study the simultaneous decisions of China, the European Union (EU), Japan and the US to form FTAs and how these decisions affect one another. The existing trade literature has largely focused on the participating countries' economic characteristics and on past established FTAs to explain the formation of FTAs. However, these traditional models cannot predict why two big countries decide to form independent FTAs with the same partner even if there are many instances of such an arrangement in the data. For instance, Peru has an FTA with China, and another one with the US. Similarly, Singapore signed two independent FTAs with these two big countries. These observations motivated me to empirically analyze decisions to form an FTA where big countries behave strategically when selecting their partners.

My main objective is to understand how big countries affect one another's FTA decisions. On the one hand, FTAs can promote the formation of other FTAs, i.e. they act as a building block to other FTAs. There can be various reasons to this but the main one is a loss of market access. According to the article XXIV of the General Agreement of Tariff and Trade, countries are allowed to give special treatment to some selected partners. As a result, these selected partners would enjoy special treatments (which is a free trade zone in the case of FTAs) that others do not get. This in turn prompts these other countries to also form an FTA.

On the other hand, FTAs can also act as a stumbling block to the formation of other FTAs. In this case, countries outside the agreement do not have an incentive to form a competing

FTA. Many trade economists argue that FTAs reduce external tariffs for non members. Consequently, exporters outside the agreement benefit indirectly from the FTA formation and do not have any incentives in signing an agreement with the importer.

The main novelty of this paper is that by using an econometric method developed in the Industrial Organization field, it provides an evidence of the direction of strategic interaction between FTAs.

The rest of the paper is structured as follows. Section 2 summarizes the literature on the effect of strategic interaction on FTA decision. In section 3 I develop a three-country model that examines the aggregate welfare of two countries of different sizes when they form a new FTA. I calculate the different parametric ranges over which big countries are willing to form FTAs with the small country and ranges over which they are willing to share a common FTA partner.

I derive two important results from my model. First, strategic interactions affect FTA decisions and their effects can be either negative or positive. A negative strategic interaction among FTA decisions reduces the incentive of a big country to form an FTA with a small country when the latter already establishes an FTA with another big country. In the presence of a positive strategic interaction, a big country finds it more profitable to have an FTA with a small country that already formed an FTA with another big. Second, including strategic interactions in FTA decisions leads to multiple equilibria. A negative strategic interaction results in a multiplicity over the identity of the big countries that form an FTA, whereas a positive strategic interaction can result in two trade agreement regimes: one without FTA and one with both big countries forming an FTA.

The second finding has an important implication on estimation: traditional estimation methods are inappropriate unless one specifies a particular equilibrium selection to tackle the issue of multiple equilibria. Both strategic interactions and multiple equilibria are not addressed in

existing empirical literature on FTA determinants. As a result, I use an econometric framework borrowed from the Industrial Organization literature to estimate my model. Instead of finding the exact probability distribution of the data, as is done for instance with maximum likelihood estimation, the framework consists of simulating the upper and lower bounds of each FTA choice probability and minimizing the distance between the set of bounds and the choice probabilities. Section 3 then presents the estimation procedure used, and explains how to construct an interval estimation for inference instead of point estimation to overcome this equilibrium issue.

Section 4 describes the data used for estimation. It paints a general overview of FTA formation. It also suggests some evidence in support of strategic interactions among the four big countries when they form an FTA.

In Section 5 I report the estimation results. I start with two benchmark results that both use a probit model. They rely on the assumption that the decision of one big country to form an FTA with a partner does not affect the decisions of the other big countries relative to that same partner. I provide strong evidence that accounting for the interaction between FTA decisions significantly affects FTAs that the big countries form. The strategic interactions between FTA decisions of big countries can be either positive or negative. In particular, economic rivals such as the US and China display more competition: the decision of one of them to form an FTA with another partner significantly increases the likelihood of the other country to also form an FTA with the same partner.

Section 5 also describes how my estimated model can be used to run a conterfactual exercise on the Trans-Pacific Partnership (TPP). In particular, I use the model to measure the effect of the US's interest in the TPP on the likelihood that the other big countries want to have FTAs with TPP members. I show that accounting for strategic interaction positively affects the interests of China, the EU and Japan on forming FTAs with countries involved in the TPP.

1.2 Related literature

This article is related to two opposing strands of literature on the effects of FTA on the formation of other FTAs. On the one hand, economists believe that FTAs act as stumbling blocks to the formation of other FTAs. On the other hand, they can be also building blocks to other FTAs.

1.2.1 FTA as a stumbling block to the formation of other FTAs

There are various reasons as to why FTAs are stumbling blocks to the formation of other FTAs. In static models with political economy, as is found in Levy (1997) and Krishna (1998), FTAs can provide members and their lobby groups with important gains in terms of more access to their preferred export market. As a result, these groups would oppose any further liberalization, rendering the formation of FTAs as stumbling blocks.

Economists have also thought that FTAs might divert trade from non-members to members. However, contrary to popular beliefs, trade diversion created by the formation of FTAs is very narrow in scope. The main reason is that FTA members have incentives to also reduce their trade barriers, i.e. their external tariffs, against non-members alongside with the free trade with other members. This reduction in external tariffs is what distinguishes FTA from Custom Unions (CUs). Whereas CU members have to coordinate their external tariffs, FTA members can separately set theirs. According to Richardson (1990), the consequence is that CU members jointly choose a common external tariff so as to make each country member better off. But for FTA members, external tariffs are set by individual countries. And the member with a relatively small comparative advantage in a good will not keep protection against imports of that good from non-members. When the tariff reduction against non-members is important enough, it eliminates any potential trade diversion consequences.

Among the proponents of the arguments above are Kennan and Riezman (1990), Bond et al. (2004) and Ornelas (2005). When the external tariffs are low enough, non-members of

an FTA benefit more because they see their exports to the FTA markets increasing without giving in any concession in return. Thus, the gains for non-members are reflected by the increased market access that boosts their producer surplus, with no change in the other components of welfare (consumer surplus and tariff revenue). With this improved access to the FTA markets and increase in welfare, non-members do not have incentives to reduce their trade barriers. As a result, FTA reduces the gains for non-members to create other FTAs. Ornelas goes further in the implication of FTA on global free trade and says that "FTA reduces the non-members' extra gains from multilateral liberalization". Consequently, FTAs can act as a stumbling block to the formation of other FTAs.

1.2.2 FTA as a building block to the formation of other FTAs

For other researchers, FTAs can be building blocks to the formation of other FTAs because of the trade diversion they create. Trade diversion can be defined as the increase in trade volume between members after the creation of an FTA, at the expense of that of non-members. When FTA formation is analyzed through the lens of a competing exporters model in which a country imports the same good from two or more other countries, trade diversion can occur, as argued by Saggi and Yildiz (2010).

In a three-country model, FTA can also act as a building block to the formation of other FTA when one of the initial member benefits more from becoming a "hub", that is by having two independent FTAs with the other two countries. This benefit exists for the hub because the additional FTA creates a preferential market access enjoyed by the hub in the other countries. Lake (2017) argues that this situation occurs under asymmetry. In particular, when the economy consists of two small countries and one big country, the latter benefits more by forming FTAs with each small country.

This article also extends various literature on FTA and inference in discrete games. First, to my knowledge, it is the first paper to directly include strategic interactions, in addition

to economic characteristics of the participating countries, as one of the main determinants of FTA formation. Hence, my paper adds to various strands of literature on the subject. In particular, my article shares some key elements with the work by Chen and Joshi (2010) by analyzing countries' incentives to form FTAs. Like them, I identify characteristics such as distance and size to crucially affect the formation of a new FTA and found that other countries' FTAs matter in FTA decisions. Unlike them, I found that these other FTAs can positively affect the formation of new FTAs. My paper is also related to Bond et al. (2004), and Saggi and Yildiz (2010) by using a partial equilibrium analysis to study the welfare implication of FTAs in a three-country model. My work also employs pairwise stability with transfer used by Goyal and Joshi (2006) and Furusawa and Konishi (2007). Like them, I theoretically study FTA formation in a network-type environment to highlight the role of interdependence between FTA decisions. Unlike them, I provide a method to directly estimate these decisions.

Second, my paper adds to the growing empirical literature on FTA formation that estimate strategic interactions as a determinant of FTA decisions. Baier and Bergstrand (2004) are the first to provide an empirical analysis of the economic determinants of FTA formation. They use economic variables such as distance, economic size, difference in capital-labor ratios between two partners to accurately predict 85% of the 286 FTAs in their data. Using a probit model, they found that the likelihood of FTA formation between two countries is higher under the following distinct conditions: when the pair are located close to each other but far from the rest of the world; or when the two partners are both large economies; or when the pair display greater differences in their capital-labor endowment ratios.

Chen and Joshi (2010) and Baier et al. (2014) provide an additional determinant of FTA formation on top of economic sources by measuring the effects of FTA interdependence. For Chen and Joshi (2010), the strategic effects come from third-party effects measured by a dummy variable indicating whether one of the partners in the negotiation already has an

FTA with other countries. In their estimation, they also control for country-pair economic characteristics, such as GDP, the difference in GDP, distance, etc. Using probit models, they found strong evidence that existing FTAs affect other countries' incentives to form new FTAs. For Baier et al. (2014), the sources of strategic interdependence are "own-FTA effect", or the effect of either partner already having other FTAs, and the "cross-FTA effect", or the effect of FTAs formed by the rest of the world. Again, they are measured by the lagged number of FTAs that one of the countries in negotiation has with other countries and the lagged number of FTAs formed by the rest of the world, respectively.

My paper substantially differs from these articles by directly estimating strategic interactions in my estimation. Unlike any previous work on FTA interdependence, my article posits that countries are making simultaneous decisions about their FTAs. As a result, I estimate the effects of an FTA decision of one country with a partner on the decision of another country to form an FTA with the same partner. I don't use lags like Baier et al, nor indirect measure of interdependence like Chen and Joshi.

Third, I show that multiple equilibria in FTA decisions can arise when strategic interactions affect the likelihood to form an FTA. In this case, a probit model, generally used to estimate the determinants of FTA, is not feasible. Instead of that, I use moment inequalities as the main estimation framework. My approach thus contributes to a growing empirical trade literature that uses moment inequalities to derive a bound estimation of parameters of interest. These works include Ciliberto et al. (2017), Morales (2018), and Dickstein and Morales (2018). Ciliberto et al. study the role of superstar exporters and estimate their effects on the export decisions by other exporters. Similarly, Morales et al. use a bound estimation to analyze export decisions. In contrast, my article is the first to address FTA decisions using a methodology close to that of Ciliberto and Tamer (2009) to partially identify strategic interactions in FTA decisions.

Finally, my model allows me to run a counterfactual analysis on the effects of FTA decisions,

which is impossible to get if standard econometric approaches were used. Using the estimated model, I analyze the effects of the US's decision to join the Trans-Pacific Partnership (TPP), had it happened, on China, the EU and Japan. I found that the likelihood of these three big countries forming FTAs with TPP members would have increased if the US had signed the agreement.

1.3 Model of FTA formation

In this section, I develop a model which argues that big countries think and act strategically between them when they form an FTA. As a result, this section starts by laying out the model assumptions. My model builds on the three-country framework used by Bagwell and Staiger (1999). Then, I proceed to solve for the model equilibrium and show the implication of strategic interactions on the existence of multiple equilibria. Finally, I explain how I estimate strategic interactions among FTA decisions by the big countries and how I deal with multiple equilibria.

1.3.1 Trade model

To formalize my model, I compare countries' welfare in three different circumstances: when the world has no FTA established, when only a pair of countries establish an FTA, when two independent FTAs are formed. Such a comparison shows how strategic interactions affect the decision to form an FTA.

1.3.2 Model assumptions

Assume that the world consists of $N = 3$ non-identical countries: two big countries and one small country. Each country is deciding whether or not to form a free trade agreement with its trading partner. The formation of a free trade agreement is considered as a two-stage game. In the first stage of the game, two or more countries simultaneously choose whether they want to establish an FTA between them. In the second stage of the game, countries

play a game that determines post-FTA-decision welfare.

The following FTA outcome s can emerge from the first stage: no FTA denoted by $\{\phi\}$; an FTA $\{ik\}$ formed between only the pair i and k, for any $i,k \in N$; two independent FTAs denoted by $\{ik,jk\}$ with $i \neq j$; and a global free trade denoted by $\{ijk\}$. In the second stage, each country i receives a payoff of $w_i(s)$ when the outcome s has been chosen in the first stage.

Throughout the remainder of this section, I maintain the following assumptions:

Assumption 1.

1. Countries that choose to form an FTA incur a cost ξ;
2. Transfers between countries are possible.

Given the assumptions above, a pair of countries i and k will form an FTA if and only if the net aggregate welfare of the two countries increases after the trade agreement. Let $\Omega_{ik}(s) = w_i(s) + w_k(s)$ be the aggregate welfare obtained by country i and k under the outcome s. Thus, given that the world does not have any FTA formed yet, i and k establishes a new FTA if and only if

$$\Omega_{ik}(\{ik\}) - \xi \geq \Omega_{ik}(\phi) \tag{1.1}$$

Here, I depart from most literature in that when two countries decide to form an FTA, I look at the aggregate welfare instead of the individual one. The reason is because in the presence of asymmetry, a small country obviously gains from forming an FTA with a big country as it gets free access to a bigger market. However, the big country might not necessarily gain if it accounts for only its individual welfare. Because of this, I allow for a possibility of transfer from the small country to the big one. This is known as **pairwise stability** with transfers, a notion proposed by Bloch and Jackson (2006).

Definition 1.3.1. Denote by $y_{ij} \in (0,1)$ the FTA link that exists between country i and country j. In a setting that allows transfers, the FTA network is pairwise stable if:

1. for all pairs i and j such that $y_{ij} = 1$, the aggregate net welfare is positive;

2. for all pairs i and j such that $y_{ij} = 0$, the aggregate net welfare is negative.

1.3.3 Model equilibrium

To formalize the role of strategic interaction in FTA decisions, consider a model where each one of three countries, denoted by i, j and k, is producing two goods x and y, with the latter being a numeraire good. Throughout the remainder of this section, i and j are considered big countries, and k is a small country.

In country i, let the utility function for consuming X_i and Y_i amounts of good x and y, respectively, be of the form: $U_i(X_i, Y_i) = u_i(X_i) + Y_i$, where $u(X_i)$ is quadratic. As is well known, this utility function leads to a linear demand function of the form: $P_i(X_i) = \alpha_i - X_i$, where $P_i(X_i)$ is the price of X_i in country i, α_i denotes i's market size.

Suppose that there is a representative firm in each country that produces good x and sells it in every market, both at home and abroad. Suppose that marginal costs of production and transportation cost are zero. However, a firm i pays a tariff T_k in country k if no FTA is signed between the two countries, i.e. the FTA outcome does not include $\{ik\}$.[1] In my model, the existence of an FTA between i and k is indicated by a dummy variable y_{ik} taking the value 1 if such an FTA is established and 0 otherwise.

Firms compete as Cournot oligopolists in each market. Therefore, each firm chooses the amount of good x that maximizes its profit in each market. For a firm i [2], let π_{ii} and π_{ik} be

[1] In my model, countries i, j and k are assumed to be WTO members. As a result, each of them applies non-discriminatory tariffs to all foreign countries. However, according to the Article XXIV of GATT, these countries are allowed to pursue bilateral or multilateral trade agreements (or FTAs). As a result of an FTA, tariffs are set to zero for members involved in the FTA, whereas each of them can independently decide of the external tariff applied to imports from countries outside the agreement.

[2] This follows since there is only one representative firm in each country.

its profit in its home market and in country k, respectively. Then,

$$\pi_{ii} = P_i(X_i)x_{ii} \tag{1.2}$$

where x_{ii} represents the output of firm i in country i.

In country k, firm i chooses to produce x_{ik} that maximizes:

$$\pi_{ik} = [P_k(X_k) - T_k(1 - y_{ik})]\, x_{ik} \tag{1.3}$$

After solving for the model, I obtain total welfare $w_i(s)$ for a country i as the sum of consumer surplus, producer surplus or profits, and tariff revenue when the FTA outcome is s. Thus,

$$w_i(s) = CS_i(s) + \sum_j \pi_{ij}(s) + TR_i(s) \tag{1.4}$$

Throughout the remainder of this section, I construct my welfare analysis from the perspective of country i. Note that both country i and country j are identical. Thus, my result also extends to country j naturally. [3]

I now examine how the decision of country i to form an FTA with a small country k depends on the decision of country j to also establish an FTA with k. To do so, I proceed to a welfare analysis under two circumstances: when j and k has an FTA between them, and when they do not have one. As a result, there are two possible cases: (i) the strategic interaction between FTA decisions is negative; (ii) or, the strategic interaction is positive. In the first case, the FTA decision by j negatively affects that of i such that if country j already has an FTA with country k, then country i does not want to establish an FTA with k anymore. In the second case, FTA decisions are positively affected by each other. This case means that

[3] I do not look at two outcomes: the global free trade outcome, and an FTA between two big countries. In the appendix, I show why these two outcomes are not identified as equilibria in my model.

country i wants to form an FTA with k only when country j also has an FTA with k.

1.3.3.1 Negative strategic interactions

Equation (1.1) implies that a negative strategic interaction between the FTA decisions of the big countries exists when the following two conditions simultaneously hold:

$$\begin{aligned} \Omega_{ik}(\{ik\}) - \xi &> \Omega_{ik}(\{\phi\}) \\ \Omega_{ik}(\{ik, jk\}) - \xi &< \Omega_{ik}(\{jk\}) \end{aligned} \tag{1.5}$$

Equation (1.5) indicates that if j does not have an FTA with k, then i will have an incentive to form one with k. However, if j forms an FTA with k, then i will prefer to stay out.

With large enough support for ξ's, the FTA game has multiple equilibria in the identity of the big country with which k will form an FTA. To see why, note that if equation (1.5) is valid for country i, then a similar reasoning also applies to country j since i and j are identical. Since FTA formation is a simultaneous move game, then k can choose to establish an FTA with either i or j.

Let

$$C_1 = \frac{7}{16}\alpha_i T_i + \frac{1}{32}T_i^2 + \frac{1}{32}T_k^2 + \frac{7}{16}\alpha_k T_k$$

and

$$C_2 = \frac{13}{32}T_i^2 - \frac{3}{16}T_k^2 + \frac{7}{16}\alpha_i T_i + \frac{7}{16}\alpha_k T_k$$

Assumption 2. Suppose that $T_k > \sqrt{\frac{12}{7}}T_i$ and $T_k > \sqrt{\frac{12}{7}}T_j$

Proposition 1.3.1. Under *assumption 2.*, when the cost ξ is between C_2 and C_1, the game results in either i and k forming an FTA or j and k having an FTA.

A negative strategic interaction among FTA decisions is illustrated in proposition 1.3.1 because only one FTA is formed in the range of costs between C_2 and C_1: each big country

does not want to form the FTA when the other big country already has one with this small country.

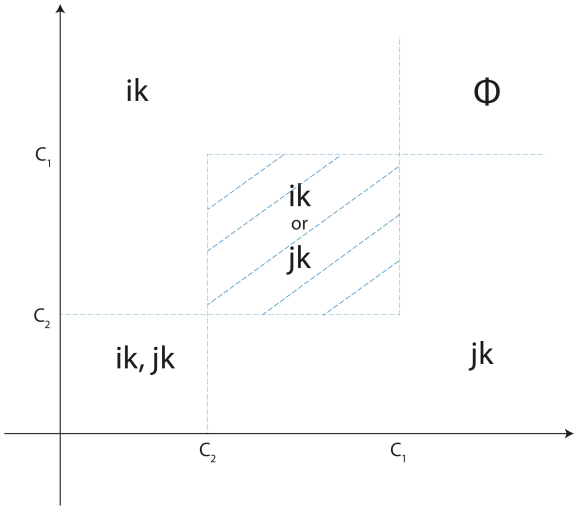

Figure 1.1: Regions of multiple equilibria under negative strategic interactions

Figure 1.1 shows how the range of costs modify the FTA decision of each big country with regard to the small country. The range of cost for country i is on x-axis, whereas the y-axis represents the cost for country j. The multiple equilibria in the identity of the big country with which country k forms an FTA is located in the hatched rectangle in the middle. If costs of establishing an FTA with k are bigger than C_1 for both i and j, then no FTA will be formed in this economy. Similarly, when the costs are below C_2 for both i and j, then they each form an FTA with k.

1.3.3.2 Positive strategic interactions

According to equation (1.1), a positive strategic interaction between the FTA decisions of the big countries exists when the following two conditions simultaneously hold:

$$\begin{aligned} \Omega_{ik}(\{ik\}) - \xi &< \Omega_{ik}(\{\phi\}) \\ \Omega_{ik}(\{ik, jk\}) - \xi &> \Omega_{ik}(\{jk\}) \end{aligned} \tag{1.6}$$

Equation (1.6) states that the net aggregate welfare of country i and k when they have an FTA is boosted by an FTA between j and k. However, i and k prefer no agreement to having one if j and k do not establish an FTA.

In this case, multiple equilibria arises because the model predicts that under a certain range of ξ, both no FTA in the economy and having two independent FTAs separately involving the big countries can be possible outcomes.

Let C_1 and C_2 be the same threshold as above.

Assumption 3. Suppose that $T_k < \sqrt{\frac{12}{7}} T_i$ and $T_k < \sqrt{\frac{12}{7}} T_j$

Proposition 1.3.2. Under *assumption 3*, when the cost ξ is between C_1 and C_2, the game results in either no FTA $\{\phi\}$ or two independent FTAs $\{ik, jk\}$.

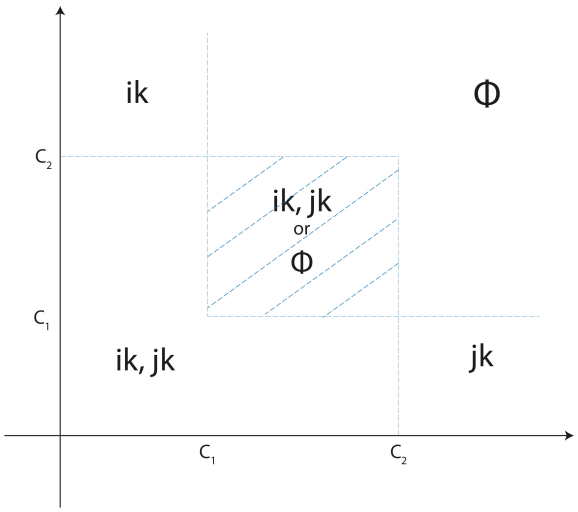

Figure 1.2: Regions of multiple equilibria under positive strategic interactions

The existence of a positive strategic interaction among FTA decisions is illustrated by proposition 1.3.2 because inside this range of costs, the big countries are not willing to be the sole partner of the small country. However, if one big country establishes an FTA with the small country, the other one will always form one. Thus, the FTA decision by one big country positively affects the FTA decision of another one. The hatched area of figure 1.2 illustrates proposition 1.3.2 and shows the region of equilibrium multiplicity.

1.3.4 Empirical model of FTA formation

This section builds on the theoretical model above, and presents both the econometric implementation and the estimation strategy used in the paper. In particular, I explain how to directly estimate strategic interactions among FTA decisions and deal with multiple equilibria.

Let us denote by i one of the big countries, that is China, the EU, Japan, and the US. Each one of them can potentially form an FTA with another country $j = 1, ..., J$. Note that j can also include any "big" country other than i. Let us denote by y_{ij} the equilibrium FTA outcome between i and j, where $y_{ij} = 1$ if the two countries agree to an FTA, and $y_{ij} = 0$ otherwise. I am interested in $y_j = (y_{china,j}, y_{EU,j}, y_{Japan,j}, y_{US,j})$, the vector of equilibrium FTA decisions that bound country j with each one of the big countries.

1.3.4.1 Welfare and equilibrium

Based on the theoretical model earlier, country i and country j are willing to form an FTA when the aggregate welfare they obtain from the new relationship offsets the cost of negotiation and the opportunity cost of the existing trade regime.

The aggregate welfare depends on a vector of observed factors X that contain i and j's observable characteristics. Observable characteristics include economic size such as GDP and bilateral variables such as distance.

More importantly, the theoretical model shows that aggregate welfare changes with strategic interactions between FTAs or the existence of FTAs between the small country and another big country. Note that i is the big country here.

Following the discussion, let the net aggregate welfare U be modeled according to the following reduced form equation:

$$U \equiv X_{ij}^{'}\beta_i + \sum_{k \neq i} \gamma_{ki} y_{kj} + \epsilon_{ij} \tag{1.7}$$

The term X_{ij} is a vector that captures the observable characteristics that affect the aggregate welfare net of the opportunity cost of maintaining the status quo. In my estimation, I choose to include measures of economic size and demand in country i and j, the existence of a common language between them, and the distance between them. ϵ_{ij} represents a vector of unobserved welfare shifters. As a reference to my theoretical model, ϵ_{ij} can be thought of as the negative of negotiation cost NC. Note that I am analyzing a game under complete information. As a result, ϵ_{ij} is observed by the other country $j \neq i$, but is unobserved only to the econometrician.

The main parameter of interest is γ_{ki} which captures the impact of strategic interaction. On one hand, a positive γ_{ki} indicates competition. More precisely, country i's decision to form an FTA with some country j is positively affected by an FTA between k and j. On the other hand, a negative value for γ_{ki} indicates that the incentive for country i to form an FTA with j is reduced by the decision of k and j to also form an FTA.

An equilibrium can be viewed as a configuration $y \in \{0,1\}^N$, where N is the number of "big" countries, such that for each "big" country i that has an FTA with country j, $u_{ij} \geq 0$, whereas for another "big" country k without such an FTA with country j, $u_{kj} < 0$.

Let the set of equilibria be defined as:

$$E(\epsilon, X; \theta) = \{y \in \{0,1\}^N : y_{ij} = 1(X_{ij}^{'}\beta_i + \sum_{k \neq i} \gamma_{ki} y_{kj} + \epsilon_{ij} > 0), \forall i\} \tag{1.8}$$

For this article, let $y = (0,0,0,0)$ describe an FTA relationship between the four big countries and another country. y means that none of these four countries developed an FTA relationship with the other country. The set of Nash equilibria that supports this configuration is any $\epsilon_{ij} < -X_{ij}^{'}\beta_i \, \forall i$.

1.3.4.2 Estimation

The estimation procedure consists of finding the parameters Θ of welfare that are defined in equation (1.8), and consistent with the conditions imposed in definition 1.3.1. The idea is to derive the probability of each possible y given the data.

As shown in the previous section, the model described above is prone to multiple equilibria, depending on the realization of x and ϵ. Continuing with the example above, the outcomes $y = (0,0,0,0)$ and $y = (1,1,1,1)$ can be both equilibria when $-(X_{ij}^{'}\beta_i + \sum_{j \neq i} \gamma_j) < \epsilon_{ij} < -X_{ij}^{'}\beta_i$.

Ciliberto and Tamer (2009) explain in detail the difficulty of estimating a game with multiple equilibria. In particular, methods such as likelihood estimation or method of moments can not be used. One way to deal with this issue is to specify an equilibrium selection mechanism, as done by Bjorn and Vuong (1984), or to estimate one, as shown in Narayanan (2013).

The problem with specifying an equilibrium selection mechanism is the addition of more restrictions in the model. In this paper, I do not want to impose more conditions than the ones specified in definition 1.3.1. Thus, I adopt the partial identification approach developed by Ciliberto and Tamer (CT, 2009) by imposing bounds on the probability for each possible outcome $\mathbf{y}$ of the game, without making any additional assumptions regarding equilibrium

selection.

Assumption 1.3.1. *Suppose we have a random sample of observations on outcomes and characteristics (y_{ij}, X_{ij}) on a pair of countries i and j. Let ϵ, the unobserved component of welfare, be an i.i.d random vector with joint distribution function F_ϵ, known up to a finite dimensional parameter.*

Suppose there is an equilibrium selection mechanism that selects an outcome from all possible outcomes. Let the set of all possible outcomes be denoted by Y. Then, the probability of the outcome y given X is:

$$Pr(y|X) = \int Pr(y|Y, X, \epsilon) dF_\epsilon \tag{1.9}$$

where $Pr(y|Y, X, \epsilon)$ specifies the probability that the outcome y is chosen from the set Y. The set Y could potentially contain multiple equilibria. Therefore, we can rewrite equation (1.9) as follows:

$$Pr(y|X) = \int_{y \in Y, |Y|=1} Pr(y|Y, X, \epsilon) dF_\epsilon + \int_{y \in Y, |Y|>1} Pr(y|Y, X, \epsilon) dF_\epsilon$$

where the first integral on the right hand side includes the probability of having y as the only equilibrium, and the second integral represents the probability of y being one of many equilibria.

As a result, I can construct a lower and an upper bound on the probability of outcome y such that:

$$\underline{Pr}(y|X;\theta) \leq Pr(y|X) \leq \overline{Pr}(y|X;\theta),$$

where $\underline{Pr}(y|X;\theta)$ is the population probability that given X and θ, the definition 1.3.1 holds for y and it does not hold for any other outcome $y' \neq y$, and $\overline{Pr}(y|X;\theta)$ represents the population probability of having definition 1.3.1 hold for y, given X and θ.

The identified set Θ_I is then given by:

$$\Theta_I = \{\theta : \underline{Pr}(y|X;\theta) \leq Pr(y|X) \leq \overline{Pr}(y|X;\theta)\}$$

The model will find the upper and lower probability bounds for all possible outcomes. Since I do not observe $Pr(y|X)$, I estimate it consistently from the sample with the empirical probability $\widehat{Pr(y|X)}$, which I obtain by using a multinomial logit model. Also, I use simulation methods to obtain the bounds and get $\underline{Pr^s}(y|X;\theta)$ and $\overline{Pr^s}(y|X;\theta)$.[4] The estimation consists then of finding $\hat{\theta}$ that satisfies $\underline{Pr^s}(y|X;\theta) \leq \widehat{Pr}(y|X) \leq \overline{Pr^s}(y|X;\theta)$ by minimizing the following objective function:

$$\hat{\theta} = arg\min_{\theta} Q(\theta) = \sum_{m=1}^{M}\sum_{i=1}^{n} Q_{im}(y,\theta)$$

where

$$\begin{aligned} Q_{im}(y,\theta) = & 1[\widehat{Pr}(y|X) < \underline{Pr^s}(y|X;\theta)] \left\| \underline{Pr^s}(y|X;\theta) - \widehat{Pr}(y|X) \right\| \\ & + 1[\widehat{Pr}(y|X) > \overline{Pr^s}(y|X;\theta)] \left\| \widehat{Pr}(y|X) - \overline{Pr}(y|X;\theta) \right\| \end{aligned}$$

To conduct inference on the model, I use the method developed by Chernozhukov, Hong and Tamer (2007) to construct a confidence region Θ_α such that:

$$\hat{\Theta_\alpha} = \left\{ \theta \in \Theta : S * (Q_S(\theta) - \min_k Q_S(k)) \leq c_\alpha \right\}$$

1.4 Data

Before estimating the magnitude of strategic interaction, I will present some statistics that support its importance in FTA formation. In particular, the data reveals that the rate at

[4] see Ciliberto and Tamer (2009) for more detailed information.

which "big" countries form new FTAs seems to move in parallel, and this is especially true for traditional rivals such as the US and China. Moreover, the "big" countries form alliances by establishing various FTAs within their region. This section starts by describing the data source before going in-depth into some descripitive analysis.

In this paper, I use four sources of data: the Bergstrand database, the World Bank, the IMF and the Cepii datasets. The Free Trade Agreement data comes primarily from the Bergstrand database, publicly available at no cost on his website.[5] The data lists all pairs of countries in the world along with the history of preferential agreements between each pair from 2002 to 2012. In my estimation, I restrict the sample to include only two-way preferential agreements where the pair of countries agree to a mutual tax concession. There are various types of two-way preferential agreements depending on the level of integration. At the lowest level, both partners agree to a mutual concession on each other's tariffs while leaving other external tariff at the discretion of each country. The next level, called a customs union, has both partners agree on mutual tariff concessions and on common external tariffs. At the next level of integration lies the common market which has all the characteristics of a custom union, but in addition, members agree on the free movement of capital and services. The final level of integration is the economic union where members agree on common monetary and fiscal policies, on top of being a common market. In my article, all these four levels of integration are counted as FTAs because they all are two-way preferential tax concessions.

The data on GDP comes from a combination of the World Bank and the International Monetary Fund (Direction of Trade Statistics) datasets. The other datasets on bilateral characteristics, such as distance and common language, of each country pair come from Cepii [6], which is another publicly available data source. Cepii combines data from different sources such as the World Bank, the International Monteary Fund (IMF), and the CIA factbook.

[5] https://www3.nd.edu/~jbergstr/

[6] http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=32

1.4.1 FTA overview

The importance of strategic interaction between "big" countries in FTA formation can be seen in the data in two ways: (i) over time, the number of FTAs among these countries has increased; (ii) these economies chose their partners strategically.

Figure 1.3 shows the number of FTAs the "big" countries formed between 1986 and 2012. Note that in this section, I will use Germany instead of the EU because the data on FTAs for Germany indicates the evolution of EU members overtime. Before 2001, the number of FTAs formed by each "big" country was steady (although this is not true for Germany because the number of its FTAs is inflated by new members of EU). However, when the EU started to accumulate more members, the US also started pursuing more FTAs. Similarly, China's FTAs dramatically rose. By 2012, the US had a total of 18 agreements and China had 18 FTAs.

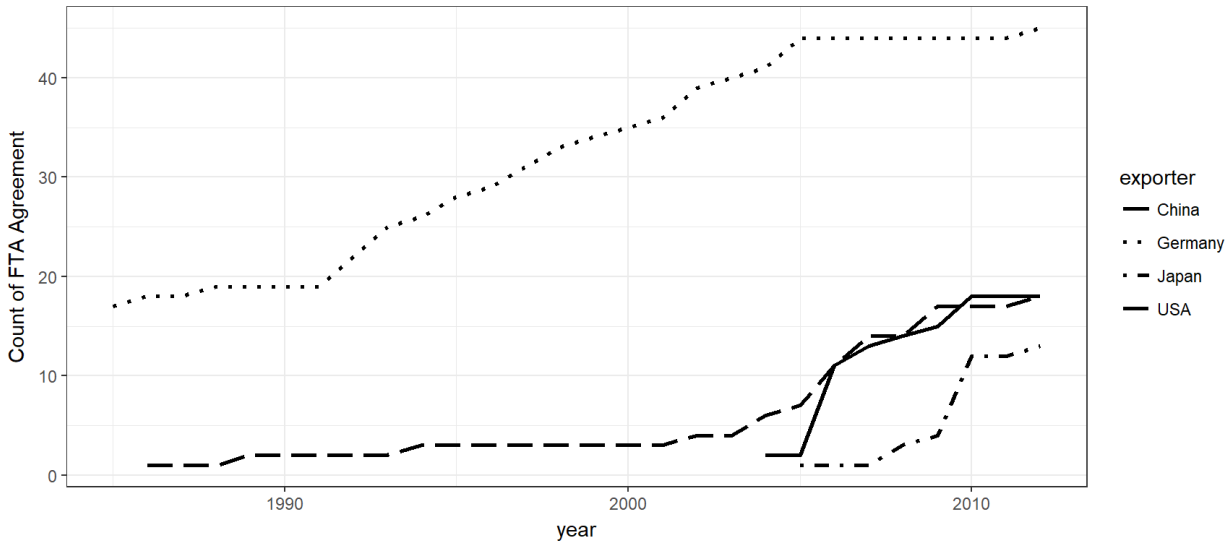

Figure 1.3: Overview of FTA agreements for China, Germany, Japan and USA

Table 1.1 further illustrates the strategic and political factors entering into FTA decisions. The data shows that the number of FTAs established by the "big" countries in 2004 and in

2012 in Asia, North America, Africa and Europe. It also reveals that the "big" countries chose their partners so as to form strategic blocs around themselves. Over time, the US established more FTAs in the American continent than any of the other "big" countries, China in Asia, and the members of EU were also growing. In 2012, the US has the most FTAs in North America with 8 agreements, which are 6 agreements more than that in 2004. China established the most FTAs in Asia with 11 agreements, 10 more than what they had in 2004. Naturally, Germany has the most FTAs in Europe with the formation of EU. This suggests that "big" countries are trying to increase their power within their region by having more FTAs there. In doing so, they are also able to limit the presence of other "big" countries in their region.

Table 1.1: Number of FTAs by region

country	year	Africa	Asia	Europe	North America
China					
China	2004	0	1	0	0
China	2012	0	11	0	2
EU					
Germany	2004	3	4	32	1
Germany	2012	5	5	32	1
Japan					
Japan	2012	0	8	1	1
US					
USA	2004	0	3	0	2
USA	2012	1	6	0	8

Notes: Each row reports the number of FTA formed by the big countries.

The data also shows that overtime, "big" countries try to be more present in one another's markets by establishing more FTAs in those markets. For instance, the US presence in Asia has increased with six FTAs in 2012, whereas in 2004, it only had three trade agreements in that region.

1.4.2 Variables

Following the trade literature, my independent variables include the sum of i's and j's GDP per capita (standardized and in natural logarithm), the distance (in natural logarithm) and a dummy variable assuming the value 1 (or 0) if two countries speak the same language (Common Language). The sum of GDP has always been used as a measure of economic size. Bilateral distances and common language are used as measures of "similarity" and "closeness" that have an effect on an FTA formation. The use of these variables as determinants of FTA is common (as in Baier and Bergstrand (2004) and Chen and Joshi (2010)).

Table 1.2 summarizes the variables. Some of them are standardized and transformed for the regression purposes, but they appear in levels in the table below.

Table 1.2: Summary Statistics

	Min	Q1	Median	Mean	Q3	Max
Country Specific Attributes						
GDP	0.11	4.15	17.31	241.47	131.33	9,685.37
Population	0.02	1.79	7.21	36.81	24.76	1,344.13
FTA	0.00	0.00	0.00	0.41	1.00	1.00
Bilateral Characteristics						
Distance	55.67	3,139.95	6,080.73	6,397.26	8,847.82	19,853.25
Common Language	0.00	0.00	0.00	0.06	0.00	1.00

Notes: The table reports summary statistics for all control variables. GDP is measured in Million of British Pound Sterling; Population is measured in Millions; Distance is measured in km.

1.5 Empirical results

This section presents the results of the estimation for the strategic effect in FTA formation. To understand the importance of strategic interaction, I will estimate a model where big countries make their FTA decision independently of one another. As a result, I will use two simple probit models: the first model ignores the strategic interaction entirely, and the second one estimates the competitive effect but fails to account for endogeneity in FTA

decisions.

1.5.1 Probit model without strategic effect

In this part, I estimate the determinants of FTA formation while ignoring strategic interaction by estimating a simple probit model on the following reduced-form equation:

$$y_{ij} = 1\left[X_{ij}\beta_i^{'} + \epsilon_{ij}\right] > 0$$

Table 1.3 reports the parameter estimates and the standard errors of the determinants of FTA formation. Column (1) reports the estimation for China. Column (2) presents the results for the European Union. In column (3) are the results for Japan. And finally, the last column shows the estimation results for the US. The variables distance and GDP per capita have been standardized.

Table 1.3: Probit Results on FTA

	China	EU	Japan	USA
GDP per capita (log)	−0.162	0.177	0.016	0.288*
	(0.147)	(0.111)	(0.149)	(0.160)
Distance (log)	−0.547***	−0.846***	−0.438***	−0.180
	(0.137)	(0.146)	(0.130)	(0.121)
Common Language	6.013	1.156***		0.978***
	(230.529)	(0.271)		(0.324)
Constant	−1.432***	−0.713***	−1.560***	−1.945***
	(0.152)	(0.202)	(0.161)	(0.271)
N	183	177	177	183
Log Likelihood	-45.255	-92.534	-42.133	-49.975
Akaike Inf. Crit.	98.510	193.068	90.266	107.949

Notes: The table gives coefficient estimates from a probit model without strategic interaction. All variables (except for Common Language) are standardized. Standard errors in parentheses. *,**,*** denote significance at the 10%, 5%, 1% levels, respectively.

When ignoring strategic effect, GDP per capita is predicted to positively affect FTA forma-

tion decision for the EU, Japan and the USA, but negatively impacts that of China. This is expected because China usually signs FTA agreements with smaller surrounding countries, whereas the EU contains few leading economies such as Germany and France. However, the coefficients on GDP are not statistically significant for any country except for the US. The estimates for the distance effect are negative and significant for all big countries except for the US. Distance is predicted to reduce the probability of forming FTAs. According to Ethier (1998), neighboring countries tend to make more trade agreements since a regional arrangement is easier to negotiate. Common language fosters FTA formation and is statistically significant.

1.5.2 Probit model with strategic effects

To ensure comparibility with the equilibrium model, I add the strategic interdependence in FTA decisions to the above model. However, unlike the equilibrium model, I ignore both the endogeneity issues in the interaction and the possibility of multiple equilibria.

Table 1.4 reports the parameter estimates and standard errors by running a probit model on the following reduced-form equation:

$$y_{im} = 1\left[X_{ij}\beta_i^{'} + \sum_{k\neq i}\gamma_{ki}y_{kj} + \epsilon_{ij}\right] > 0$$

The main parameter of interests are the competitive effects. Other explanatory variables, namely GDP per capita and distance, are standardized as before.

Ignoring the endogeneity of strategic interdependence does not change the signs of GDP, distance and common language when I use a simple probit model. There is a small but positive effect of GDP in FTA formation for the EU, Japan and USA. This effect is only significant for the EU and the US. GDP displays a negative, but insignificant effect on China's FTA formation. Distance deters FTA formation for all countries, which conforms

Table 1.4: Probit Results with interaction

	China	EU	Japan	USA
GDP per capita (log)	−0.241	0.209*	0.139	0.292*
	(0.217)	(0.118)	(0.216)	(0.166)
Distance (log)	−0.542***	−0.781***	−0.002	−0.250*
	(0.173)	(0.156)	(0.178)	(0.129)
Common Language	5.446	1.144***		0.873***
	(337.519)	(0.282)		(0.336)
Strategic Interaction				
EU	−0.668		0.177	−0.131
	(0.456)		(0.492)	(0.309)
China		−1.002**	2.383***	0.616
		(0.501)	(0.555)	(0.474)
Japan	2.221***	0.453		0.509
	(0.614)	(0.653)		(0.529)
USA	1.183**	0.024	0.341	
	(0.476)	(0.367)	(0.522)	
Constant	−1.726***	−0.642***	−2.436***	−1.995***
	(0.279)	(0.215)	(0.428)	(0.326)
N	183	177	177	183
Akaike Inf. Crit.	71.975	194.306	63.620	107.408

Notes: The table gives coefficient estimates from a probit model without strategic interaction. All variables (except for Common Language) are standardized. Standard errors in parentheses. *,**,*** denote significance at the 10%, 5%, 1% levels, respectively.

to standard theory that predicts FTA formation within region. Moreover, all coefficients on distance are significant, except for that of Japan. Since a common language between two partners facilitates negotiation, I found a positive impact of this variable on FTA formation.

The main coefficients of interest lie in the bottom half of the table. When ignoring the endogeneity of the cross effect of FTA decisions, Table 1.4 shows that there can be competition or cooperation between big countries. The estimation confirms that the US and China compete strategically in terms of their FTA decisions. An FTA between China and some country j is predicted to increase the probability of the US and country j signing an FTA and vice versa. Nonetheless, the coefficient estimate on the US for China is significant, but the reverse is not true. Japan and China also exhibit a significant competition against each other in terms of FTA formation. The strategic interaction between the EU and the US goes only in one way, with the USA's decision to form an FTA positively affecting the decision of the EU to also have an FTA, but the reverse does not hold. However, both coefficients are insignificant.

1.5.3 Estimation of the equilibrium model

In this section, I estimate the equilibrium model in equation (1.8) by taking into account the endogeneity of strategic interactions, and the possibility of multiple equilibria. To compare the estimation of the model before and after China entered the World Trade Organization, I will present the results for both the year 2000 and the year 2012.

Table 1.5 reports the estimation results from the FTA data in 2012. It presents the 95% confidence region for the identified sets of each parameter. These confidence intervals, denoted by Θ_{95}, are calculated according to the methodology of Chernozhukov et al. (2007).

Most variables are statistically significant for the year 2012. In general, economic size positively impacts FTA formation for the EU, Japan and the US, but has a negative impact on the decision to form an FTA for China. The coefficient on GDP per capita is estimated to be in [-1.02, -0.93], [0.30, 0.38], [6.89, 6.98], [5.69, 5.76] for China, the EU, Japan and the US,

Table 1.5: Regression from the equilibrium model in 2012

	China	**EU**	**Japan**	**USA**
Economic Factors				
GDP per capita (log)	[-1.02, -0.93]	[0.30, 0.38]	[6.89, 6.98]	[5.69, 5.76]
Distance (log)	[0.37, 0.46]	[-2.13, -2.05]	[-4.71, -4.67]	[2.90, 2.99]
Common Language	[-0.50, -0.44]	[8.88, 8.96]	[-3.55, -3.47]	[-0.98, -0.89]
Strategic Interaction				
China		[1.24, 1.34]	[-2.24, -2.15]	[0.53, 0.62]
EU	[2.45, 2.54]		[3.02, 3.09]	[-0.14, -0.04]
Japan	[-4.52, -4.44]	[-2.63, -2.55]		[0.78, 0.87]
USA	[2.47, 2.55]	[-1.18, -1.10]	[-0.38, -0.29]	

Notes: The set estimates above contain 95% confidence region for the true parameters

respectively. Hence, all estimates are statistically significant and have the same sign as in both probit models seen earlier. However, the effect of GDP per capita is more pronounced for Japan and the US in the equilibrium model than in the probit models. Distance has different effects across big countries. Distance positively affects the FTA formation of China and the USA. The coefficients of distance are estimated to be in [0.37, 0.46] and [2.90, 2.99] for China and the US, respectively. Thus, the impacts of distance measured by the equilibrium model differ from that of the probit models for these two countries. However, the EU and Japan are more likely to form an FTA with neighboring countries with the coefficients on distance estimated to be in [-2.13, -2.05],[-4.71, -4.67], respectively. This result is influenced heavily by the EU, which is composed of neighboring countries in Western Europe

Our estimates of main interest lie in the bottom half of the table. The table reports the lowerbound and the upperbound measures of the degree of cooperation or competition between big countries regarding FTA formation. Generally, the data exhibits a pattern of cooperation between big countries that are considered traditional allies, and a pattern of competition among traditional rivals. For instance, the table reports that the US is more likely to form an FTA with countries with which China is also interested in having an FTA,

whereas the probability that the US forms an FTA with a country shrinks if the latter forms an FTA with the EU. Similarly, China is more likely to be interested in forming an FTA with countries that have an FTA with the US or the EU, and the effects of both the US and the EU on China's FTA decision are far greater than the other way around. However, the probabilities that the EU and Japan form an FTA with a country are predicted to be reduced when the US already has an FTA with that country. This is in contrast to what is reported when endogeneity is ignored. Earlier, the US had a positive effect on the FTA formation of all other big countries.

Table 1.6: Regression from the equilibrium model in 2000

	China	**EU**	**Japan**	**USA**
Economic Factors				
GDP per capita (log)	[1.98, 2.06]	[-0.46, -0.38]	[0.88, 0.97]	[1.02, 1.09]
Distance (log)	[-0.57, -0.47]	[0.74, 0.81]	[-1.20, -1.17]	[0.36, 0.45]
Common Language	[-0.21, -0.14]	[-0.65, -0.57]	[0.27, 0.36]	[0.11, 0.20]
Strategic Interaction				
China		[1.78, 1.87]	[-0.87, -0.78]	[0.63, 0.73]
EU	[1.25, 1.34]		[0.02, 0.10]	[-0.24, -0.14]
Japan	[-2.49, -2.43]	[-0.82, -0.75]		[-0.62, -0.53]
USA	[1.90, 1.98]	[-0.76, -0.69]	[-1.05, -0.97]	

Notes: The set estimates above contain 95% confidence region for the true parameters

Table 1.6 presents the results if the estimation of my equilibrium model for the year 2000. Most coefficients in Table 1.6, in particular the coefficients capturing strategic interaction, retain the same sign as those in Table 1.5. This result is in line with the argument that the strategic interaction between big countries started after the failure of Doha round and the ensuing multilateral negotiation. However, the estimates have a much smaller magnitude, showing that the degree of competition was not as intense as in 2012.

1.5.4 Marginal effects

Table 1.7 shows the marginal effect of a (one standard deviation) increase of each variable on the FTA formation of China, EU, Japan and USA, respectively. Following Ciliberto and Tamer (2009), I calculate the marginal effect as the largest change in the upperbound probabilities of the FTA structure where a big country formed an FTA with another country. These effects are obtained by increasing one variable at a time and estimating the model with this data. Then, for each entry structure, I calculate the mean of the upperbound across all the different countries. I also calculate the mean of the upperbound across countries at the value in the data. Finally, the marginal effects correspond to the largest difference between the two averages. In this case, the marginal effect is interpreted as the biggest average change in the likelihood of a big country forming an FTA with another country.

Table 1.7: Marginal Effects

Independent Variables	China	EU	Japan	USA
Economic Factors				
GDP per capita (log)	0.520	0.620	0.530	0.620
Distance (log)	0.030	0.003	-0.003	0.001
Common Language	0.001	-0.660	-0.060	-0.610
Strategic Interaction				
China	NA	-0.270	-0.260	0.270
EU	-0.005	NA	-0.005	-0.003
Japan	-0.002	-0.002	NA	-0.005
USA	-0.006	-0.006	-0.006	NA

Notes: The table reports marginal effects for each variable. Marginal effects are computed as the average change in upperbound probabilities when each variable is increased by one unit at a time.

The variable GDP per capita (standardized and in log form) has a positive marginal effects on all big countries. For China, there is one equilibrium structure where the likelihood that China formed an FTA with a country increases by 52 percentage points when I increase log of GDP per capita by one standard deviation. The biggest effect of this variable is on EU

and the USA with the likelihood to form an FTA increasing by 62 percentage points when I increase log of GDP per capita by one standard deviation. Increasing distance affects the big countries differently, with a positive effect on China, the EU and the USA, and a negative effect on Japan. Increasing distance (in log form) between China and another country by one standard deviation would result in a 3 percentage points increase in the overall likelihood of China having an FTA with that country. Common language negatively affects all countries but China.

I am particularly interested in the last four rows. They present the marginal effects of an entry of one big country on other big countries. As can be seen from the table, the entry of China into an FTA with another country has a positive marginal effect on the USA's FTA formation. This bolsters the competitive effects between the two economies, and in particular the increase of FTA formation between the US and some Asian economies.

1.5.5 The effect of the Trans-Pacific Partnership

The Trans-Pacific Partnership (TPP) was a huge free trade agreement signed in February 2016 by twelve countries (the US, Japan, Malaysia, Vietnam, Singapore, Brunei, Australia, New Zealand, Canada, Mexico, Chile, and Peru) in the Asia-Pacific region. The deal aimed to foster trade between members by slashing tariffs. The goal was to deepen economic ties between these twelve countries which are already responsible for about 40 percent of the world's economic output, and to create a fully integrated economic area. When the US withdrew from the agreement in January 2017, the other members formed (including Japan) a new agreement known as the Comprehensive and Progressive Trans-Pacific Partnership (CPTPP). Let us take a closer look at the TPP from the eyes of the big countries.

The TPP created some divides among Americans. Its detractors saw it as a deal favoring big businesses at the expense of manufacturing jobs and wages as it intensifies competition between the members' labor forces. For the proponents of the TPP, not only was it beneficial

from an economic stand point, but it also advances US strategic interests in the Asia-Pacific region where China is growing in influence. For instance, the Obama administration argued that the TPP would increase US exports and lower consumer prices because of the lower tariffs. On the strategic side of the equation, the same administration argued that the TPP provided the US with a trade deal and alliances with Japan, another big country. As a result, that would strengthen US leadership in Asia.

Using my model, I investigate whether the initial US interest in forming TPP with the other eleven members would affect the likelihood of other big countries forming an FTA with these countries. In particular, I would like to show whether my simulation predicts that China wants to strengthen its presence in the Asia-Pacific region by forming FTAs with some of these countries.

To account for the TPP effect, I augment the model with a TPP variable which is set to 1 if two countries are in the TPP and 0 otherwise. To obtain the effect, I estimate a model that includes the TPP variable along with all the other variables used in earlier models to obtain the bounds. Then for each market structure, I take the average of upperbound across markets. I redo the same step by setting the TPP variable to zero for the US. The result of this exercise is summarized in Table 1.8.

Table 1.8: Effect of the Trans-Pacific Partnership

Independent Variables	China	EU	Japan
TPP Effect	0.21	0.19	0.17

Notes: The table reports the average change in the upperbound probabilities if the US joined TPP

My model shows that the interest by the US in having the TPP with the other 11 countries causes the EU, Japan and China in particular to also want to have its own FTAs with these countries in general. For instance, my simulation indicates that on average, the US interest

in TPP increases the likelihood of China, the EU and Japan to forming an FTA with the other TPP members by 21, 19, and 17 percentage points, respectively.

My result still suggests that strategic interaction influences the FTA formation of the big countries. In fact, one could argue that as a result of the US interest in the TPP, starting with the Bush administration and continuing with the Obama's, China has pushed on signing the Regional Comprehensive Economic Partnership (RCEP) since 2012 with sixteen Asia-Pacific countries (including Australia, Japan, New Zealand, India and Republic of Korea). Moreover, China also launched the "Belt and Road Initiative" to develop infrastructure through Central Asia in order to bolster trade.

1.6 Conclusion

This article analyzes the determinants of FTA formation decisions by China, the EU, Japan and the US. I show that accounting for strategic interactions among big countries alters FTA formation in at least two ways. On the one hand, a small country can establish independent FTAs with two or more big countries; in other words, strategic interactions among FTA decisions could be positive. This new result could not be predicted by the existing literature although it is present in the data. On the other hand, introducing strategic interactions in the model creates an issue of multiple equilibria that needs to be accounted for in any empirical estimation. Consistent with my theoretical model, the estimation shows that strategic effects are statistically significant and can be positive or negative. In particular, big countries, such as the US and China, that are traditionally considered as "rivals", tend to display a positive interaction among their FTA decisions. As an example, China's having an FTA with a country increases the probability of the US having an FTA with that country by 27 percentage points. Moreover, I also show that using traditional estimation frameworks fails to account for multiple equilibria and the endogeneity of the strategic effects, and it results in a large degree of bias where the direction of the strategic interaction changes

entirely.

It is important to note that our results have a few shortcomings. The most important limitation is the assumption that unrelated FTAs are independent. For instance, I do not account for the effect that an FTA between the US and Mexico has on the FTA between Japan and India. Such dependence can be modeled through a network estimation, which is beyond the scope of the current literature due to both computational complexities and the difficulty of estimation. The second limitation is related to the use of a static game in my model. This assumption allows me to account for multiple equilibria and estimate the strategic interaction between multiple big countries, but my work can be complemented with a dynamic study on FTA formation, which models the fact that an FTA does not change dramatically from one year to the next one. In particular, countries do not sever links between them easily because FTAs agreed on in any year are likely to carry over to the following year.

Chapter 2

Delay in multilateral trade negotations

2.1 Introduction

The General Agreement on Tariffs and Trade (GATT) made international trade more open by overseeing 47 years of trade negotiation with eight successful rounds. Yet little is known about these rounds as all the data from each bilateral negotiation had been kept in secret, until recently. In 2016, the World Trade Organization (WTO) made public detailed records of most bilateral negotiations during eight rounds of the GATT. This article analyzes the determinants of delay/duration in a multilateral trade negotiation during the three earliest rounds of the GATT: Geneva, Annecy, and Torquay rounds.

Delay and duration have been studied thoroughly in the literature of bargaining, and economists have identified several reasons why delay occurs in a negotiation. One reason is imperfect information. In this case, bargaining delays occur because parties need more information to reduce uncertainty. Another reason is externality. Decisions between parties affect other nonparties, and the former cannot internalize all the benefits of the negotiation. In both cases, there is always a cost to delaying.

Yet there are various reasons why traditional models cannot explain the GATT's bargaining framework. First, traditional bargaining models are analyzed through many back-and-forth offers and counteroffers, whereas the GATT rounds did not have much of that feature according to Bagwell and Staiger (2017). Second, there was almost no cost of delaying in the GATT negotiations. Delay is costly in traditional bargaining model because the more a party waits in making a decision, the smaller the payoff gets because of a discounting factor. In a GATT negotiation model, the welfare for a country does not shrink because of the discounting factor. In fact, time discounts do not affect payoffs at all since the welfare resulting

from a particular tariff concession is realized only after the negotiation round ends. Third, a tariff bargaining within each GATT round was held between a pair of countries, but the outcome of the negotiation impacts other GATT members. Tariff concessions were extended to other GATT members even if these latter did not negotiate with either party during the round. That is a direct result of the Most-Favored-Nation (MFN) rule which stipulates that all GATT members should impose the same tariff schedule against one another. The GATT also calls for reciprocity to ensure that countries offer and receive similar concessions. All these features were not studied in traditional bargaining frameworks.

A major implication of these features is the possibility of a free-rider issue. In GATT's "multilateralized" system, countries have incentives to delay their negotiation in order to benefit from other outcomes without offering back any concessions. But there is a cost to that strategy: the possibility of a break down increases as negotiations are dragged on for longer periods of time. This begs the question: how long should countries delay their negotiations? This paper sheds some light on that question.

To get a better understanding of delay, I explain the origin as well as the foundational principles of the GATT. Tariff negotiations within the organization were based on a few key principles guiding the conduct of negotiations: they were the Most-Favored Nation (MFN) and the Reciprocity rules. After describing these principles, I talk about stylized facts about the GATT rounds. Bagwell et al. (2017) documented a series of stylized facts about the GATT round in Torquay. They find that there are a few back-and-forth offers and counteroffers. Tariff negotiations in Torquay focus on which products are offered to a particular country more than how much tariff cut is offered. Bagwell et al. find that "countries make counter-proposals by adjusting the set of tariff cuts they offer". They also find that "the biggest supplying countries play the dominant role in negotiations". This suggests that in the GATT's multilateral tariff negotiations, the big players negotiate and make a deal before other countries. As a result, I find that only a few pairs of countries

make a deal early in the round while most pairs delay their negotiations.

After these stylized facts, I establish a theoretical framework of tariff bargaining by building on the GATT rules. In particular, I focus on the role of externalities and the existence of deadline on negotiation delays in GATT rounds. I derive conditions under which delays occur in multilateral bargaining where negotiations are conducted between pairs of countries and where some information are private when a negotiation is on-going.

In this paper, I augment traditional models with network measures to explain why some GATT negotiations had delay while others did not. Because of the structure of each round, a tariff negotiation between a pair of countries cannot be studied independently from other negotiations. Moreover, Bagwell and Staiger argue that during the Torquay round, countries were changing their offers after the failure of the US-UK negotiation. All of these suggest that the decision of one pair of countries can affect that of others.

The purpose of this article is then to understand how peer effects alter the duration of a multilateral negotiation. I depart from previous works in one major way: I consider that GATT members involved in a particular round of negotiation form a network of negotiatiors where each country is considered as a node, and a link between nodes indicates countries engaged in tariff negotiation between one another. In doing so, I study not only the role of deadlines, but also spillovers or peer effects on the duration of each negotiation. First, deadlines might increase delay because they give GATT members windows to extend negotiations and reach an agreement only at the "eleventh hour". Second, delay also occurs because of peer effects which come in two forms: the importance of each pair, and the closeness between pairs. I show that there are countries whose negotiations are more important than others. These are the "central" countries in the network.

I compiled a newly unveiled data by the WTO in order to extract any information on the beginning and ending dates of negotiation, the identity of all parties involved for each GATT

round, etc. I estimate the effects of externalities in the entire negotiation with the network's centrality and distance measures for each pair of countries. In a network, centrality measures the importance of each country (node) relative to other countries (nodes). Distance measures the number of edges (paths) connecting two nodes. In this context, I assume that when a pair of countries meet, the duration of the negotiation depends on other countries that reached an outcome before them: how central these other countries are to the entire network (centrality), and how important these other countries are to that particular pair (distance).

This paper is structured as follows. Section 2 introduces previous works on the determinants of bargaining duration while lays out the hypotheses tested in later part. Section 3 talks about the history of GATT, its founding principles, and the bargaining protocols. Section 4 analyzes delay in GATT negotiation from a theoretical point of view. In section 5 I present the data by describing how I transcribed the data from WTO website and how I extracted the variables used for the estimation. Section 6 presents the estimation results.

2.2 Related literature

My work is related to various literature on bargaining delay and on trade negotiation. Bargaining delay has garnered attention from economists because the early literature that started with Rubinstein's work mostly predicts an immediate agreement. In general, the bargaining literature identifies factors such as incomplete information, bargaining externalities, and overconfidence or optimism as the main cause of delay in a negotiation.

Bargaining delays occur because each party in the negotiation has some private information that the other negotiating party does not have. In this case, delay is a strategic tool to uncover that private information. A common example of private information in this strand of literature is when players have private valuations of the object of negotiation. Some players can have a high valuation and others have a low valution of the good. Therefore, delays are used to separate the two types of players. Cramton (1991) uses that argument in his paper

by studying strategic delay in an infinite horizon alternating offer model. He argues that delays exist to learn players'valuations, and that less patient players want to settle early.

Fuchs and Skrzypacz (2012) also analyze delays in a dynamic bargaining setting with one-sided private information and a deadline. Delay emerges in their analysis because the seller can wait until the deadline and get the disagreement options. As a result, the seller keeps on making unacceptable offesr, but changes his strategy once the negotiation nears its end. This leads to more agreements taking place at the "eleventh hour".

Delay also arises in multilateral bargaining settings because of externalities. In this case, the underlying object can be thought of having a public good property. Jehiel and Moldovanu (1995) analyze the role of negative externalities in causing delay in a long, finitely repeated negotiation game, where a seller negotiates with many potential buyers. From the point of view of the seller, some buyers are more "attractive" than others and thus could be sold the object at a higher price because they suffer from higher negative externalities if they do not get the object. Therefore, the seller might wait to extract higher prices. But this strategy can be also costly because as the deadline approaches, the probability of selling to an unattractive buyer also increases. Gomes (2005) argues that delay may be present in a multilateral dynamic contracts with externalities when contracts may be renegotiated. In particular, a free-rider problem arises because agents wait on other players to form a coalition and enjoy the externalities resulting from this coalition.

Overconfidence and optimism also introduce delay in negotiations. Yildiz (2003) shows that optimism can generate delay in a finite horizon two-player negotiation game. Galasso (2010) studies negotiation with and without externalities between one seller and multiple buyers. He shows that without externalities, an overestimation of the likelihood of receiving an offer and that of the likelihood of making a great offer result in a delay. Similarly, the presence of high positive externalities induces the seller to delay the agreement to extract higher payoffs.

Like these papers, my article acknowledges the presence of delay in a negotiation. I identify externalities and deadline as playing a major role in trade bargaining. But there are other features of trade negotiations that are not explicitly studied in previous articles. In traditional bargaining models, the underlying object is usually indivisible. Thus, a player either owns or does not own the object at the end of the negotiation. Usually, the outside option is then not having the object. In GATT's tariff bargaining, the outside option can be of two types. In the worst-case scenario where no countries have made a deal, governments get the amount of trade liberalization they had before the round. But in most cases, some pairs struck a deal. Because of the Most-Favored-Nation (MFN) principle that I explain in detail in the next section, GATT members would benefit from tariff concessions that they did not directly negotiate. As a result, the outside option is no longer the previous tariffs but the negotiated ones. There are then incentives for every participating countries to delay and "free ride" any deal. An implication of this observation is that the externality is dependent on which pair of countries are having a deal. Externalities that are dependent on the identity of the participants are not fully explored in traditional bargaining model.

Another feature is the multilateral characters of the GATT rounds. In a traditional multilateral bargaining, the negotiations are usually between one seller and several potential buyers. In the GATT rounds, there are several sellers as well as several buyers of tariff cuts. Multiple countries are exporting the same product in a market and are therefore all interested in this product's tariff. As a result, each bilateral negotiation cannot be analyzed independently of other negotiations. Since outcomes might be interdependent, the negotiation game should be studied in a network structure to catch all the subtleties of the relationships between bilateral negotiations. This is not found in most traditional bargaining literature.

My article follows other empirical studies of bargaining delay in trade negotiations. Moser and Rose (2012) study the duration of 88 regional trade agreements and find that a negotiation takes less time when there are fewer participants at the negotiation table, or when

negotiations are between richer countries. Fearon (1998) argues that the presence of intergovernmental organizations reduces delay in a negotation because it provides more structure to the negotiation. For instance, these organizations enforce the bargaining rules such as who can make an offer and when. Moreover, as Young observes, international organizations also reduce transactional costs by structuring the negotiation agendas and by assisting in the formulation of negotiating texts. Simonelli (2011) provides an empirical study of duration with a focus on the role of intergovernmental and nongovernmetal organzations. She finds that these organizations affect the length of negotiations in various ways: an involvement of intergovernmental organization makes the bargaining longer for security-related agreements, but shorter for non-security agreement.

Although the articles above help understand delay in trade bargaining from a general perspective, they did not study GATT/WTO rounds which had the bilateral/multilateral feature and which potentially induce a free-rider problem. Because of the Most-Favored Nation, a GATT member should impose the same tariff on all of its imported goods, irrespective of their sources. Therefore, in a tariff negotiation, a potential externality might exist for countries that do not directly participate in the negotiation, thus the free-rider problem.

Economists were divided on this MFN free-rider problem. On one hand, several authors established the existence of the free-rider issue. Among them are Caplin and Krishna (1988) who argue that MFN tariff reductions by the participants of a negotiation improve the terms of trade of non-participants, resulting in many countries not fully participating in tariff negotiation.

Ludema and Mayda (2009) also provide a theory-based evidence of this issue. I will explain their model to grasp the extent of the problem. Suppose N countries are exporting to the domestic country, denoted by country 0, and all of them are WTO members. Governments maximize a weighted social welfare given by the sum of consumer surplus, producer surplus. A tariff revenue enters the welfare function only for the domestic country. The welfare is

denoted by w_0 and w_i with $i = 1, ..., N$ for the domestic country and the exporters, respectively. A tariff negotiation between the domestic country and its trading partners consists of finding the reduction of domestic tariff τ in exchange of transfers $t = (t_1, ..., t_N)$ from the foreign countries. Ludema and Mayda impose two restrictions: (i) that any country may withdraw from negotiations, which they called as voluntary participation; and (ii) that the agreed tariff maximizes the joint welfare of all participating countries. Let $A \subseteq N$ be the set of the participating countries in the set of all exporting countries. The negotiated tariff $\tau^n(A)$ that maximizes $w_0(\tau) + \sum_{i \in A} w_i(\tau)$ decreases with the cumulative market share of the participating exporters, $\Theta_A \equiv \sum_{i \in A} \theta_i$.

Moreover, the domestic country agrees to reduce its tariff if the sum of the transfers and the welfare under the new tariff exceeds the welfare under the unilaterally optimal tariff $\bar{\tau}$, i.e.:

$$w_0(\tau^n(A)) + \sum_{i \in A} t_i \geq w_0(\bar{\tau})$$

Similarly, an exporter i participates in the negotiation if what it pays as a transfer is less than what it gets by participating instead of free riding, or

$$t_i \leq w_i(\tau^n(A)) - w_i(\tau^n(A|i))$$

Together, the two equations above determine that in equilibrium the set of participants A should satisfy:

$$\Omega(A) = \sum_{i \in A} w_i(\tau^n(A)) - w_i(\tau^n(A|i)) - [w_0(\bar{\tau}) - w_0(\tau^n(A))] \geq 0$$

Ludema and Mayda argue that the free-rider problem exists because the set of participants A can be restricted to only exporters above a certain size. Let x be a critical exporter such that the size $\theta_i \geq \theta_x$ for the participating countries, and $\theta_i \leq \theta_x$ for nonparticipating countries. The

authors show that there exists x such that tariff can be reduced while satisfying $\Omega(x) \geq 0$. In other words, only exporters with a certain size participate in the negotiation, and the extent of the tariff cut is decreasing with the cumulative size of the participating exporters. This is in essence the free-rider problem.

On the other hand, some economists are skeptical about the existence of a free-rider issue in multilateral negotiations and argue that any potential externality is internalized through the multilateral structure of any GATT/WTO negotiation. Earlier, the problem exists because the terms of trade change when import tariffs decrease. Instead, Bagwell and Staiger (1999) use a general equilibrium framework to introduce the idea of reciprocity as the mutual changes in trade policy that bring about equal changes in import volumes across trading partners. One major implication of this is that the GATT's principle of reciprocity leaves the world prices unchanged. Bagwell and Staiger (2017) show that under multilateral reciprocity, simultaneous negotiations (such as that of GATT) can result in tariff reductions leaving the world price unchanged. As a result, tariff reductions do not give rise to a free-rider problem. Let us sketch Bagwell and Staiger's arguments below, starting with two countries and expanding with three countries.

Assume domestic and foreign ($*$) countries trade two goods. The domestic (foreign) market imports x (y). The local relative price facing the domestic (foreign) producers and consumers is $p \equiv \frac{p_x}{p_y}$ ($p^* \equiv \frac{p_x^*}{p_y^*}$). The domestic (foreign) non-prohibitive tariffs are presented by t (t^*). Let $\tau \equiv (1+t)$ and $\tau^* \equiv (1+t^*)$, then prices can be written as $p = \tau p^w \equiv p(\tau, p^w)$ and $p^* = \frac{p^w}{\tau^*} \equiv p^*(\tau^*, p^w)$, where $p^w \equiv \frac{p_x^*}{p_y}$ is the world relative price. In each country, production depends on the local relative price; consumption is determined by both local relative price and tariff revenue which is distributed as a lump sum to consumers. Therefore, for the domestic country, the production is $Q_i = Q_i(p)$ for $i \in \{x, y\}$, consumption is $D_i = D_i(p, R)$ where $R = [D_x(p, R) - Q_x(p)][p - p^w]$. In other words, all variables are influenced by the local relative price p and the world price p^w. The foreign production, consumption and tariff revenue

can also be defined analoguosly. Similarly, domestic imports $M(p,p^w)$ and exports $E(p,p^w)$ can be defined as a function of these two parameters, where $M(p,p^w) \equiv C_x(p,p^w) - Q_x(p)$ and $E(p,p^w) \equiv Q_y(p) - C_y(p,p^w)$. Likewise, we can write foreign imports and exports as $M^*(p^*,p^w)$ and $E^*(p^*,p^w)$, respectively. The equilibrium world price, $\tilde{p}^w(\tau,\tau^*)$ is determined by market clearing conditions that domestic export is equal to foreign import. This means that welfare, which is the sum of consumer surplus, producer surplus and tariff revenue, can be written as a function of p (p^*) and $\tilde{p}^w$, i.e. domestic and foreign welfare functions are $W(p,\tilde{p}^w)$ and $W^*(p^*,\tilde{p}^w)$, respectively.

Let us review how reciprocity and MFN get rid of third-party externalities. First, the terms of trade theory posits that holding local price fixed, each government likes when its terms of trade improve, i.e. $W_{\tilde{p}^w} < 0$ and $W^*_{\tilde{p}^w} > 0$.

Suppose that at the beginning of the bargaining, the initial pair of tariffs, (τ^0,τ^{*0}), is exogenous. The resulting world and domestic local pries are $\tilde{p}^{w0} \equiv \tilde{p}^w(\tau^0,\tau^{*0})$ and $p^0 \equiv p(\tau^0,\tilde{p}^{w0})$, respectively. Suppose further that the negotiation results in a new pair of tariffs, (τ^1,τ^{*1}) which yield in the new world and domestic local prices $\tilde{p}^{w1} \equiv \tilde{p}^w(\tau^1,\tau^{*1})$ and $p^1 \equiv p(\tau^1,\tilde{p}^{w1})$, respectively.

According to Bagwell and Staiger (2010), the principle of reciprocity requires that the ideal mutual changes in trade policy bring about changes in the volume of each country's imports that are equal in magnitude to the changes in the volume of its exports. In other words, the new tariffs respect the principle of reciprocity when:

$$\tilde{p}^{w0}[M(p^1,\tilde{p}^{w1}) - M(p^0,\tilde{p}^{w0})] = [E(p^1,\tilde{p}^{w1} - E(p^0,\tilde{p}^{w0}))]$$

Using the balanced trade condition, the equation above can be written as:

$$[\tilde{p}^{w1} - \tilde{p}^{w0}]M(p^1,\tilde{p}^{w1}) = 0$$

This says that changes in tariffs that conform to the principle of reciprocity will leave the world price unchanged.

To understand how reciprocity coupled with MFN eliminates the free-rider issue in Bagwell and Staiger, let us move to a three-country model. Everything is defined as before, but now the domestic country exports good y to foreign countries $*1$ and $*2$ and imports good x from each of them. Suppose that the domestic country applies two tariffs τ^1 and τ^2 to the imports from countries $*1$ and $*2$, respectively. Then there should be also two separate world prices p^{w1} and p^{w2} that apply to these countries. Recall that the domestic local price is $p = \tau^1 p^{w1}$ and $p = \tau^2 p^{w2}$. The MFN rule requires that the domestic country imposes the same tariff on both exporters, i.e. $\tau^1 = \tau^2$. Given the same price p, it follows that $p^{w1} = p^{w2}$, therefore the welfare function of each country still depends on only two parameters: its local relative price and the world price. In particular, the welfare for foreign country 2 is $W^{*2}(p^{*2}, \bar{p}^w)$.

Now, suppose that domestic and foreign country 1 decide to make a reciprocal reduction in their tariffs τ and τ^{*1}, whereas foreign country 2 leaves its tariff τ^{*2} unaltered. Since the negotiation respects the reciprocity rule, then it also leaves the terms of trade $\tilde{p}^w(\tau, \tau^{*1}, \tau^{*2})$ unchanged. As a result $p^{*2} = \frac{p^w}{\tau^{*2}}$ is also fixed. Thus, $W^{*2}(p^{*2}, \tilde{p}^w)$ also remains unaltered. Therefore, according to Bagwell and Staiger any tariff negotiation that respects MFN and reciprocity does not generate a spillover for the non-participating country.

More recently, Zeng (2018) extends the work of Bagwell and Staiger by empirically analyzing the role of externalities in bargaining delay. Zeng has two conclusions on delay. First, the delay between the first offer and the second offer, and the delay between the first offer and the final agreement decrease with the exporter market concentration in the importing market. His main argument relies on private information about political pressure: in order to signal whether it faces high or low political pressure, an exporter delays in making an offer. Second, the delay until the initial exporter makes an offer first increases then decreases with the exporter's market concentration.

My article extends Zeng's paper by focusing on the data on GATT rounds. However, I differentiate from his article in two main ways. First, I measure delay as the time between the beginning of the round and the end of a bilateral negotiation. Negotiations are supposed to start on the same date, the beginning of the round. The reason why some countries are delaying their offer or their agreement is mainly to see what is done by other countries. In particular, since the information on each offer and counteroffer within a particular bilateral negotiation is held secret until the pair reaches an agreement, countries have incentives to delay. As is stated by Bagwell et al. (2017), many countries were expecting that the U.S. would be successful in getting rid of the UK Preferential Trade Agreements with its Commonwealth partners. As a result, many other countries were waiting on this bilateral negotiations, and changed their offer once US-UK negotiations failed. Second, I analyze three rounds of GATT instead of only focusing on Torquay. For Bagwell et al. and Zeng, analyzing the round in Torquay was important as that gives a detailed look of that round. In fact, Bagwell et al. were able to derive stylized facts that characterize the Torquay round from this data. However, studying delay in GATT's tariff negotiation should be more general because the Torquay round might have been heavily influenced by the US and the UK negotiation.

Finally, my work is also related to literature that incorporates network statistics to measure externalities. In particular, Nakajima (2007) estimates peer effects on smoking behaviour and identifies the presence of positive peer effects in his model. Lin and Xu (2017) uses centrality measures to identify the role of social interactions in a large network model.

2.3 The General Agreement on Tariffs and Trade (GATT)

Since its inception in 1947, the GATT has reshaped international trade in different ways: it lowered various barriers to trade, and 150 countries are now members of the World Trade Organization (WTO), the successor of the GATT, to keep on making trade freer.

2.3.1 History of the GATT

The GATT was created in response to the increasing trade barriers that plagued the international trade in the 1920s and 1930s. After World War I, many countries around the world had increased their trade barriers. The greatest reminder of the bad consequences of protectionism was the U.S. imposition of the Smoot-Hawley Tariff Act in 1930. During that time, the U.S. average tariffs increased from 38 percent to 52 percent. As a retaliation, general tariffs around the world were around 50 percent.

To reverse this trend in protectionism, various countries convened together to restructure trade-policy and bring dialogue back. As a result, multilateral meetings such as the World Economic Conference in 1927 were held. However, these attempts were unsuccessful because of the absence of a clear structure under which to conduct a multilateral negotiation: governments needed rules that should ensure cooperation while enforcing compliance and punishing deviants.

Therefore, only bilateral trade agreements blossomed during the interwar period. In particular, the U.S. implemented the Reciprocal Trade Agreement Act in 1934. This agreement was characterized by two important rules that ensured its success: (i) the U.S. offered a tariff reduction to other members in exchange for reciprocal import tariff reduction from them; (ii) the lowered tariffs would extend to all U.S. partners to which it had given Most Favored Nation (MFN) status, i.e. tariffs should be applied without discrimination. This agreement meant that the U.S. were able to restore cooperation with its partners. Satisfied with the result of the agreement itself, the U.S. wanted to create a multilateral institution and include more countries.

At the end of World War II, 23 countries[1] negotiated the General Agreement on Tariffs and

[1]These 23 countries were Australia, Belgium, Brazil, Burma (Myanmar), Canada, Ceylon (Sri Lanka), Chile, China, Cuba, Czechoslovakia, France, India, Lebanon, Luxembourg, Netherlands, New Zealand, Norway, Pakistan, South Africa, Southern Rhodesia (Zimbabwe), Syria, the U.K., and the U.S.

Trade.

2.3.2 Principles of the GATT

From the first round of tariff negotiation in 1947 to the creation of the WTO in 1994, the GATT was successful in two important ways. First, over the course of 47 years, the GATT had successfully gathered countries around eight rounds of negotiation to reduce import tariffs imposed on one another. The GATT had been attracting more participating countries than any other multilateral event over several years: 128 countries participated in the last official GATT round, the Uruguay Round, whereas the first round, held in Geneva, only had 23 members. There are various reasons to that. For example, most country found that the spike in tariffs during the interwar period was not beneficial and needed to change. But the fundamental difference between the GATT and any previous attempts at trade negotiation was the protection that the GATT provided to its members in case of a deviation from agreements. That protection came from the principles that guided the GATT, which I am talking about in detail in the next section. But in essence, the GATT gave countries the power to retaliate or renegotiate any previous commitment, which have made GATT members more willing to cut their tariffs down. As a result, the GATT was able to significantly reduce tariff barriers. We talked about the consequences of the U.S. Smoot Hawley tariff imposition and the retaliatory responses from other countries where tariff spiked above 50 percent. However, after eight rounds of negotiation, the average ad-valorem tariff had decreased to less than 4 percent.

Second, negotiations under the GATT had expanded from being solely focused on goods during the first five rounds to including other items such as services and intellectual property at the Uruguay Round. For instance, antidumping measures were included in the Kennedy round. Nontariff measures took an important place in subsequent negotiations such as the Tokyo and Uruguay rounds. These steps laid the foundation for the creation of the World

Trade Organization in 1994. Table 2.1 summarizes all the GATT rounds as well as the main subjects covered in each one of them.

Table 2.1: GATT Rounds of Tariff Negotiation

Year	**Round**	**Subjects**	**Members**
1947	Geneva	Tariffs	23
1949	Annecy	Tariffs	13
1951	Torquay	Tariffs	38
1956	Geneva	Tariffs	26
1960-61	Dillon Round	Tariffs	26
1964-67	Kennedy Round	Tariffs and antidumping	62
1973-79	Tokyo Round	Tariffs, nontariff measures, framework agreements	102
1986-94	Uruguay Round	Tariffs, nontariff measures, services, intellectual property, dispute settlement, textiles, agriculture	128

Source: WTO website

To understand how the GATT was so successful where other multilateral negotiations had failed, one needs to study the principles upon which it was built. Note first that according to Bagwell and Staiger, the GATT was never created to achieve a global free trade.

In fact, the GATT had relied on two fundamental principles to conduct negotiations and dispute settlement.

2.3.2.1 Principle of reciprocity

Reciprocity is one of the key foundations of multilateral negotation within the GATT rounds. Unlike any previous attempt at multilateral tariff negotiation, the GATT allowed countries to retract from previously commitment because its members thought that governments were more likely open to negotiations and generous in their commitment if they were allowed to back off from their prior commitments when external circumstances change.

There are two cases under which reciprocity can be applied. In the first case, a country might want to raise its import tariff to a level higher than the "bound" that it agreed during previous negotiation. Even if this could be legal because of change in national circumstances, it would adversely affect this country's trading partner. Consequently, adversely affected trading partners are permitted by the GATT/WTO to review all previous commitments, which can be accomplished in two ways. First, adversely affected trading partners are permitted to ask for liberalization in other areas of interest if they exist. Second, adversely affected trading partners could also increase some of their tariffs above the "bound" so as to rebalance market access.

In the second case, reciprocity can be invoked in dispute settlements. Sometimes, a country does not respect its previous commitment in a way that is not following the GATT's legal procedures. Adversely affected trading partners could then ask for compensation to rebalance the deal.

Note that reciprocity is not identified as a foundational principle of GATT. However, it is mentioned in various parts of the GATT's articles.

2.3.2.2 Principle of nondiscrimination

The nondiscrimination principle gives the multilateral characteristic of negotiations under the GATT. Because of this rule, countries in negotiation have to extend concessions to all other GATT members, even if the latter did not actively participate in the negotiation. But because of this rule, tariff negotiations potentially engender externalities to non-negotiating parties, which might cause delay in tariff negotiations. The principle of nondiscrimination is embodied by the Most-Favored-Nation (MFN) treatment rule.

The MFN treatment specifies that goods from all GATT members should be treated equally irrespective of its sources. Note that GATT tariff negotiations were held bilateraly between two contracting parties. However, once they agreed with each other to commit to lowering its

tariff, the agreement was "multilateralized". This means that the same terms of agreement, the same lower tariff will be granted to all other GATT members on a nondiscriminatory basis, even if these other countries did not directly participate in the initial bilateral negotiation. For instance, when the US and France negotiate to lower their tariffs, all the other members will benefit from their deal. That is the essence of the MFN principle and the biggest reason why countries would want to become a member of the GATT/WTO. The MFN principle provides one GATT member with the assurance that its exported goods will receive the same treatment available to any other GATT member.

Nevertheless, there are exceptions to this nondiscrimination principle, and they are specified by the article XXIV of the GATT. In essence, this article permits the GATT members to sign side agreements between one another to further their integration. In particular, the article allows preferential trade agreements (PTAs) between members where the signatories of these agreements commit to lower-than-MFN tariff rates between them. In this case, PTA members enjoy lower tariff rates while the rest of the GATT members are subject to the MFN tariffs. A common example of PTAs is a free trade area such as the North American Free Trade Agreement where goods produced in Canada, the US or Mexico freely circulate in all three countries, whereas other foreign exporters pay for import tariffs to sell in those markets.

2.3.3 The GATT's bargaining protocols

Now that the governing principles of the GATT were laid out, this section talks in detail about how the negotiating rounds were conducted. Note that all GATT rounds did not follow the same protocol. In particular, the first five GATT rounds as well as the Uruguay round were based on an item-by-item request and offer method of tariff negotiations. The other rounds of GATT followed a different procedure where tariff reductions were calculated according to formulas. I will talk about only the first type of negotiation because this paper

focuses on the first three rounds of GATT. Here is the summary of the protocol for the first round of the GATT held in Geneva:

1. Each country submits to its partners a list of requests on the tariffs it is asking concessions.

2. Then each country submits a list of offers that details the concessions it is willing to give

3. Each pair of countries directly negotiate over their requests and offers.

Before the start of a round, countries were required to provide other members with their latest custom tariffs and foreign trade statistics. In order to prevent countries from manipulating their tariffs prior to a bargaining round, a base date is specified for the calculations of the tariffs that existed prior to the first meeting.

At the same time, each participating country submits their requests to their partners. These requests contain the list of products as well as the corresponding tariff cuts a country asks from another member. As explained in the GATT protocols of negotiation, these lists were made public for all participating governments and were therefore public information. After that, meetings were held in secret between each pair.

At the start of a round, countries were submitting their offer lists to let their negotiating partners know which items from their imports they are willing to negotiate on along with the tariffs offered for these items. Here, the Principal Supplier rule helps determine which country can request a negotiation session (by sending its offer list) with which country. According to Bagwell and Staiger, the protocol of the initial GATT round held in Geneva specified that "any product of which a participating country supplied a principal part of the total imports of this product should be expected to be available for negotiation". Although this definition of principal supplier was vague, it did note that the principal supplier of a product could be several countries altogether. The information in this stage are not public

because they are exchanged between each negotiating pair.

After requests and offers were exchanged and negotiations started, countries were secretly meeting in pair to conduct the bilateral tariff negotiation. The back-and-forth offers and counteroffers in each bilateral negotiation were also kept secret to other countries outside the negotiating pair.When a bilateral negotiation was finished, the resulting agreement (in case there is one) was transmitted to the GATT Secretariat that made it publicly known.

In later GATT rounds, the protocols have evolved with changes about the information made public. For example, in Annecy round, the initial offers were shared among all participants, although that was not the case for Geneva.

2.3.4 Stylized facts

Bagwell et al. (2017) offered eight stylized facts on tariff negotiation. The features of trade negotiation they described are insightful and help understand various characteristics of the GATT's trade bargaining that makes it different from traditional trade bargaining. However, the authors focus solely on the Torquay round, in general and on the US negotiations, in particular. In this section, I will present a more general stylized facts that are based on the data on the first three rounds of the GATT.

Fact 1: There are smaller numbers of back-and-forth offers and counteroffers

Note that the back-and-forth offers and counteroffers refer to the modification of offers or requests that one country sent to its negotiating partner. While each negotiation round lasted for at least a few months, the number of offers and counteroffers for each pair of countries is limited. An interpretation given by Bagwell et al. (2017) is that the initial requests and offers already contained the right elements, but countries waited on other pairs to settle first. This feature is a direct result of the multilateral character of the GATT tariff negotiation. It also suggests that there is an order to reaching an agreement. Countries are making the outcome of their negotiation conditional on "important" other pairs having a deal. I will

describe later what "important" countries mean in a multilateral trade negotiation where bilateral decisions are interdependent.

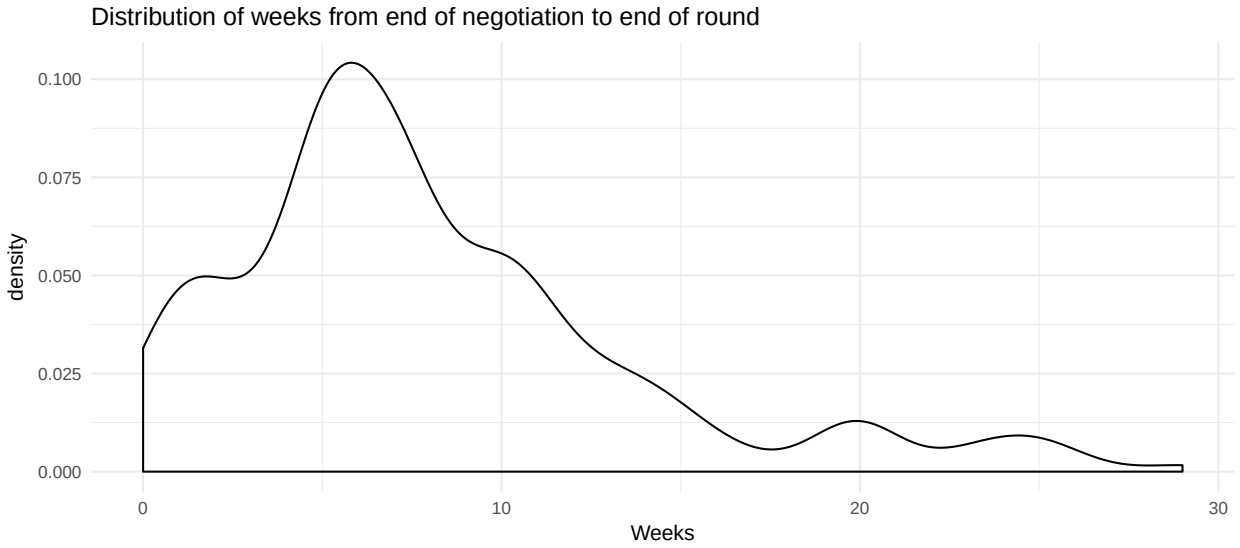

Figure 2.1: Distribution of duration, all rounds combined

Fact 2: Most pairs of countries settle right before the end of a round.

Figure 2.1 shows the distribution of weeks from the end of a negotiation until the end of the round to which the negotiation belongs. In general, most negotation ends around 5 weeks before the end of the corresponding round. And few negotiations settle right at the end of the round. What is the cause of this delay in such a multilateral bargaining setting? My paper argues that both the deadline and spillover effects are the main factors driving this trend.

2.4 A model of peer effects in the GATT negotiation

2.4.1 A theoretical model

This paper delves into the role of peer externalities on tariff negotiation. In particular, I want to uncover the relationship between settled and ongoing negotiations within a multilateral trade bargaining framework such as the GATT rounds.

In the Torquay round, one of the most important negotiations was the bilateral bargaining between the US and the UK (with a number of its Commonwealth partners). According to Bagwell et al.[2], countries were expecting a deal between the US and UK and were "counting on indirect trade benefits from the MFN tariff cuts negotiated between third parties". Once this negotiation failed, the author found that negotiating partners were adjusting their offers to the US. This discussion suggests that for some countries, delay can be a strategic tool to observe the results of other important negotiations because they are counting on the externalities from these important negotiations. To see this, let us look at an example of a negotiation with three rounds.

2.4.1.1 A motivating example

Consider a game consisting of 3 rounds between three countries: X, Y, and Z. Negotiations are held only between Z and X on one hand, and Y and X on the other hand. Before negotiations start, X selects its first partner. This choice is important because it determines which partner will have the chance to decide at the last round T=3. Without loss of generality, say country Z has been chosen as the first partner that X negotiates with first.

At round 1, X makes an offer to Z. Z can either agree or not, but with probability δ_Z the negotiation can fall apart. If Z agrees the game ends with the proposed tariffs and proposed welfare. Otherwise, the game moves to round 2, where X negotiates with Y, and with probability δ_Y their negotiation can fail. Similarly, Y can either agree or not. In the

[2]"Multilateral Trade Bargaining: A first look at the GATT bargaining records"

first case, the negotiation between Y and X ends. In the second case, the game moves to the last round where X negotiates with Z again. This time, negotiations will end whether there is an agreement or not.

The ***subgame perfect Nash equilibrium (SPNE)*** of the finite horizon game above can be obtained by backward induction.

In the last round, Z makes a decision. Let us denote by $w_i^{D_Z D_Y}$ the welfare of country $i \in \{Z,Y\}$ if Z makes a decision D_Z and Y makes a decision D_Y if i settles last, and by $\tilde{w}_i^{D_Z D_Y}$ a corresponding welfare if i accepts an offer first. Then in the last round T, the decision of Y is known. If Y accepted an offer, the expected welfare for Z is $V_Z^3(w^A) = \delta_Z w_Z^{NA} + (1-\delta_Z) w_Z^{AA}$. If Y did not accept an offer, Z's expected welfare is $V_Z^3(w^R) = \delta_Z w_Z^{NN} + (1-\delta_Z) w_Z^{AN}$.

In round 2, Y is making the decision. Both X and Y know that if Y does not accept the offer, then their negotiation fails and Y's expected welfare is $V_Y^3(w^R) = \delta_Z w_Y^{NN} + (1-\delta_Z) w_Y^{AN}$. So Y's best strategy in round 2 is to accept any offer $w_Y^2 \geq V_Y^3(w^R)$. At the same time, accepting an offer w_Y^2 means $w_Y^2 = \delta_Z \tilde{w}_Y^{NA} + (1-\delta_Z) \tilde{w}_Y^{AA}$.

This means that Y rejects the offer if:

$$\delta_Z \tilde{w}_Y^{NA} + (1-\delta_Z) \tilde{w}_Y^{AA} < \delta_Z w_Y^{NN} + (1-\delta_Z) w_Y^{AN}$$

Delay then occurs because the expected welfare when Y is the first mover is less than the expected welfare when it is a second mover.

Suppose that $\delta_Z = 0$, i.e. the negotiation between Z and X always succeeds, then if $\tilde{w}_Y^{AA} < w_Y^{AN}$, then delaying is better. Suppose that $\delta_Z = 1$ or the negotiation between Z and X always fails, then delaying is better if $\tilde{w_Y}^{NA} < w_Y^{NN}$.

In round 1, Z is making the decision. If it accepts an offer, its expected welfare is equal to $\delta_Y \tilde{w}_Z^{AN} + (1-\delta_Y) \tilde{w}_Z^{AA}$. If Z delays, then with probability δ_Y it receives $V_Z^3(w^R)$ and with

probability $1-\delta_Y$ its expected welfare is $V_Z^3(w^A)$. Z's strategy is then to refuse any offer such that:

$$\delta_Y \tilde{w}_Z^{AN} + (1-\delta_Y)\tilde{w}_Z^{AA} < \delta_Y V_Z^3(w^R) + (1-\delta_Y)V_Z^3(w^A)$$

If Y always accepts an offer ($\delta_Y = 0$), there is a second-mover advantage for Z if $\tilde{w}_Z^{AA} < \delta_Z w_Z^{NA} + (1-\delta_Z)w_Z^{AA}$. Similarly, if Y always rejects a deal ($\delta_Y = 0$) then it is best to make a decision after Y if $\tilde{w}_Z^{AN} < \delta_Z w_Z^{NN} + (1-\delta_Z)w_Z^{AN}$.

These equations show that a second-mover advantage is possible for some countries. In that case, it is profitable to delay the negotiation and wait for the other country to settle first.

2.4.1.2 Model

In this section, I present a model of trade negotiations that is based on the GATT procedures and principles (such as the MFN principles, bilateral negotiations within a multilateral round, etc.).

I consider a transferable-utility tariff negotiation game between three countries: X, Y, and Z. For simplicity, I am focusing on the negotiations between X and Y, and X and Z, and on the impact of one negotiation on the other. The negotiation has three stages. In the first stage, the leader decides the order of negotiation, that is which country it is first going to negotiate with, and which country comes second in the negotiation. Without loss of generality, I assume that country X is the leader such that it decides whether the sequence of negotiation is YZ or ZY. In the first case, X negotiates with Y before Z, and in the second case, X negotiates with Z first.

Once the order of negotiation has been decided, the second stage is the actual tariff bargaining between countries. This stage consists of deciding the payoffs that X offers its partner in exchange of tariff concessions.

In the final stage, the negotiating partners decide of the level of tariff concessions. The GATT wants to reduce tarif levels so I assume that the agreed tariff concessions maximize the aggregate welfare of countries participating in the negotiation. This follows the negotiation framework by Ludema and Mayda (2013). Moreover, I apply the MFN principle of GATT, so any agreed concessions will have an impact on subsequent negotiations. For example, if the sequence of negotiation is YZ, then any tariff level outcome for X and Y will be taken into account in the negotiation between X and Z. This negotiation game can be solved backwards.

2.4.1.3 Welfare and tariff

For any country $i \in \{X, Y, Z\}$, let τ_{ik}, p_{ik}, p^*_{ik} represent the MFN tariff, the domestic price, and the world price of good k in country i. The welfare that country i gets from importing and exporting good k is obtained by:

$$w_{ik} = s_{ik}(p_{ik}) + \pi_{ik}(p_{ik}) + \sum_{j \neq i} \pi_{jk}(p^*_{jk}) + (p_{ik} - p^*_{ik}) M_{ik}(p_{ik})$$

where s_{ik} is the consumer surplus, π_{jk} is the producer surplus from the export of good k to country j, M_{ik} is the total imports of good k. The total welfare of country i is then $W_i \equiv \sum_k w_{ik}(p_{ik}, p^*_{jk})$.

Note that $p^*_{jk} \equiv p^*_{jk}(\tau_{jk})$ and $p_{ik} = \tau_{ik} p^*_{ik}$, then the total welfare can be written as $W_i \equiv W_i(\tau_i, \tau_j)$, where τ_i is the vector of tariffs in country i, and τ_j is defined analogously.

The initial tariff levels are denoted by $(\tau^0_x, \tau^0_y, \tau^0_z)$. The corresponding payoffs for countries X, Y, and Z are w^0_x, w^0_y, and w^0_z, respectively.

Countries then bilaterally meet to grant reciprocal tariff reductions to one another. As mentionned earlier, tariff concessions within GATT are obtained by maximizing the aggregate welfare of countries involved in the negotiation. For instance, countries i and $j \neq i$ negotiate (τ_i, τ_j) that maximize $W_{ij}(\tau_i, \tau_j, \tau_k) \equiv w_i(\tau_i, \tau_j, \tau_k) + w_j(\tau_i, \tau_j, \tau_k)$.

2.4.1.4 Negotiation

In this section I characterize the equilibria of tariff negotiations between X and Y on one hand, and X and Z on the other.

First, consider the case where X picks Y first. In this stage, if tariffs were reduced from their initial levels (τ_x^0, τ_y^0) to (τ_x^1, τ_y^1), country X has to offer country Y at least w_y^0 for Y to accept the offer because if the negotiation does not succeed, tariffs stay at their initial levels, resulting in the old welfare w_y^0 for Y. If the subsequent negotiation between X and Z does not go through, X's welfare is then $w_{xy}(\tau_x^1, \tau_y^1, \tau_z^0) - w_y^0$.

Next consider the subgame between X and Z. When X approaches Z, the results of the negotiation between X and Y are already public knowledge. Therefore in case of a negotiation breakdown between X and Z, the outside options are $w_{xy}(\tau_x^1, \tau_y^1, \tau_z^0) - w_y^0$ and $w_z(\tau_x^1, \tau_y^1, \tau_z^0)$ for X and Z, respectively. If X and Z want a deal that results in $(\tau_x^2, \tau_y^1, \tau_z^2)$ then X has to offer Z at least $W_z(\tau_x^1, \tau_y^1, \tau_z^0)$ and does not have incentive of giving more than that. In this case, X's payoff from the whole negotiation is $w_{xy,xz}(\tau_x^2, \tau_y^1, \tau_z^2) - w_y^0 - w_z(\tau_x^1, \tau_y^1, \tau_z^0)$

Analogous results can be obtained if X makes an offer to Z before Y. Under these circumstances, the acceptable offer to Z includes a payoff of at least w_z^0. Similarly the acceptable offer to Y is to get at least a payoff of $w_y(\tau_x^1, \tau_y^0, \tau_z^1)$. Therefore, X's payoff from making acceptable offers and having these offers accepted when X makes a deal with Z first is $w_{xy,xz}(\tau_x^2, \tau_y^2, \tau_z^1) - w_y(\tau_x^1, \tau_y^0, \tau_z^1) - w_z^0$

2.4.1.5 Sequence of negotiation

Definition 2.4.1. Given $(\tau_x^2, \tau_y^1, \tau_z^2)$, I define tariff equivalence as the existence of another set of tariffs $(\tau_x^2, \tau_y^2, \tau_z^1)$ such that the two sets of tariff bring about the aggregate welfare when the proposer does not change its tariff offer in both sets:

$$w_x(\tau_x^2, \tau_y^1, \tau_z^2) + w_y(\tau_x^2, \tau_y^1, \tau_z^2) + w_z(\tau_x^2, \tau_y^1, \tau_z^2) = w_x(\tau_x^2, \tau_y^2, \tau_z^1) +$$
$$w_y(\tau_x^2, \tau_y^2, \tau_z^1) + w_z(\tau_x^2, \tau_y^2, \tau_z^1)$$

Therefore, the two sets of tariff maintain the same tariff for the leader and allowing different alternatives tariffs for other countries, resulting in the aggregate payoffs remaining unchanged.

Going back to the negotiation game, X then prefers to negotiate with Y before Z if and only if

$$w_{xy,xz}(\tau_x^2, \tau_y^1, \tau_z^2) - w_y^0 - w_z(\tau_x^1, \tau_y^1, \tau_z^0) > w_{xy,xz}(\tau_x^2, \tau_y^2, \tau_z^1) - w_y(\tau_x^1, \tau_y^0, \tau_z^1) - w_z^0$$

Under tariff equivalence, the equation above is equivalent to:

$$w_y(\tau_x^1, \tau_y^0, \tau_z^1) - w_y^0 > w_z(\tau_x^1, \tau_y^1, \tau_z^0) - w_z^0 \tag{2.1}$$

According to equation (2.1), Y gets higher externality than Z when negotiating second. In this case, when X settles with Z first, it has to pay Y more in order to settle with Y. The reason is because Y gets a higher positive externality by having the tariff of X decreased from a negotiation with Z.

When X and Z agree to decrease their tariff, and Y's tariffs have not changed, the consumer surplus in Y does not change, nor does tariff revenue. Thus, the welfare gains come from the producer surplus $\pi_{xk}(p_{xk}^*)$ and $\pi_{zk}(p_{zk}^*)$.

Therefore, equation (2.1) then compares the producer surplus Y gets if Z settles first with X and the producer surplus Z gets if Y settles first with X. The reason Y would get more out of XZ's outcome than Z out of XY's outcome is if Y is the principal supplier for X. In

this case, Y would benefit from a tariff reduction from X, in particular when the outcome comes from X and Z's negotiation, meaning that Y does not have to make any concessions. This means that X negotiates with "important" countries (principal suppliers) first. In my estimation part, "important" translates into central because in a network of countries that negotiate with one another, the most important ones have high centrality.

Another point that should be obvious but worth mentionning is that a negotiation affects another one when they are related, or in other words, when each pair in either negotiation has a country in common. For example, X imports from both Y and Z, so the negotiation between X and Z is affected by the negotiation between Y and Z, and vice versa. A negotiation between a pair B and C is not important to X and Z, unless either X or Z exports to B (or C). This means that negotiation outcomes also depends on some definition of distance between pairs. This is what I measure by closeness in my applied estimation.

2.4.2 Econometric model

In this section I depict each round of negotiation as a network graph of countries with a collection of N nodes connected by a set of links. In this case, countries present in the round constitute the nodes, and the link represents whether there was a tariff negotiation between two countries in that round. Moreover, this graph is undirected because tariff negotiations during GATT rounds were reciprocal, meaning countries offer concessions to one another. To characterize such type of networks, I construct a symmetric NxN binary matrix A with an entry $a_{ij} = 1$ when there is a link between node i and j.

Graph theory provides various measures of strategic interactions or peer effects within a network. I am interested in two measures: centrality and distance. In this paper, I use degree to measure social-influence and centrality, and the minimum number of paths between two nodes to measure distance.

A degree is the number of links a node has in the network. In my case, it measures the total

number of negotiations a country has. Assume that l_{cm} takes the value 1 when countries c and m negotiated in a round, and is equal to 0 otherwise. Let $L = \{m : l_{cm} = 1\}$ be the set of every country in negotiation with c. Then the degree centrality for country c is the cardinality $|L|$.

On the one hand, centrality measures the effect of powerful nodes on other nodes' decisions to make an agreement. This idea of ranking nodes by their degrees stems from Bagwell and Staiger. They claim that countries revisited their offers and requests after the collapse of US-UK agreements during the Torquay round. In that particular round, the negotiation between these two big countries were thought of as the most important bargaining of that round.

On the other hand, distance also indirectly captures any free-riding problem. In a bilateral negotiation with multilateral implication, countries would wait for others close to them to settle first. In particular, when countries c and m are negotiating, c would wait for other negotiations involving m. This way, c would benefit from those concessions. This is essentially the free-rider problem arising from the MFN rule.

2.4.3 Empirical strategy

To estimate peer effects on negotiation outcomes and duration, I develop a process in which a pair of country continually changes its negotiation status over time. I conduct my analysis at the level of pairs of countries, I assume that a pair is indexed by i, and there are M pairs of countries in a round. Let also the set $I(t)$ contain the list of all pairs having reached an agreement before time t. When a pair of countries negotiates tariffs, they are deciding whether to agree or not over certain concessions. Let these decisions occur in discrete time t, measured in weeks in this paper. Let $t = 0, 1, 2, ... \in \mathbb{Z}$. Let $y_i(t) \in \{0, 1\}$ denote the negotiation outcome for a pair i at time t such that $y_i(t) = 1$ means that the pair i reached an agreement, and $y_i(t) = 0$ means that the negotiation did not succeed for pair i.

I assume that the negotiation status does not change anymore after there is an agreement, that is once countries settle at time t, the outcome does not change for any time $r > t$. This is a reasonable assumption despite the existence of a GATT provision that allows countries to revisit their negotiation following the results of other negotiations. However, such a case has not happened often during the early rounds of the GATT.

Each pair of countries receives an aggregate latent utility $y_i^*(t)$ from having an agreement. Throughout this paper, I assume that this utility is given by the following function:

$$y_i^*(t) = \alpha_i + \beta T_t + \sum_{j \in I(t)} \gamma X_{ij} + \sum_{j \in I(t)} \delta Z_j + \epsilon_{it} \tag{2.2}$$

T_t represents the number of weeks left until the deadline of the round. β then captures the "eleventh hour" effect on a negotiation. X_{ij} measures the distance or the shortest path between the pairs i and j. γ estimates one of the strategic effects because it captures the heterogeneity effect on i's negotiation of the distance between i and all pairs j that finished a negotiation before i. Z_j is the measure of centrality for the pair j in the entire network. δ then estimates the effect on i's negotiation of the importance of the pair j. Finally, ϵ_{it} captures all unobservable costs in the bargaining involving i at time t.

This model then says that a pair i would update its negotiation status at time t after observing all other pairs j that reached an agreement before t. In particular, i assesses each pair j according to how central the latter is to the entire network (centrality), and how important j is relative to i (distance).

2.4.4 Estimation

To estimate my model, I use a logit model of panel data with random effect. Chay and Hyslop (2000) provide an implementation of this method introduced by Honore and Kiryazidou (2000). If the relationship between the individual effects, initial conditions, and explanatory

variables are correctly specified, then Chay and Hyslop argue that random effects estimators are consistent and efficient.

Two potential issues need to be noted here: the initial condition problem and attrition. As is stated earlier, the consistency of the random effect estimators requires that the specification of the initial condition be correctly specified. In my panel data, this is not an issue because the process of each negotiation begins at the start of each round, so that the first observation corresponds to the true initial period. As Heckman (1978, 1981a) observed, the initial conditions are therefore independent of the individual effects and considered exogenous. Hence, I ignore the initial condition problem in my estimation.

Similarly, non random attrition can cause issue in the estimation. In this paper, pairs are dropped out of the sample once they reach a settlement, which potentially creates attrition problem. However, this is not an issue in this case. Therefore, I ignore attrition by assuming random exogenous attrition.

The random effects model assumes that $\alpha_i \sim N(0, \sigma_\alpha^2)$ and $\epsilon_{it} \sim logit$. The likelihood contribution observation i is then:

$$L(\theta|y_i, X_i) = \int \prod_{t=1}^{T} P(y_{it}|\alpha_i, Z_j, X_{ij}) dF_\alpha \tag{2.3}$$

2.5 Data

In the next section, I will present the data on the GATT rounds and talk about how I constructed the variables I need for my estimation.

2.5.1 Summary statistics

This paper uses a novel data on the GATT rounds. The data was recently declassified by the WTO and made publicly available online. It contains detailed records on the back-and-forth

bilateral negotiations between the GATT members during the seven rounds of the GATT. A tariff negotiation during the GATT rounds is characterized by three steps: first, countries are exchanging requests which contain the list of products that they are asking concessions from their partners; then, when two countries agree to proceed with the negotiation, they exchange a list of products and tariffs on which they are willing to offer concessions. Finally, the offer and requests can be modified until involved parties settle. The outcome of each negotiation can be an agreement or a disagreement. For the purpose of this paper, I extracted several key information on each bilateral negotiation for the first three GATT rounds that took place in Geneva, Annecy, and Torquay. I made a list of all pairs of countries that negotiate tariffs with one another, and compiled the date when requests were exchanged, the date when the negotiating parties sent their first offer, the date when final concessions were exchanged, and the outcome of the negotiation.

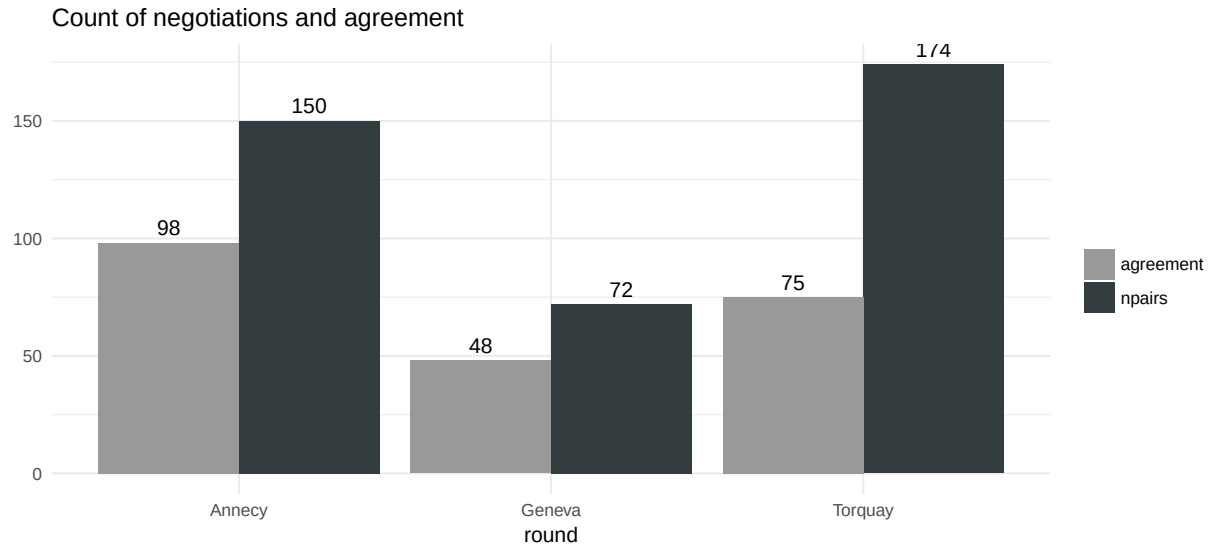

Figure 2.2: GATT Trade negotiation

Figure 2.2 summarizes key information on each round. It shows the number of agreement reached, as well as the total number of pairs of countries involved in negotiation in each round. There were about 75, 150, and 174 bilateral negotiations in Geneva, Annecy, and Torquay, respectively. Only 43.1% of negotiations resulted in agreement in Torquay, whereas

it was 66.67% and 65.33% in Geneva and Annecy, respectively.

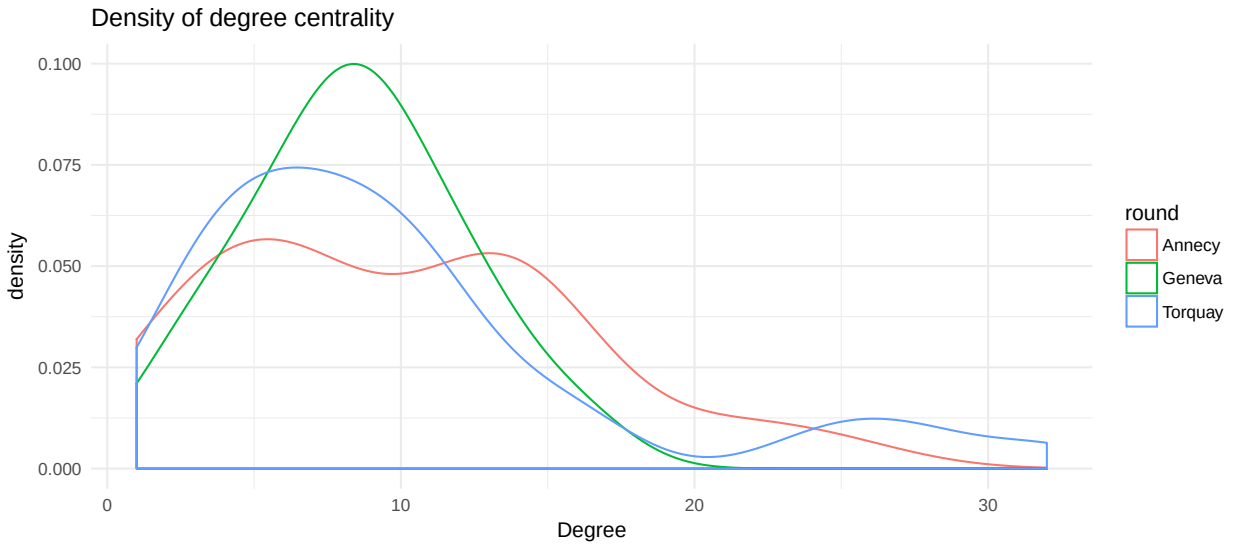

Figure 2.3: Distribution of centrality

Figure 2.3 depicts the distribution of degrees in each round. As said earlier, a degree measures the relative importance of each country in the network. In the first Geneva round, most countries wanted to negotiate with one another. This justifies the left-skewed density of degree values for Geneva. For the other rounds, as more countries entered into negotiations, and as they became selective of with whom they are negotiating, the skewness shifts to the right. The mode of the distribution is closer to zero for Torquay (3rd round of GATT) than it is for Geneva.

In figure 2.4, I plot the distribution of time from the end of negotiation to the end of each round for negotiations that eventually ended up in agreement. The x-axis is measured in weeks. The distributions are skewed to the right, with Geneva having more data points around 0 than other rounds do. This suggests that most agreements occur near the end of their corresponding round, and that countries are delaying their negotiations.

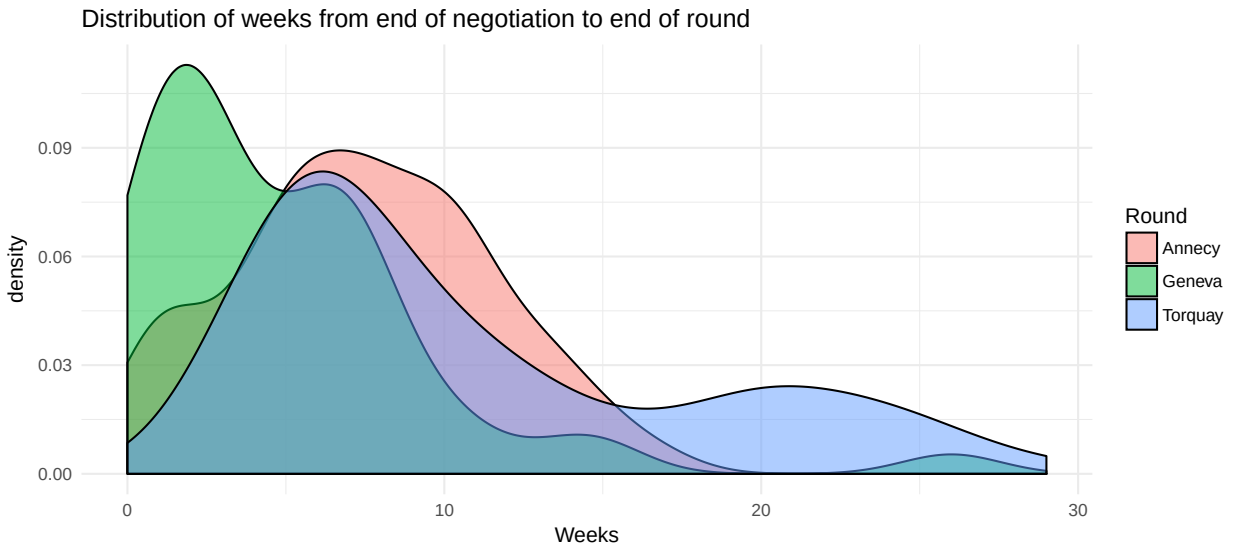

Figure 2.4: Distribution of duration

2.5.2 Variables construction

In this paper, I created the full panel dataset by transforming a cross-sectional data into a weekly panel data. To do so, I expand each negotiation in each round into weekly data points from the day the negotiation itself begun until the end of the round. I had to create three independent variables to capture network effects and the effects of deadline. The first independent variable, number of weeks until the end of round, counted the weeks left until the end of the round from a particular week of the negotiation. The construction of other independent variables is described below.

To analyze peer effects in these GATT rounds, I constructed a network of countries. In this network, countries form the nodes, whereas an edge represents the negotiation between two countries. If two countries negotiated tariffs in Torquay, but not in Geneva round, then they are linked in the network for Torquay, but not in that of Geneva. A network of negotiating countries is then constructed for each round by forming a matrix of dummy variables where countries are both listed in rows and in columns. In this matrix, a value of 1 indicates that the country listed in a row and the country listed in the column were negotiating in that

particular round. As is usual in the network literature, the diagonal of this matrix is filled with 0.

To construct the variables used in my estimation, I calculate the degree and the eigen value for each node, as well as the minimum distance between each pair. Then, an average is taken for each possible pair of countries. For the average distance between two different pairs of countries in particular, I take the average distance between one country from the first pair and one country in the second pair, and average it again. Note that peer effects, evaluated as distance, degree, and eigen value, are measured only for countries that already settled. To do that, for each pair of countries that is still negotiating in one particular week, I evaluate the average eigen value or degree of all pairs of countries that already finished their negotation before that particular week. Similarly, each week, I also calculate the average distance between the pair in negotiation and all other pairs which already settled before that week.

2.6 Empirical results

This section presents the results of the estimation of peer effects on negotiation outcomes and duration in Geneva, Annecy, and Torquay. As said earlier, attrition is assumed to be exogenousn.

Table 2.2 reports the results from estimating the models of peer effects. In columns (1), (2) and (3), I present the results for Geneva, Annecy, and Torquay, respectively. In the last column, I combine all three datasets, and included a dummy variable to separate the effect of rounds from the other variables.

The estimates of the degree and distance effects in column 4 are 0.2 and -0.9, respectively. The effect of the variable measuring weeks until the end of round is estimated (in column 4) to be -0.4.

Table 2.2: Regression with no attrition correction

	(1) Geneva	(2) Annecy	(3) Torquay	(4) All
agreement1				
Degree	-4.151*	0.048	0.167	0.221***
	(-2.04)	(0.17)	(0.72)	(4.10)
Average Distance	-17.980*	-1.026	-4.034	-0.901*
	(-1.99)	(-0.46)	(-1.88)	(-2.14)
Weeks Until End of Round	-7.820***	-2.686***	-1.854***	-0.373***
	(-7.89)	(-26.76)	(-31.21)	(-15.89)
Geneva				-0.087
				(-0.23)
Torquay				-1.396***
				(-4.27)
Constant	90.059***	15.749***	6.392**	-0.849
	(6.73)	(8.01)	(2.79)	(-1.39)
lnsig2u				
Constant	7.440***	5.501***	6.086***	2.318***
	(23.27)	(36.16)	(37.83)	(14.13)
N	1950	2581	4870	9401

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The first point to make is that all variables are statistically significant when the three rounds are combined. This suggests that the duration of a negotiation depends on how much time parties in the negotiation have left to negotiate, which pairs of countries have already finished their negotiations.

The second point to note is that in general the direction of the network effects are consistent with my expectations. Degree positively affects (except for the Geneva sample) the probability to settle at time t. Countries with higher importance in the network affect subsequent negotiation outcomes, as is the case in Bagwell and Staiger (2017) when the US and the UK failed to reach an agreement. Distance has a negative effect across all specifications, meaning that the probability that a pair of countries increases when countries closer to them in the network have already finished negotiating. The variable "weeks until the end of round" also has a negative effect. Geneva might display unusual result because this is the first round of GATT that explored bilateral negotiations with multilateral impacts on all members.

If the estimates just described are capturing peer effects on negotiation outcomes and duration in GATT rounds, then the results suggest that countries settle their negotiation around the end of the round for two reasons. First, they were mostly pressured by the deadline effect because as the end of the round approach, the probability of agreement increases, and this effect is statistically significant. Second, countries are also waiting for "big" countries to settle. When the negotiation outcomes of important pairs were disclosed, countries are more open to settle their negotiation. This is consistent with the claim by Bagwell and Staiger for the Torquay round. The authors suggest that more countries were settling their negotiations after the results from the US-UK negotiation.

2.7 Conclusion

If the world wants to have a global free trade, then it is important to understand how multilateral trade negotiations work. But it is hard, as is evidenced by the failure of Doha

round where negotiations have stalled since 2008. In this paper, I shed more lights into understanding tariff bargaining by looking at the first three rounds of GATT: Geneva, Annecy, and Torquay. In particular, I look at factors affecting the outcomes and duration of negotiations.

In doing so, I created a network of negotiating countries in each round and analyzed the role of centrality and distance of a pair on the decision of other pair to settle a negotiation. I found three results. First, when the number of important or "central" pairs of countries that have agreement increases, then other pairs are more willing to also settle their negotiations. This result is valid for Annecy, Torquay, and all the rounds together. Second, countries are also waiting for each partner to settle with others before settling negotiations with that partner as distance has a negative effect on outcomes and duration in the estimation. However, the variable distance is not statistically significant in all specifications. Finally, a significant number of countries in multilateral negotiations with deadline significantly wait right before the end of the round before settling their negotiations. In the estimation, as the deadline approaches, the likelihood of an agreement increases. These results are robust to other specification, in particular to the definition of centrality. I use eigen values instead of centrality and obtain the same direction and significance for all variables.

The three results above suggest that having a deadline is important in multilateral negotiation because countries are more likely to have an agreement and settle their negotiations when the deadline approaches. The next important factor in multilateral negotiation is also having the "important" countries come to an agreement first. This leads to more countries willing to settle, especially when outcomes are extended to other members, as was the case in the GATT rounds.

APPENDIX

This appendix contains all the calculations necessary to establish the proofs of propositions in the paper.

Welfare

Using equations (1.2) and (1.3), I obtain the following profit-maximizing output for country i:

- the output sold domestically is:

$$x_{ii} = \frac{1}{4}\left[\alpha_i + T_i(1-y_{ij}) + T_i(1-y_{ik})\right] \tag{2.4}$$

- the import from country j is:

$$x_{ji} = \frac{1}{4}\left[\alpha_i - 3T_i(1-y_{ij}) + T_i(1-y_{ik})\right] \tag{2.5}$$

- the import from country k is:

$$x_{ki} = \frac{1}{4}\left[\alpha_i - 3T_i(1-y_{ik}) + T_i(1-y_{ij})\right] \tag{2.6}$$

- the export to country j is:

$$x_{ij} = \frac{1}{4}\left[\alpha_j - 3T_j(1-y_{ij}) + T_j(1-y_{jk})\right] \tag{2.7}$$

- the export to country k is:

$$x_{ik} = \frac{1}{4}\left[\alpha_k - 3T_k(1-y_{ik}) + T_k(1-y_{jk})\right] \tag{2.8}$$

Moreover, the consumer surplus is $CS_i = \frac{1}{2}X_i^2$ where the aggregate consumption X_i is $X_i = x_{ii} + x_{ji} + x_{ki}$.

Additionally, the linear demand function gives a very simple profit function. Thus, at home, the profit is $\pi_{ii} = x_{ii}^2$ and in a foreign market k, it is $\pi_{ik} = x_{ik}^2$.

Finally, tariff revenue for i is levied from imports originating from a country having no trade agreement with i. Therefore, $TR_i = T_i(1-y_{ij})x_{ji} + T_i(1-y_{ik})x_{ki}$.

Proof of proposition 1.3.1

Note that when $\xi < C_1$:

$$\Omega_{ik}(\{ik\}) - \xi > \Omega_{ik}(\{\phi\})$$

Hence, when the cost is below C_1, i prefers having an FTA with k to no FTA given that j does not form one with k. Above C_1, i does not establish an FTA with k, no matter what j does.

Similarly, when $\xi > C_2$:

$$\Omega_{ik}(\{ik, jk\}) - \xi < \Omega_{ik}(\{jk\})$$

This indicates that when the cost is below C_2, i prefers to establish an FTA with k if j also has an FTA with k. Above C_2, i finds it costly to have an FTA with k if j and k also has one.

Under assumption 2, it is easy to show that $C_1 > C_2$. Moreover, if the cost of having an FTA with k is between C_2 and C_1 for both i and j, only one FTA involving k and one big country exist because in this region, each big country finds it profitable to have an FTA over not having one, but at the same time, not having one is better if the other big country is already involved with k. This proves the existence of a negative strategic interaction between FTA decisions among big countries because an FTA established by one big country necessarily drives away the incentive for the other big country to also form an FTA.

However, there is no selection as to which big country prevails in the FTA with country k, hence the multiplicity in equilibrium.

Proof of proposition 1.3.2

$\Omega_{ik}(\{ik, jk\}) - \xi > \Omega_{ik}(\{jk\})$ As before, when $\xi < C_1$:

$$\Omega_{ik}(\{ik\}) - \xi > \Omega_{ik}(\{\phi\})$$

Hence, in this range of cost, i always forms an FTA with k. This is also valid for j.

Similarly, when $\xi > C_2$:

$$\Omega_{ik}(\{ik, jk\}) - \xi < \Omega_{ik}(\{jk\})$$

This means that in this range of cost, i is not willing to form an FTA with k.

It is easy to show that when assumption 3 holds, $C_2 > C_1$.

When the cost ξ is between C_1 and C_2, strategic interaction matters in FTA decision. Note that since $\xi > C_1$, i does not want to form an FTA with k if j does not either. But if j has an agreement with k, it is profitable for i to also form one. A similar reasoning applies to j. In the end, we have an equilibrium where both i and j form an FTA with k, or neither one has an agreement with k. Hence, we also obtain multiple equilibria.

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