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Trade Liberalization on the EU-US GMO Agreement:

A Political Economy Approach

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Abstract:

The EU and the US launched negotiations on a Transatlantic Trade and Investment Partnership (TTIP) in July 2013. Among the TTIP aims, there are negotiable terms under which the EU would import more genetically modified (GM) products and change its labeling regulations on GM Organisms (GMOs). This paper discusses a trade agreement of agricultural products between two countries, with different GM regulatory regimes from a political economy perspective. We identify the negotiation equilibrium of the GMO Trade Agreement and compare it with a stricter trade policy. We find that if the trade agreement leads to a lenient GM regulation, lobbying intensifies. However, this effect is moderated if there are exports of non-GM products.

Keywords: Political Economy, GMOs, international trade

JEL codes:F42, Q18,P16

1. Introduction

After the subprime mortgage crisis and the Euro crisis, many countries are now willing to develop new economic policies. The WTO negotiations and the Doha Round, however, have hardly moved forward. Thus, some countries have launched regional bilateral or multilateral trade agreements. The largest ones are the Trans-Pacific Partnership and the Transatlantic Trade and Investment Partnership (TTIP). The TTIP is an agreement between the European Union (EU) and the United States (US). The two parties launched the TTIP negotiations in July 2013. The agreement potentially offers significant benefits to the US and the EU's economies in terms of trade and growth. According to a report from the Centre for Economic Policy Research (2013), a trade agreement which eliminates tariffs and reduces non-tariff barriers could boost the US and the EU economic growth by more than $100 billion a year. Hence, both parties have an incentive to start bilateral negotiations. The TTIP aims, include negotiable terms under which the EU would import more Genetically Modified (GM) products and loosen its labeling regulations on GM Organisms (GMOs) (Hansen-Kuhn and Suppan 2013).

Currently, the GMO policy regimes differ between the EU and the US. The EU has strict regulations on GMOs, such as labeling and coexistence while the US does not require labels nor has specific coexistence rules (Wesseler and Kalaitzandonakes, 2011). Even though these two large economies have a divergence in GM food policies, they are important trade partners of each other. EU-US trade climbed to $787 billion in 2013, double the level of 2000 (Transatlantic Economy 2014). After 2011, EU agricultural product sales on the US market kept on growing to over €15 billion in 2012, which is a 13% increase compared to 2011 (Agricultural and Rural Development data, EU Commission 2014). However, the EU imports only about 30 million tons a year of GM crops for animal consumption (EU Commission 2001), and the total agricultural from the US is to the EU is only 4.8 percentage (WTO 2013). In contrast, in the US, the largest GM commercial producer has 88 percent of corn, 94 percent of cotton and 93 percent of soybeans of GM crops (USDA ERS 2013) and imports 2.1 percent of agricultural products from the EU (WTO 2013). TTIP proposals to achieve regulatory coherence during the negotiation. Even though we do not know the outcome of the negotiation, it offers a chance for collaboration between two countries with very different GM regulations.

Many scientists (Anderson, et al., 2013, Graff, et al., 2009, Qaim, 2009, Shao, et al., 2013) argue that the GMO regulation approval process is a political rivalry between different interest groups. Some interest groups (such as biotech R&D firms, GM farmers and retailers) would be in favor of the agreement, whereas the interest groups who represent conventional agriculture (e.g. conventional farmers, chemical producers) and environmentalists would prefer stringent GM regulations and would therefore oppose the agreement. The GMO Trade Agreement(GTA) negotiation may intensify the current GMO debate within the EU.

In this study, we assess the effect of the negotiations on the lobbying efforts in the GMO debate in the country. We use a political economy model to describe a scenario where two countries with different GM regimes start negotiations over a GTA.

Many previous studies discuss free trade agreement (FTA) negotiations using a political economy approach. Grossman and Helpman (1995) describe a bilateral FTA negotiation and discuss the required economic terms and conditions of an FTA equilibrium outcome. Levy (1993) studies the interaction between multi-and bilateral FTA negotiations. He finds that bilateral negotiations can undermine political support for multilateral free trade because a bilateral FTA offers larger gains than the multilateral FTA. Many of these studies focus on aggregate welfare and simplify by assuming a single traded good. Later, Fajgelbaum, et al. (2011) developed a framework to study trade with differentiated products. They provide a tool for studying welfare consequences of the trade and trade policy by differentiating consumers by income and preferences on goods' quality and variety. Maggi and Rodriguez-Clare (1998) develop a small-country model to show that when factors are static in short term but mobile in long run, the government prefers a free-trade agreement in general because its payoff is less if it gets involved in a political game.

In this paper, we start the discussion from a political point of view. The political process follows the Grossman and Helpman (1994) model. We focus our discussion on bilateral GTA negotiations. The GTA negotiation will affect welfare differently in both countries because of the asymmetric GM regulations. The domestic debate could intensify when the government decides to join the GTA. But we also show that simultaneous foreign exports could mitigate the domestic debate, because the profits from the foreign market can compensate the domestic loss of a less strict GM trade regulation for conventional farmers. The paper departs from previous research on GMO regulations and international trade by i) solving for the possible economic equilibrium agreement and its conditions in the presence of "semi-differentiated" goods. ii) Addressing the welfare effects of entering a GTA negotiation. iii) The effect of non-GM exports on the lobbying efforts.

The paper proceeds as follows: section 2 discusses the political economy equilibrium in the country before launching the GTA negotiation. Section 3 introduces the bilateral GTA negotiation and the possible equilibria of the political game. We present the welfare consequences for the country and the effects on lobbying effort in section 4. In Section 5, we add exports to the model and show their effect on the lobbying effort. Section 6 summarizes the main findings and implications of the paper.

2. The Model

We assume that there are two countries in the world, the domestic country and the foreign country. There is a difference in the regulation and acceptance of GM technology between two countries, but otherwise they are symmetric in terms of economic structure. The two countries have different GM regulations that influence the GM firms' profits. There are regulation compliance costs for the GM firms in both country. We also assume that the current GM regulation are the outcomes of their domestic political game between interest groups.

The domestic country has stricter GM regulations, and the acceptance of GM food in the domestic country is relatively low. In contrast, there is less debate in the foreign country about agricultural GM technology, and the GM regulation is less strict. The foreign country applies more GM technology in agricultural production and it also exports GM products. The domestic country produce mainly conventional agricultural goods due to strict GM regulations. We assume that the GM technology is an advanced safe agricultural technology that increases farm level production in comparison to conventional farming. In the world market, both countries trade food products and numeraire goods with each other. Two countries have bilateral trade of both GM and non-GM products, but trade volumes are small due to regulation differences on both products. GM labelling regulations are Non-tariff Barriers (NTBs) in the international trade (Kreipe, 2010). We assume NTBs as tariff equivalents (TEs) (Ferrantino, 2006, Linkins and Arce, 1994, Winchester, 2009) of the GM import. So, we aggregate tariff and non-tariff barriers in the bilateral trade as t. Higher import standards induce higher GM import costs. In our model, there is a GM import cost for the foreign firm who export GM products to the domestic country, and a non-GM import cost for the domestic non-GM exporter. Thus, before the negotiation, two countries have tariff income from the trade and distribute it proportionally to consumers. Notations with and without asterisk are variables of the foreign country and the domestic country, respectively.

In the following discussion, we focus on the domestic economy due to the symmetry.

2.1 The economy of the domestic country

There are two sectors, an agricultural food sector and a numeraire good (z) sector, in the economy. Labor $(L_i, i = G, N)$ is the only input for both sectors with constant returns to scale. There are two representative firms in the food sector, a conventional and a GM producer. We denote the output of the GM food products as x_G and x_N is the output of the conventional food products, and let $x_G = g(L_G)$ and $x_N = f(L_N)$. We have $g' > f'$ according to higher productivity of the GM technology. There is a domestic regulation compliance cost θ added to the GM firm. If the GM regulation is strict, the costs of using agricultural GM technology are higher for the firm. The non-GM firm has to spend more efforts to get non-GM price premium. So, the GM firm prefers a smaller θ. The profit function of two firms are:

$$\pi_G = p_G x_G - c_G(w, \theta)$$

$$\pi_N = p_N x_N - c_N(w) \qquad (1)$$

where p_G and p_N are the prices of the GM and non-GM product, respectively. w is the wage, which is as the labor input cost for both firms. The marginal profit of the GM firm increases with decreasing in θ. The GM regulation cost has no direct influence on the non-GM firm's profits. But the non-GM firm prefers a higher θ, because higher regulation cost limits the competition from the GM firm.

We normalize the total number of consumers to one, and divide them into three kinds. Fraction α consumes only GM food products and owns the GM firm, fraction β consumes only consume conventional food products and owns the non-GM firm. The rest of the population γ demands variety, so they consume both GM and non-GM food products.

Consumers belonging to either α or β group also use their income to make a share of donations to their lobby groups. Each consumers belongs to an interest group also have a share of their firms' profit. γ consumers do not make donations and no profit share neither.

So, the net income of a consumer in each group gives:

$$I^{\alpha}(\theta) = w + \frac{1}{\alpha}\pi_G(\theta) + \frac{1}{\alpha}t_G^0 m^A - \frac{1}{\alpha}B^{\alpha}(\theta)$$

$$I^{\beta}(\theta) = w + \frac{1}{\beta}\pi_N(\theta) + \frac{1}{\beta}t_G^0 m^A - \frac{1}{\beta}B^{\beta}(\theta)$$

$$I^{\gamma}(\theta) = w + \frac{1}{\gamma} t_G^0 m^A$$

(2)

where $\frac{1}{\alpha} B^{\alpha}(\theta)$ or $\frac{1}{\beta} B^{\beta}(\theta)$ are donations to the respective lobby groups. Consumers from γ group only have wage and tariff-rents as their income. They do not need to make contributions and do not have profit share. $t_G m$ a lump sum transfers from GM import that distributed to all consumers, where t_G is the import cost. Similarly, there is an import cost t_N for the non-GM exports to the foreign country. Countries that have strict GM regulations generally have a strict trade policy on GM imports, such as the European countries and some African countries (Paarlberg, 2010). A stricter GM regulation in the domestic country implies higher GM trade barriers, that is, higher θ and higher t_G. Put differently, a countries' agricultural biotechnology policy is consistent for both home and abroad, for example, a stricter domestic GM policy and a high standard for GM imports. But it does not mean that, if the trade standard on GM products changed, the domestic GM regulations will be changed immediately. There are two separate requirements and policy making processes for the home GM firm and foreign GM export firm. So, in our comparative model, t is not a function of θ. Here, we specify t_G^0 as the current import rents from the GM trade and m^A as the GM imports level before the negotiation.

Individuals consume both numeraire goods and food products subject to their income. Consumers maximize their utility $U^i = z^i + u(x_G^i) + v(x_N^i)$, where z^i is the consumption of numeraire goods, $x_{G,N}^i$ is the consumption of GM or non-GM goods for consumer from group $i = \alpha, \beta, \gamma$. $U^i(\cdot)$ is a quasi-linear function. The total demand of GM products is $\left(x_G^\alpha + x_G^\gamma\right)$ and total demand of non-GM products is $\left(x_N^\beta + x_N^\gamma\right)$. So, the domestic excess demand of GM products is $M_G = \left(x_G^\alpha + x_G^\gamma\right) - x_G$, and the domestic GM price is $p_G = p_G^* + t_G^0$. In the foreign country, the excess GM supply is $X_G = x_G^* - \left(x_G^{\alpha*} + x_G^{\gamma*}\right)$. $M_G = X_G$ in the world market. Similarly, the domestic country exports the excess non-GM products $X_N = x_N - \left(x_N^\alpha + x_N^\gamma\right)$, which equals the excess demand in the foreign country, $M_N = \left(x_N^{\alpha*} + x_N^{\gamma*}\right) - x_N^*$. The price of non-GM products in the foreign market is $p_N^* = p_N + t_N^0$, where t_N^0 is the current non-GM trade cost of the foreign country..

We assume total labor supply is $\bar{L}$, so total labor income is $w\bar{L}$. Aggregate welfare of each group is given:

$$W^\alpha(\theta) = \alpha w\bar{L} + cs_G^\alpha(\theta) + \pi_G(\theta) + \alpha t_G^0 m^A$$

$$W^\beta(\theta) = \beta w\bar{L} + cs_N^\beta(\theta) + \pi_N(\theta) + \beta t_G^0 m^A$$

$$W^\gamma(\theta) = \gamma w\bar{L} + cs_G^\gamma(\theta) + cs_N^\gamma(\theta) + \gamma t_G^0 m^A \quad (3)$$

We can write the aggregate welfare as the sum of three groups:

$$W(\theta) = w\bar{L} + \pi_G(\theta) + \pi_N(\theta) + cs_G(\theta) + cs_N(\theta) + t_G^0 m^A \quad (4)$$

2.2 The Political Process

We assume the GM regulation is an outcome of a political game between different interest groups. In the model, there is an incumbent government who cares about the votes. There are two interest groups, and they are collectives of voters. The government represents one of the lobby group's interest, which depends on the groups' efforts in the political game. The government should balance between the general interests and special interests. We simplify the political issue and let social welfare represents the votes of general interests and contributions from two interest groups are the competition of special interests. So, the government maximize total votes from voters, which is the sum of social welfare and contributions in our model. Lobbies make contributions to influence the policy outcome when the government formulate new policies, and they make new contribution schedules if they believe that there is a need to update regulations (for example, negotiations of free trade agreement).

Two interest groups, a pro-GM group (PGM) who lobbies for a lower GM cost and an anti-GM group (AGM) who lobbies for a higher GM policy cost, in the political game. Even though the AGM does not use GM technology in the production, a lenient GM policy will decrease the GM production cost, lower the GM price and attract more γ consumers. Both groups make contributions to their governments for a desired agricultural biotechnology policy to maximize their welfare. Lobbying is costly to interest groups, which means that interest groups spend $(1+\lambda^i), i \in (\alpha, \beta)$ unit from their welfare for one unit contribution. λ^i

is a nonnegative parameter that represents the lobbying efficiency of two groups. A higher λ^i means lobbying is relatively more costly for group *i* or group *i* is less efficient in the lobbying process. We assume interest groups never make contributions higher than the groups' welfare, that is, $W^i - \left(1+\lambda^i\right)C^i \geq 0$, where C^i is the lobbying contribution from group *i*. Group γ is not involved in lobbying and therefore makes no donations or contributions. They are passive in the political process and are "free-riders" in the political game.

The timing of the political game in both countries is as follows: the two interest groups announce their contribution schedules simultaneously to the government in the first stage. The government then chooses a GM policy that maximizes its payoff in the second stage. The government payoff is the sum of the weighted welfare plus the contributions of the respective groups. That is,

$$G(\theta) = aW(\theta) + C^{\alpha}(\theta) + C^{\beta}(\theta) \tag{5}$$

where $a(0 < a < 1)$ is a weight parameter, indicating relative importance of general intersets in the policy making process. But depending on the contribution efforts, weights are different for two groups.

If $W^i - \left(1+\lambda^i\right)C^i \geq 0$, and contribution schedules are locally truthful, the optimal contribution of each group is determined by:

$$\frac{\partial C^i(\theta)}{\partial \theta} = \frac{1}{(1+\lambda^i)} \frac{\partial W^i(\theta)}{\partial \theta} \text{ for } i = \alpha, \beta \tag{6}$$

Since the government maximizes its own payoff rather than the social welfare, the politically optimal GM policy is different from equation (5):

$$\frac{\partial G(\theta)}{\partial \theta} = a\frac{\partial W(\theta)}{\partial \theta} + \frac{\partial C^\alpha(\theta)}{\partial \theta} + \frac{\partial C^\beta(\theta)}{\partial \theta} = 0 \tag{7}$$

Substituting (6) into (7) gives:

$$\frac{\partial G(\theta)}{\partial \theta} = \left(\frac{1}{1+\lambda^\alpha} + a\right)\frac{\partial W^\alpha(\theta)}{\partial \theta} + \left(\frac{1}{1+\lambda^\beta} + a\right)\frac{\partial W^\beta(\theta)}{\partial \theta} + a\frac{\partial W^\gamma(\theta)}{\partial \theta} = 0 \tag{8}$$

From equation (8), we can see the parameters (e.g. $\left(\frac{1}{1+\lambda^\alpha} + a\right)$) before each partial derivatives are different. It means that the government influences each groups' welfare by putting different weights on general and special interests during the political process and those weights depend on the lobbying efforts.

Since the two countries are large players in the world the market, the trade flow of food products between them is large. But different trade policy increase non-tariff barriers that impede the increment of the bilateral agricultural trade flow. So they both have incentive to negotiate an agricultural trade agreement when there is an opportunity.

2.3 The GM Trade Policy

The domestic and the foreign country trade both conventional and GM food products in our model. However, the domestic country only exports non-GM goods to the foreign country and imports few GM goods due to the strict GM regulations. Put differently, the strict domestic GM policy influences its GM trade policy, and this generates high import cost.

To see the policy effects more clearly, we first assume that the domestic country only imports GM food products from the foreign country; after that we add a non-GM export to the model.

In the model, we assume the domestic GM regulation has a positive relations to the GM trade policy, that is, higher θ and higher t_G. Lobby groups have similar lobbying functional form for the trade policy, the optimal lobbying schedule is determined by:

$$\frac{\partial C^i(t_G)}{\partial t_G} = \frac{1}{(1+\lambda^i)} \frac{\partial W^i(t_G)}{\partial t_G} \text{ for } i = \alpha, \beta \tag{9}$$

Rewriting the domestic government payoff function of the trade policy as: $G_D = aW(t_G) + C^\alpha(t_G) + C^\beta(t_G)$. The politically optimal GM regulation t_G^0 before an agreement is made is determined by:

$$\frac{dG_D}{dt_G^0} = a\frac{\partial W(t_G^0)}{\partial t_G^0} + \frac{\partial C^\alpha(t_G^0)}{\partial t_G^0} + \frac{\partial C^\beta(t_G^0)}{\partial t_G^0} = 0 \tag{10}$$

3. The Bilateral GTA Negotiation

We suppose the incumbent domestic government has set an initial GM trade policy (t_G^0) and try to negotiate a GTA with the foreign country. The GTA has a promising perspective for both countries if there is a GM trade cost deduction. However, loosening the domestic GM policy may hurt the non-GM producers and consumers. In addition, the GM firm will also face more intensive competition from abroad. Interest groups may have an incentive to revise their contribution schedules after they know the government involves in the negotiation and probably change the current trade regulations on GMOs. The PGM, who is currently relatively worse-off in the domestic GM lobbying game, has an opportunity to change its status in the trade policy game. The relative better-off lobby, AGM, would like to keep its current status or lobby for an even higher GM regulation cost. We will discuss the main players in the game from the domestic point of view and describe why they have an incentive to lobby during the negotiation.

3.1 Players

Pro-GM Lobby. In the domestic lobbying game, PGM is the lobby that is relatively worse-off. The current strict GM policy decreases the welfare of the GM lobby. The GM firm cannot use as much GM technology inputs as it likes. Thus, the GM output and profits are lower in the domestic country. The GTA negotiation will bring about another lobbying game. The PGM has a chance to lobby for a less strict domestic GM policy. Consumers belonging to this group will benefit from the lower GM price. Even though there are more consumers who dislike GM products (fraction β is large in the domestic country), its lower price attracts more indifferent consumers (fraction γ) to consume GM food. Less strict GM trade policy will increase GM imports and decrease the domestic GM price, but there is a possibility that the domestic government reduces GM compliance costs and increase firm's competitiveness. Therefore, the GM lobby has incentive to revise its contribution schedule in the GTA game.

Anti-GM lobby. AGM is currently the group that is relatively better-off in the lobbying game. Conventional food has a relatively higher production cost and price. If the GM import barriers become lower, the non-GM firm may lose its market share in the domestic food market because the price difference between GM and non-GM increases due to the increased GM imports and increased local production of GM products, attracting indifferent consumers to GM products. So, the AGM has an incentive to revise its contribution schedule and lobby with the government to terminate the GTA negotiation or at least keep the GM trade policy at the current level.

The Incumbent Government. A concluded GTA offers lower prices and more commodities in the market and this increase domestic welfare. Since welfare is an argument in the government's payoff function, and the potential welfare increment is large. The government would like to pursue an agreement if it can provide an increase of votes. Moreover, the lobbies now offer new contribution schedules and thus the government's payoff will also increase.

3.2 The Unilateral Stance

To clearly see the negotiation effects on welfare and lobbying, we discuss the domestic government's decision first. The process is different from the domestic lobbying game. In the first stage, the lobbying groups offer their contribution schedules for the government to negotiate the agreement. The government will choose a set of contribution pairs, and decide to pursue or reject the agreement according to its votes change in the second stage.

Winters (1987) argues that the negotiation of NTBs reduction can be analyzed with the techniques of a tariff negotiation. He defines the costs and benefits from a NTBs negotiation as follows: the domestic country's "benefits" of a concession in TE is equal to the reduction of regulation costs of the foreign country. This especially applies in a two-country model. Countries value their negotiation stances subject to the gains from regulatory change. NTB have a direct effect on the trade volume and an indirect effect on the price (Herberg (1990)). Thus, we assume that the rents from the NTB reduction equals to the benefits from lower regulation costs, and the benefits are distributed proportionally among consumers. We define the TE rents from the NTB reduction as: $t_G(\Delta m)$, where Δm is the import volume change through the negotiation. It is an *ex ante* value of the negotiation stances. Therefore, if we use superscript A, B to denote the pre-GTA and GTA negotiation conditions, the welfare of each group after a concluded negotiation:

$$W^{\alpha B}(t_G) = \alpha w\bar{L} + cs_G^{\alpha B} + \pi_G^B(t_G) + \alpha t_G(m^B - m^A)$$

$$W^{\beta B}(t_G) = \beta w\bar{L} + cs_N^{\beta B} + \pi_N^B(t_G) + \beta t_G(m^B - m^A)$$

$$W^{\gamma B}(t_G) = \gamma w\bar{L} + cs_G^{\gamma B} + cs_N^{\gamma B} + \gamma t_G(m^B - m^A) \tag{11}$$

and

$$W^B = w\bar{L} + \pi_G^B + \pi_N^B + cs_G^B + cs_N^B + t_G(m^B - m^A) \tag{12}$$

We denote the contribution schedule of an interest group as $C^{iA}(t_G)$ and $C^{iB}(t_G)$ for the contributions under pre-GTA and GTA negotiations, respectively. The government then maximizes its payoff by taking new contributions into consideration after entering the negotiation. The government pursues the GTA only if the change of its payoff after GTA is positive, which means an increase of votes:

$$\begin{aligned} \Delta G_D &= a\left(\Delta W\right) + \Delta C^{\alpha} + \Delta C^{\beta} \\ &= a(W^B - W^A) + \left[\left(C^{\alpha B} - C^{\alpha A}\right) + \left(C^{\beta B} - C^{\beta A}\right)\right] \geq 0 \end{aligned} \tag{13}$$

We define *unilateral stances* as a set of positions that the government will choose in response to the domestic interest groups' equilibrium behavior. The government's starting position determines the fate of the agreement. We denote $\{t_{Ge}\}$ as the set of unilateral stances, where $e \in \{D, F\}$ for the domestic country and the foreign country. Following Grossman and Helpman (1995), we define a unilateral stance as:

The government will choose a unilateral stance from $\{t_{Ge}\}$ *if there exists a set of contributions* $\{C^{iA}(t_{Ge}), C^{iB}(t_{Ge})\}$*, one for each lobby i, before the negotiations such that:*

(a) $C^{ij}(t_{Ge}) \geq 0$ *for* $j = A, B$ *and for all i;*

(b) $C^{ij}(t_{Ge}) \leq \max\left[0, W^{ij}(t_{Ge}) - (1+\lambda^{ij})C^{ij}(t_{Ge})\right]$*;*

(c) $\{t_{Ge}\}$ *satisfies* $\left\{a\Delta W^{j} + \sum_i \Delta C^{ij} \geq 0\right\}$*;*

(d) for lobby i , there exists no other contributions $\left(C^{ij}\right)^{O} \geq 0$ *and no* $\{t^{O}_{Ge}\}$ *such that:*

(i) $a\Delta W^{j}(t^{O}_{Ge}) + \sum_i \Delta\left(C^{ij}\right)^{O} \geq 0$ *and*

(ii) $W^{ij} - (1+\lambda^{ij})\left(C^{ij}\right)^{O} > W^{ij} - (1+\lambda^{ij})C^{ij}$.

where $\left(C^{ij}\right)^{O}$ and t^{O}_{Ge} represent "other" contributions and trade policy choices, respectively. We find this unilateral stance by using backward induction. It is the set of positions $\{t_{Ge}\}$ for the domestic government in the GTA negotiation that guarantees positive payoffs increase. The contribution schedules of lobbying groups are unique and maximize their welfare in the political game.

The foreign country has the same political process and also has a unilateral stance regarding the tariff policy negotiation. Before the foreign government decide to negotiate, the foreign AGM is the relatively worse-off group in the political game. After the governments start the negotiation, two lobbies in the foreign country make contributions to influence the negotiation outcome. Therefore, the foreign PGM group would like to keep the profitable position and while the foreign AGM would like to change to a better-off situation during the lobbying game.

3.3 The Bilateral Equilibrium

We consider the situation when both governments decide to pursue a GTA in this section. If not, the optimal tariff will be the same as what we discussed in section 2.3. We define a GTA is an equilibrium agreement if and only if a unilateral stance in both countries are equal, that is, $t_{GD} = t_{GF}$. However, the equilibrium agreement may not be the optimal choice to both countries. We can find the optimal unilateral regime is $\overline{t}_{Ge}$ from government payoff functions, which determined by

$$\frac{\partial \Delta G_e}{\partial t_{Ge}} = a\frac{\partial \Delta W(\overline{t}_{Ge})}{\partial t_{Ge}} + \left[\frac{\partial \Delta C_\alpha(\overline{t}_{Ge})}{\partial t_{Ge}} + \frac{\partial \Delta C_\beta(\overline{t}_{Ge})}{\partial t_{Ge}}\right] = 0 \tag{14}$$

Our definition gives the unilateral stances as a range of choices that constitute a positive ΔG_e. But depending on the shapes of the governments increased payoffs, there may be more than one intersections of two positive payoff curves. Each gives the two governments a different payoff pairs. Each government would prefer the equilibrium agreement to be located as close to its own optimal unilateral stance as possible. Since two countries have different GM regulations, they will make efforts to achieve regulatory coherence and make concessions from their optimal unilateral stance during the negotiation. The final agreed tariff should lie in the overlaps of the feasible sets. They need to choose a trade policy where both have a positive increment in payoff. One possible solution is the Nash Bargaining solution. We denote this solution t_G^* in the GTA negotiation, and it satisfies:

$$\max_{t_G}\left[(u_D(t_G{}^*) - u_D(t_{GD}^0))(u_F(t_G{}^*) - u_F(t_{GF}^0))\right] = \max_{t_G}\left[(\Delta G_D)(\Delta G_F)\right] \tag{15}$$

where $u_e(\cdot)$ is the governments' payoff from the political game. The original trade policies will not bring any payoff increments to both government, so $u_D(t_{GD}^0)$ and $u_F(t_{GF}^0)$ are both zero. Their payoffs are maximized when they agree at t_G^*.

The agreement solution can be also found as the solution of the equation system

$$\Delta G_D(t_{GD}) = a_D \Delta W_D^j(t_{GD}) + \left[\Delta C_D^{\alpha j}(t_{GD}) + \Delta C_D^{\beta j}(t_{GD}) \right] \geq 0 \tag{16}$$

$$\Delta G_F(t_{GF}) = a_F \Delta W_F^j(t_{GF}) + \left[\Delta C_F^{\alpha j}(t_{GF}) + \Delta C_F^{\beta j}(t_{GF}) \right] \geq 0 \tag{17}$$

Since the government will pursue a payoff increment during the GTA negotiation, we only need discuss the relations between ΔG and t_G in the first quadrant. However, there will be many situations for the optimal unilateral stance $\overline{t}_{Ge}$ and the bilateral equilibrium t_G^*. The unknowns are: 1) the shape of the positive government payoff curve; 2) the distances of the overlaps for both the domestic and foreign feasible set of outcomes (e.g. totally, partly, or no overlaps). However, we can explain the above logic of a GTA negotiation by a possible case. We assume two quadratic positive government payoff functions, as it shows in Figure 1.

[Insert Figure 1 here]

Since the negotiation is about the trade cost reduction, the starting point of t_{Ge}^0 is high for both countries. It is the pre-GTA condition, and $\Delta G_e = 0$. From the critical point t_{GD}^0 to t_{GD} is the feasible set of outcomes for the domestic country, and from the critical point t_{GF}^0 to

t_{GF} is the feasible set of outcomes for the foreign country. P_D and P_F denotes the optimal unilateral stances payoffs for the domestic and the foreign countries, respectively. The optimal unilateral stances are $\bar{t}_{GD}$ and $\bar{t}_{GF}$ for each country to maximize governments' payoff. The overlap distance is from t_{Ge}^0 to t_{GD}. However, the distance from t_{Ge}^0 to $\bar{t}_{GD}$ will not be the solution set, because the government payoffs for both countries are still increasing. Similarly, the distances from $\bar{t}_{GF}$ to t_{GF} will not be the solution sets, because the payoff are decreasing for both countries in the sets. There is a intersect P^* of two positive payoff functions, and two government maximize mutual payoffs $\left(\Delta G_D \Delta G_F\right)$ through negotiation. The trade policy solution (t_G^*) lies in the set from $\bar{t}_{GD}$ to $\bar{t}_{GF}$.

4. The GTA Effects of the Domestic Country

4.1 Welfare effects from the GTA negotiation

In this section, we discuss the effects of the optimal unilateral stance of the government instead of the GTA equilibrium effects, because the optimal unilateral stance is the outcome of the political competition in the country. Again, we will see the effects in the domestic country.

If two governments can successfully reach an agreement, they both receive an incremental payoff through the GTA negotiation. The marginal benefit from the new GM regulation to the government is greater than the pre-GTA one, that is, $\frac{\partial G^B}{\partial t_G} - \frac{\partial G^A}{\partial t_G} > 0$, according to equation (10).

Since we assume GM trade policy is consistent in the political process, we have similar functional forms when the government determines both polices. So, we have (see Appendix for calculation)

$$\frac{\partial G^B(t_G)}{\partial t_G} - \frac{\partial G^A(t_G)}{\partial t_G}$$
$$= \left(\frac{1}{1+\lambda^{\alpha}} + a\right)\left(\Delta\frac{\partial \pi_G}{\partial t_G} + \Delta\frac{\partial cs_G(t_G)}{\partial t_G}\right) + \left(\frac{1}{1+\lambda^{\beta}} + a\right)\left(\Delta\frac{\partial \pi_N}{\partial t_G} + \Delta\frac{\partial cs_N(t_G)}{\partial t_G}\right) + \left(a + \frac{\alpha}{1+\lambda^{\alpha}} + \frac{\beta}{1+\lambda^{\beta}}\right)\Delta m \tag{18}$$

where $\Delta\frac{\partial \pi_G}{\partial t_G} = \frac{\partial \pi_G^B}{\partial t_G} - \frac{\partial \pi_G^A}{\partial t_G}$ is the marginal effect change of the GM trade policy on the GM profit before and after the GTA negotiation. $\Delta\frac{\partial cs_G(t_G)}{\partial t_G} = \frac{\partial cs_G^B(t_G)}{\partial t_G} - \frac{\partial cs_G^A(t_G)}{\partial t_G}$ is the marginal consumer surplus from GM consumption before and after the negotiation. Since the GTA negotiation aims to reduce the GM trade cost, and more GM imports decrease GM price, so the term $\left(\frac{1}{1+\lambda^{\alpha}} + a\right)\Delta\frac{\partial cs_G(t_G)}{\partial t_G}$ is positive. However, $\left(\frac{1}{1+\lambda^{\alpha}} + a\right)\Delta\frac{\partial \pi_G}{\partial t_G}$ is negative because more GM imports will take some market share of the domestic GM firm and GM profit will decrease after the GM negotiation. So the marginal trade policy effects on the GM firm is smaller. In contrast, the welfare change of the non-GM production and consumption $\left(\frac{1}{1+\lambda^{\beta}}+a\right)\left(\Delta\frac{\partial \pi_N}{\partial t_G}+\Delta\frac{\partial cs_N(t_G)}{\partial t_G}\right)$ will decrease after the negotiation. If the GM trade cost decreases, the GM import will increase and the change of $\left(a+\frac{\alpha}{1+\lambda^{\alpha}}+\frac{\beta}{1+\lambda^{\beta}}\right)\Delta m$ is positive. The change of marginal government payoff from the negotiation will be positive if

$$\begin{aligned}&\left(\frac{1}{1+\lambda^{\alpha}}+a\right)\Delta\frac{\partial \pi_G}{\partial t_G}+\left(\frac{1}{1+\lambda^{\beta}}+a\right)\left(\Delta\frac{\partial \pi_N}{\partial t_G}+\Delta\frac{\partial cs_N(t_G)}{\partial t_G}\right)\\&>-\left\{\left(\frac{1}{1+\lambda^{\alpha}}+a\right)\Delta\frac{\partial cs_G(t_G)}{\partial t_G}+\left(a+\frac{\alpha}{1+\lambda^{\alpha}}+\frac{\beta}{1+\lambda^{\beta}}\right)\Delta m\right\}\end{aligned}.$$

So, we can conclude that

The government will enter the GTA negotiation if and only if the marginal loss of the domestic food industry from the equilibrium policy is less than the marginal gain of social welfare for the rest of the consumers.

4.2 Lobbying effects from the GTA negotiation

If the government would sign the agreement, the GM regulations of two countries will coincide. For the domestic country, a GTA with a lower GM import cost has effects on:

Pro-GM lobby. GM consumers will benefit from a lower GM price. Using equation (9), we can compare the marginal welfare change before and after the GTA negotiation:

$$\frac{\partial W^{\alpha B}}{\partial t_G}-\frac{\partial W^{\alpha A}}{\partial t_G}=\alpha\underbrace{(m^B-m^A)}_{>0}+\underbrace{\left(\frac{\partial \pi_G^B}{\partial t_G}-\frac{\partial \pi_G^A}{\partial t_G}\right)}_{<0}+\underbrace{\left(\frac{\partial cs_G^B(t_G)}{\partial t_G}-\frac{\partial cs_G^A(t_G)}{\partial t_G}\right)}_{>0} \tag{18}$$

Since the PGM is the relatively worse-off in the domestic GM policy game before negotiations, it would like to lobby for a policy change through the GTA negotiation. An increase in GM imports decrease the domestic GM price. More indifferent people will choose GM food after the price decreases, and requires a possible increase of GM supply and a possible domestic GM policy change. By equation (9), we also have

$$\frac{\partial W^{\alpha B}}{\partial t_G}-\frac{\partial W^{\alpha A}}{\partial t_G}=(1+\lambda^{\alpha B})\frac{\partial C^{\alpha B}}{\partial t_G}-(1+\lambda^{\alpha A})\frac{\partial C^{\alpha A}}{\partial t_G} \tag{19}$$

In addition, we find that larger GM imports will also give incentives to the PGM. The PGM would like to update its contribution schedule for a marginal welfare increase if it believes there will be an improvement of GM trade policy.

Anti-GM lobby. We compare the marginal GM trade policy change on welfare before and after the GTA negotiation of the AGM:

$$\frac{\partial W^{\beta B}}{\partial t_G}-\frac{\partial W^{\beta A}}{\partial t_G}=\beta\underbrace{(m^B-m^A)}_{>0}+\underbrace{\left(\frac{\partial \pi_N^B}{\partial t_G}-\frac{\partial \pi_N^A}{\partial t_G}\right)}_{<0}+\underbrace{\left(\frac{\partial cs_N^B(t_G)}{\partial t_G}-\frac{\partial cs_N^A(t_G)}{\partial t_G}\right)}_{<0} \tag{20}$$

We know that the AGM and the non-GM food consumption are large. From equation (20) we can see that if the GM import is small, there will be only small changes to the GM prices. Fewer indifferent consumers will change to consume GM food. So the loss of the AGM from additional imported GM food is small. The AGM then has less incentive for the regulation cost change. In contrast, if the GM import is large and there is a large decrease in import cost, a lower GM price will induce an increasing consumption of GM food. It induces a larger welfare loss for the AGM. Similarly, we have

$$\frac{\partial W^{\beta B}}{\partial t_G} - \frac{\partial W^{\beta A}}{\partial t_G} = (1+\lambda^{\beta B})\frac{\partial C^{\beta B}}{\partial t_G} - (1+\lambda^{\beta A})\frac{\partial C^{\beta A}}{\partial t_G} \tag{21}$$

The optimal contribution level for the AGM will be larger than the pre-GTA contribution if the GM import is large. Also, equation (18) and (20) are more likely to be positive under a large GM import assumption. So, both interest groups therefore have stronger incentives to lobby with the government, and spend more on lobbying than before. In other words the domestic GM debate intensifies relative to pre-GTA condition.

If we compare equation (19) to (21), we see that the contribution change of the PGM is more likely to be larger than the contribution change of the AGM. Reasons can be found from equation (18) and (20): 1) the AGM is very large (i.e. $\alpha \ll \beta$) in the domestic country, therefore the marginal loss of its consumer surplus from a lower GM import cost is larger than the marginal consumer gain of the PGM. So, a large increasing contribution will be paid for welfare increase in the GTA lobbying game for the AGM; 2) As the government enters the GTA negotiation, a possible lower GM import cost will reduce the welfare of the

AGM group, so they would contribute more during the negotiation than before that, that is, $\lambda_{\beta}^{B} > \lambda_{\beta}^{A}$. The AGM needs to spend more on lobbying for a welfare gain.

Indifferent group. Since a large GM import will bring a GM price decrease, consumers who are indifferent to either GM or non-GM food will benefit from the GTA.

Government. More open trade policy will bring a welfare increase and more contributions from lobby groups in the first stage of the GTA game. The government payoff then will increase after it joins the GTA negotiation.

However, if the governments could not coincide their interests during the negotiation, the agreement will not be signed. In the domestic country, non-GM products still take the most part of the food market, and the GM regulation stays strict. Since both interest groups have paid for lobbying, their welfare decrease even though the negotiation breaks down.

5. GTA with Exports to the Foreign Country

In the previous section, we assumed the domestic country only imports GM food products from the foreign country. Now we add the non-GM food exports in the model to see the welfare change in the domestic country. We simplify the situation by assuming there are only export gains for the non-GM firm in the domestic country and denote the additional non-GM profit gain from exporting non-GM products as E. This profit gain also changes the welfare of the non-GM group and it will influence the negotiation equilibrium t_G^* as it will influence the total government payoff. But the analysis stays the same as we discussed in section 3. So, we focus on the welfare and lobbying effects.

If the non-GM firm exports more of its food production, its profits will change. Before earning E, the total demand for non-GM products decreases when the GM import costs decreases. This causes a decrease of the non-GM price, which leads to a profit decrease. However, if the foreign non-GM trade policy change and reduce the non-GM export cost after the government enters the GTA negotiation, the non-GM firm will be compensated through the negotiatiated terms. The non-GM profit from the foreign market is not influenced by the GM import policy, so we have $\pi_N^E = \left(\pi_N^B + E\right) > \pi_N^A > \pi_N^B$.

We take partial derivatives of the different profit functions with respect to the GM import costs: $\frac{\partial \pi_N^E}{\partial t_G} < \frac{\partial \pi_N^B}{\partial t_G}$, and superscript E represents the negotiation with non-GM exports. The marginal effect of GM trade policy on the non-GM profits is smaller when the firm exports non-GM products than before, because a part of its profits $\left(E\right)$ is not influenced by the change of GM trade policy. Therefore, $\frac{\partial \pi_N^E}{\partial t_G} < \frac{\partial \pi_N^B}{\partial t_G} < \frac{\partial \pi_N^A}{\partial t_G}$.

Now we rewrite equation (20),

$$\frac{\partial W^{\beta E}}{\partial t_G} - \frac{\partial W^{\beta B}}{\partial t_G} = \beta \underbrace{(m^B - m^B)}_{=0} + \underbrace{\left(\frac{\partial \pi_N^E}{\partial t_G} - \frac{\partial \pi_N^B}{\partial t_G}\right)}_{<0} + \underbrace{\left(\frac{\partial cs_N^E(t_G)}{\partial t_G} - \frac{\partial cs_N^B(t_G)}{\partial t_G}\right)}_{=0} \tag{22}$$

In the above equation, the GM imports do not change. The consumption of non-GM food products under the GTA import regulation does not change if the firm exports non-GM products. So, the marginal effects of the GTA import costs to non-GM consumer surplus stays the same. $\left(\frac{\partial \pi_N^E}{\partial t_G} - \frac{\partial \pi_N^B}{\partial t_G}\right) < 0$ because the loss from decreasing GM import cost is compensated by the foreign profits of the non-GM firm. Therefore, the marginal welfare loss from the GM trade policy change is smaller after the non-GM firm has foreign exports. By rewriting equation (21), we have

$$\frac{\partial W^{\beta E}}{\partial t_G} - \frac{\partial W^{\beta B}}{\partial t_G} = (1+\lambda^{\beta E})\frac{\partial C^{\beta E}}{\partial t_G} - (1+\lambda^{\beta B})\frac{\partial C^{\beta B}}{\partial t_G} \tag{23}$$

Therefore, the optimal lobbying schedule will be lower for the AGM without foreign exports. The domestic GM debate thus will be less fierce than without non-GM exports.

We conclude our findings that:

When the domestic country only allows the GM imports, a GTA negotiation on GM imports will intensify the domestic GM debate. A welfare increase for the pro-GM group and a welfare loss for the anti-GM group from a decreasing GM import regulation will induce higher contributions by both groups. Lobbying cost of the anti-GM group will be higher than lobbying cost of the pro-GM group under large GM imports. However, the domestic GM debate will be less intensive if there are also non-GM exports in the negotiation, *because the welfare loss from a less strict GM import policy to the anti-GM group can be compensated by export earnings.*

6. Conclusion

The paper investigates the welfare effects of a trade agreement between two countries, two goods (GM and non-GM good), two regulatory standards (high in the domestic and low in the foreign country) and two lobby groups. We show the political process of the domestic GM policy and trade policy, and compare the equilibria before and after a trade agreement. Since the GM regulations are not the same in the two countries, a lower GM import cost will not necessarily benefit all consumers. Analytical results show that the overall non-GM consumer surplus decreases as the import costs of GM products decreases and hence the domestic price for GM products. Lower GM import costs will induce a more intensive domestic GM debate (measured by the size of lobbying contributions) about GM regulations for both lobby groups. The pro-GM lobby group as well as the anti-GM lobby group, have an incentive to increase their lobbying activities. If the trade agreement also provides opportunities to export GM products by the domestic country, the anti-GM lobby group will receive additional compensation which will decrease the tension of the debate in the country.

In the TTIP negotiation, GMOs are one of the important negotiation issue. In addition to other benefits, the EU can benefit by trading conventional agricultural products with the US.

Our results show the possibility for a less strict GM policy in the EU if a successful TTIP agreement exists. Even though a free-trade agreement is still far, an open trade policy of GM products will increase welfare in both countries.

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Appendix:

Pre-GTA condition:

Substituting equation (9) into (10), and we get

$$\frac{\partial G^{A}(t_G)}{\partial t_G}=\left(\frac{1}{1+\lambda^{\alpha}}+a\right)\frac{\partial W^{\alpha A}(t_G)}{\partial t_G}+\left(\frac{1}{1+\lambda^{\beta}}+a\right)\frac{\partial W^{\beta A}(t_G)}{\partial t_G}+a\frac{\partial W^{\gamma A}(t_G)}{\partial t_G}=0$$

(A1)

We also have groups welfare under pre-GTA GM trade policy:

$$W^{\alpha A}(t_G)=\alpha w\bar{L}+cs_G^{\alpha A}(t_G)+\pi_G^{A}(t_G)+\alpha t_G m^{A}$$
$$W^{\beta A}(t_G)=\beta w\bar{L}+cs_N^{\beta A}(t_G)+\pi_N^{A}(t_G)+\beta t_G m^{A}$$
$$W^{\gamma A}(t_G)=\gamma w\bar{L}+cs_G^{\gamma A}(t_G)+cs_N^{\gamma A}(t_G)+\gamma t_G m^{A}$$

(A2)

Taking partial derivatives with respect to t_G, and substitute into equation (A1):G

$$\frac{\partial G^A(t_G)}{\partial t_G}=\left(\frac{1}{1+\lambda^\alpha}+a\right)\left(\frac{\partial \pi_G^A}{\partial t_G}+\frac{\partial cs_G^A(t_G)}{\partial t_G}\right)+\left(\frac{1}{1+\lambda^\beta}+a\right)\left(\frac{\partial \pi_N^A}{\partial t_G}+\frac{\partial cs_N^A(t_G)}{\partial t_G}\right)+\left(a+\frac{\alpha}{1+\lambda^\alpha}+\frac{\beta}{1+\lambda^\beta}\right)m^A$$

(A3)

GTA condition:

By the same calculation, we can get

$$\frac{\partial G^B(t_G)}{\partial t_G}=\left(\frac{1}{1+\lambda^\alpha}+a\right)\left(\frac{\partial \pi_G^B}{\partial t_G}+\frac{\partial cs_G^B(t_G)}{\partial t_G}\right)+\left(\frac{1}{1+\lambda^\beta}+a\right)\left(\frac{\partial \pi_N^B}{\partial t_G}+\frac{\partial cs_N^B(t_G)}{\partial t_G}\right)+\left(a+\frac{\alpha}{1+\lambda^\alpha}+\frac{\beta}{1+\lambda^\beta}\right)m^B \quad \text{(A4)}$$

We can get marginal government payoff change by using equation (A4) minus (A3):

$$\frac{\partial G^B(t_G)}{\partial t_G}-\frac{\partial G^A(t_G)}{\partial t_G}$$
$$=\left(\frac{1}{1+\lambda^\alpha}+a\right)\left(\Delta\frac{\partial \pi_G}{\partial t_G}+\Delta\frac{\partial cs_G(t_G)}{\partial t_G}\right)+\left(\frac{1}{1+\lambda^\beta}+a\right)\left(\Delta\frac{\partial \pi_N}{\partial t_G}+\Delta\frac{\partial cs_N(t_G)}{\partial t_G}\right)+\left(a+\frac{\alpha}{1+\lambda^\alpha}+\frac{\beta}{1+\lambda^\beta}\right)\Delta m \quad \text{(A5)}$$

Figure 1

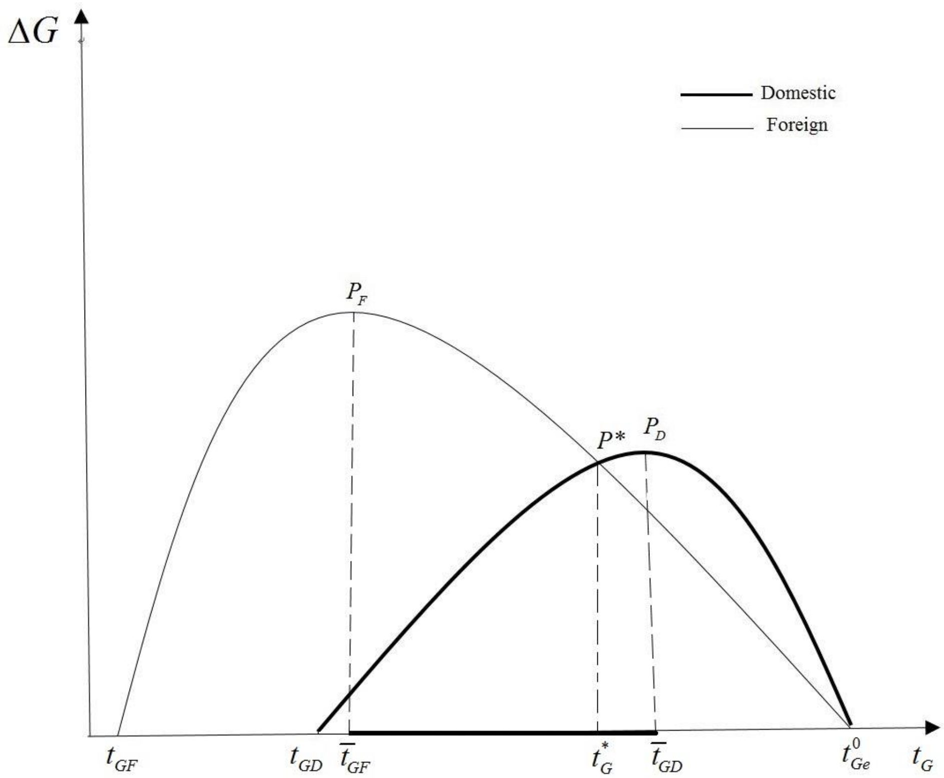

Figure 1 A Possible GTA Solution