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Bilateralism in Agriculture when Countries use Distorting Domestic Policies

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Abstract**:** *A recent theoretical research proved that countries always have an incentive to deviate from global free trade when international markets are oligopolistic and when governments are politically biased. This result suggests that global free trade in agriculture (GFTA) cannot be reached as political bias and market power have both been identified. According to May (2011), bilateral agreements could eventually be used as alternative political tools to reach GFTA. This article extends the work of this author to determine whether bilateralism could also lead to GFTA in a realistic world where governments use distorting domestic policies to protect their agricultural sector.*

Key words**:** Bilateral Agreements; Agricultural Trade Liberalization; Distorting Domestic Policies; International Trade Networks.

JEL classification**:** F12 Q17 Q18

1. INTRODUCTION

Since the Uruguay Round Agreement in Agriculture was established, countries have participated in different multilateral agreements with the objective of reaching global free trade in agriculture (GFTA). However, these negotiations have made little progress and the post Uruguay Round agricultural tariffs remain high (Devadoss, 2006). Some researchers argue that this undesirable outcome is due to the existence of high levels of distorting domestic policies in developed countries. They explain that developing countries are reluctant to participate in global trade agreements with developed countries because these domestic policies can be used to offset market concessions resulting from international agreements (Khor, 2003). According to Devadoss (2006) and Khor (2003), GFTA can only be reached by means of the elimination of distorting domestic policies.

It can be inferred from a recent work developed by May (2008) that the elimination of these policies does not necessarily lead to GFTA. In particular, this author probed that countries always have an incentive to deviate from global free trade when international markets are oligopolistic and when governments are biased

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in favour of their domestic firms. The reason is due to the fact that when a country breaks some existing international agreements simultaneously, its domestic market becomes less competitive. As a result, domestic firms increase the profits that they make in this market after these agreements are broken. This gain in profits is large enough to fully offset the loss of profits that they used to make in the ex-partner countries. Therefore, when governments are biased in favour of their domestic firms, they have an incentive to deviate from global free trade in order to favour these firms. Because market power and political bias have both been identified in the agriculture sector (Reimer and Stiegert, 2006; Hueth and Marcoul, 2006; Conforti and Salvatici, 2004; McCorriston, 2002; and Boehlje and Doreing, 2000), the result of May (2008) suggests that GFTA is not stable.

On the other hand, May (2011) found that bilateral agreements could eventually be used as alternative political tools to reach GFTA in a world where no country uses distorting domestic policies. In particular, this author found that bilateral agreements in agriculture can be facilitated by means of lump sum transfers paid to domestic firms to compensate them for trade losses. The work of May (2011) provides important guidance on how to reach GFTA when governments are politically biased and when international markets of agricultural commodities are oligopolistic. However, it is not clear whether the results obtained by this researcher hold in a world where countries use distorting domestic support. The objective of this article is to fill this gap by analysing the role of bilateralism in this more realistic world. The aim is, in particular, to determine whether the incentives of consumers and domestic agricultural firms to support bilateral agreements are affected when potential partners use distorting domestic policies. For this purpose, the new literature on International Trade Networks was adopted (see Goyal and Joshi, 2006).

The paper is structured as follows. Section 2 presents the International Trade Network model of Goyal and Joshi (2006). Section 3 explores how the incentives of consumers and firms to support bilateral agreements are affected when potential partner countries use distorting domestic policies to protect their agricultural sector. Section 4 analyses the implications of the analysis conducted in the previous section on the international network equilibrium. Finally, Section 5 concludes the paper.

2. THE INTERNATIONAL SOCIAL NETWORK (ISN) MODEL

2.1. The basic ISN model (Goyal and Joshi, 2006)

An international agreement between countries i and j is described by a link, given by a binary variable $g_{ij} \in \{0,1\}$ with $g_{ij} = 1$ if an agreement exists between countries i and j and $g_{ij} = 0$ otherwise. A network $g_{ij} = \{(g_{ij})_{ij \in N}\}$ is a description of the international agreements that exist among a set $N = \{1,\ldots,N^*\}$ of identical countries, where N^* is the total number of countries. Networks g^c and g^e are the complete network (*i.e.* $g_{ij} = 1$ for all $i, j \in N$) and the empty network (*i.e.* $g_{ij} = 0$ for all $i, j \in N$). Let G denote the set of all possible networks, $g + g_{ij}$ denote the network obtained by replacing $g_{ij} = 0$ in network g by $g_{ij} = 1$, and $g - g_{ij}$ denote the network obtained by replacing $g_{ij} = 1$ in network g by $g_{ij} = 0$. Let $N_i(g) = \{j \in N: g_{ij} = 1\}$ be the set of countries with whom country i has an international trade agreement in network g. Assume that $i \in N_i(g)$ so that $g_{ii} = 1$. The cardinality of $N_i(g)$ is denoted $\eta_i(g)$. In this model $\eta_i(g)$ is also the number of active firms in country i because of the assumption that each country has only one firm (note that the domestic firm in country i is

included in $\eta_i(g)$). Let $L_i(g) = \{(g_{ij})_{ij \in \mathcal{N}} : j \in Ni(g)\}$ be the set of links existing in country i in network g. Note that $g_{ii} \in L_i(g)$. Let $h_i \subset L_i(g) - \{g_{ii}\}$ be a link subset, and let μ_i be the cardinality of h_i.

Goyal and Joshi (2006) assumed that the objective function of the government of each country $i \in N$ is a weighted welfare function W_i: G $\rightarrow$ R. This function is:

$$W_i(g) = a_i CS_i(g) + b_i \pi_i(g) \tag{1}$$

where $CS_i(g)$ is consumer surplus in network g; π_i(g) is the total profit that the domestic firm of country i makes in network g; and a_i and b_i (with $0 \leq a_i, b_i \leq 1$) are exogenous weights representing governments' bias in favour of either consumers or domestic firms, respectively.

2.2. Market structure

In the ISN model each country in the world produces a homogeneous good which can be traded internationally. When two countries form an agreement, their domestic firms compete a la Cournot in the domestic market of these countries. This market structure assumption is suitable to study international trade in agriculture because market power in this sector has been recognized and supported by different researchers (see, for instance, Reimer and Stiegert, 2006; Hueth and Marcoul, 2006; McCorriston, 2002; Boehlje and Doreing, 2000; Deodhar and Sheldon 1995; and Patterson and Abbott 1994). It is also summed that each country establishes a prohibitive tariff avoiding any trade among them (see May, 2011; May, 2008; Furusawa and Konishi, 2007; Goyal and Joshi, 2006; and Furusawa and Konishi, 2005). If two countries decide to sign an agreement, then each one offers the other free market access.

For the analysis that is developed in this paper, two solutions of the Cournot game were considered: one for the case when no country uses distorting domestic policies; and the other solution for the case in which a particular country protects its agricultural sector with a distorting domestic policy. These solutions are described as follows:

2.2.1 Market without distorting domestic policies

Let $P_i = \alpha_i - Q_i$ be the inverse demand of the unique good in country $i \in N$, where P_i is the price of this good in the domestic market in country i, α_i represents the size of this market, and Q_i is the total output demanded in this country. Let $\gamma_i < \alpha_i$ be the marginal cost of the firm in country i. It is assumed that all countries are symmetrical (*i.e.* $\alpha_i = \alpha$ and $\gamma_i = \gamma$ for all $i \in N$). It is also assumed that firms play Cournot in each market where they compete. The equilibrium output of the firm in country i in the domestic market is given by $Q_i^i(g) = (\alpha - \gamma)/(\eta_i(g) + 1)$, and the total output of equilibrium in this market is given by $Q_i(g) = (\alpha - \gamma)\eta_i(g)/(\eta_i(g) + 1)$. Likewise, the equilibrium output of the firm in country i that is sold in country k is given by $Q_k^i(g) = (\alpha - \gamma)/(\eta_k(g) + 1)$.

Consumer surplus in country *i* (*i.e.* $CS_i(g)$), profit of the firm in country *i* in the domestic market (*i.e.* $\pi_i^i(g)$), and profit of the same firm in country *k* (*i.e.* $\pi_k^i(g)$) are given by $Q_i(g)^2/2$, $(P_i - \gamma)Q_i^i(g)$, and $(P_k - \gamma)Q_k^i(g)$, respectively. By replacing the equilibrium quantities and the inverse demand into these definitions, the following expressions are obtained: (*i*) $CS_i(g) = (\alpha - \gamma)^2 \eta_i(g)^2/2(\eta_i(g) + 1)^2$; (*ii*) $\pi_i^i(g) = (\alpha - \gamma)^2/(\eta_i(g) + 1)^2$; and (*iii*) $\pi_k^i(g) = (\alpha - \gamma)^2/(\eta_k(g) + 1)^2$. Finally, total profit made by the domestic firm of country *i* in network *g* is given by $\pi_i(g) = \Sigma_{k \in Ni(g)} \pi_k^i(g)$. From these expressions and by assuming that $\alpha - \gamma = 1$ without loss of generality, the welfare function defined in equation 1 becomes:

$$W_i(g) = a_i \frac{1}{2} \frac{\eta_i^2(g)}{(\eta_i(g)+1)^2} + b_i \sum_{k \in N_i(g)} \frac{1}{(\eta_i(g)+1)^2} . \qquad (2)$$

2.2.2 Solution with distorting domestic policies

In order to analyse the incentives of consumers and agricultural firms to sign bilateral agreements in agriculture with countries having distorting domestic policies, it was assumed the existence of a single country (country *j*) that protects its agricultural sector with a distorting domestic policy. It is also assumed that the rest of the countries (*i.e.* all country $i \in N - \{j\}$) do not protect their agricultural sectors. To simplify the analysis, the article studies in particular the incentives of consumers and the domestic firm of country *i* to support a bilateral agreement with country *j*. Formally, let us assume, without loss of generality, that the domestic firm of country $i \in N - \{j\}$ faces a marginal cost equal to $\gamma = \alpha/2$; that $\alpha = 2$; and that the domestic firm of country j faces a marginal cost equal to $\gamma_j < \gamma$. It is assumed that this firm faces a smaller marginal cost because country *j* supports its agricultural sector by means of a distorting domestic policy. Let $\lambda_j = (\alpha - \gamma_j)/(\alpha - \gamma) \subset \mathrm{R}^+$ be a parameter representing the degree of marginal cost asymmetry in country *j* with respect to the rest of the countries of the world. Because country j is more efficient than the other countries of the world as a consequence of the distorting policy (*i.e.* $\gamma_j < \gamma$), it is concluded that $\lambda_i \in (1,2]$. Finally, let us assume that firms play Cournot competition in all markets. Let $\overline{Z}(g)$ be the variable $Z(g)$ when the government of country *j* protects the agricultural sector with a distorting policy. The total equilibrium output of the domestic firm of country j in network g is given by $\overline{Q}_j^j(g) = (\eta_j(g)(\lambda_j - 1) + 1)/(\eta_j(g) + 1)$ when $\lambda_i \in (1,2]$. Likewise, the total output in equilibrium of firm i in country j is $\overline{Q}_j^i(g) = (2 - \lambda_j)/(\eta_j(g) + 1)$ when $\lambda_i \in (1,2]$. Finally, the total output in equilibrium in country j is given by $\overline{Q}_j(g) = (\eta_j(g) + \lambda_j - 1)/(\eta_j(g) + 1)$. The following expressions are obtained from these outputs:

(*i*) $\overline{CS}_j(g) = (\eta_j(g) + \lambda_j - 1)^2/2(\eta_j(g) + 1)^2$; (*ii*) $\overline{\pi}_k^j(g) = (\eta_k(g)(\lambda_j - 1) + 1)^2/(\eta_k(g) + 1)^2$; (*iii*) $\overline{CS}_i(g) = CS_i(g) = \eta_i^2(g)/2(\eta_i(g) + 1)^2$; (*iv*) $\overline{CS}_i(g + g_{ij}) = (\eta_i(g) + \lambda_j)^2/2(\eta_i(g) + 2)^2$; (*v*) $\overline{\pi}_i^i(g) = \pi_i^i(g) = 1/(\eta_i(g) + 1)^2$; (*vi*) $\overline{\pi}_i^i(g + g_{ij}) = (2 - \lambda_j)^2/(\eta_i(g) + 2)^2$; and (*vii*) $\overline{\pi}_j^i(g + g_{ij}) = (2 - \lambda_j)^2/(\eta_j(g) + 2)^2$.

2.3. Stability (May, 2008)

May (2008) proposes the use of *strongly pairwise stability* to study international trade networks. Formally, strongly pairwise stability is defined as follows: (a) the marginal benefit of country i when deleting at the same time $h_i \subset L_i(g) - \{g_{ii}\}$ international agreements is: $D_i(g, h_i) = W_i(g) - W_i(g - h_i)$; (b) a network $g \in G$ is *strong link deletion proof* if for every player $i \in \mathcal{N}$ and every $h_i \subset L_i(g) - \{g_{ii}\}$ it holds that $D_i(g, h_i) \geq 0$; and (c) a network $g \in G$ is *link addition proof* if for all $i,j \in \mathcal{N}$: $W_i(g + g_{ij}) > W_i(g)$ implies that $W_j(g + g_{ij}) < W_j(g)$. A network $g \in G$ is *strongly pairwise stable* if g is strong link deletion proof as well as link addition proof.

3. INCENTIVES TO SIGN BILATERAL AGREEMNTS

The first part of this section investigates the incentives of consumers and the domestic firm of country i to sign an agreement with country j when the latter does not protect its agricultural sector with a distorting domestic policy. This analysis is based on the research developed by May (2008). The results are then used as a benchmark to determine how these incentives are affected when country j protects its agricultural sector.

3.1 Incentives to sign bilateral agreements when no country uses distorting policies

It is easy to show that consumers always support the formation of bilateral agreements (i.e. $CS_i(g + g_{ij}) > CS_i(g)$ for all $i \in N$ and all $g \in G$). This is because international agreements reduce market power in the domestic markets of the signatory countries increasing, in this way, consumer surplus (i.e. consumer surplus effect, *CSE*). As a consequence, if countries are characterised by the unusual condition in which all governments are biased in favour of consumers, then bilateralism leads to GFTA as can be inferred from the equilibrium condition defined in Section 2.3. A domestic agricultural firm, in contrast, can either support or reject bilateral agreements. In particular, a firm supports a bilateral agreement when the profit that it makes in the new partner country (i.e. the expansion effect, *EE*) is larger than the loss of profits that this firm faces in the domestic market after the agreement is signed (i.e. the competition effect, *CE*). Conversely, a firm rejects a bilateral agreement when the *CE* dominates the *EE*. This is actually why global free trade is not stable when governments are biased in favour of domestic firms. As shown by May (2008), the *CE* dominates the *EE* when governments break simultaneously several international agreements.

3.2 Incentives to sign bilateral agreements when country *j* uses a distorting policy

This part investigates whether the incentives of consumers and firms to support bilateral agreements are affected when the potential partner country (country j) uses a distorting domestic policy to protect its agricultural sector. This analysis is presented as follows.

Proposition 1: *Consumers' incentive to support bilateral agreements is not affected when a potential partner country adopts a distorting domestic policy.*

Proof: The following expression was obtained from the definitions given in Section 2: $\overline{CS}_i(g+g_{ij})-\overline{CS}_i(g) = CS_i(g+g_{ij}) - CS_i(g) + 0.5(\lambda_j - 1)(2\eta_i(g) + \lambda_j + 1)/(\eta_i(g) + 1)^2$. Because $CS_i(g + g_{ij}) > CS_i(g)$ (May, 2008) and $\lambda_j > 1$ for definitions, it is concluded that $\overline{CS}_i(g+g_{ij}) > \overline{CS}_i(g)$. Now, since $CS_i(g + g_{ij}) > CS_i(g)$ and $\overline{CS}_i(g+g_{ij}) > \overline{CS}_i(g)$, it is concluded that consumers' incentive to support bilateral agreements is not affected when a potential partner country adopts a distorting domestic policy. □

The reason of why consumers' incentive to support bilateral agreements is not affected is because the agricultural good imported from the country that protects its agricultural sector is cheapened by the distorting policy. As a consequence, consumers are benefited from the agreement.

Let us now consider the domestic firm's incentive to support or reject a bilateral agreement. As explained above, this firm can either support or reject a bilateral agreement depending on which effect is stronger, the *CE* or the *EE*.

Proposition 2: *A firm's incentive to reject a bilateral agreement is not affected when a potential partner uses a distorting domestic support. In contrast, a firm's incentive to support a bilateral agreement is only affected when the distorting effect of the policy adopted by a potential partner is large enough.*

Proof: The following expression was obtained from the definitions given in Section 2:

$$\bar{\pi}_i(g+g_{ij})-\bar{\pi}_i(g) = \pi_i(g+g_{ij})-\pi_i(g)+(1-\lambda_j)(3-\lambda_j)\left[\frac{(\eta_i(g)+2)^2+(\eta_j(g)+2)^2}{(\eta_i(g)+2)^2(\eta_j(g)+2)^2}\right]$$

$$= \pi_i(g+g_{ij})-\pi_i(g)+\Omega(\lambda_j)$$

where $\Omega(\lambda_j)$ represents the distorting effect of the policy adopted by country *j* on the marginal profits made by the domestic firms of country *i*. Because $(1 - \lambda_j)(\lambda_j - 3) < 0$ for all $\lambda_j \in (1,2]$, it is concluded that $\Omega(\lambda_j) < 0$. This implies that if $\pi_i(g+g_{ij}) < \pi_i(g)$, then $\bar{\pi}_i(g+g_{ij}) < \bar{\pi}_i(g)$. As a consequence, the firm's incentive to reject a bilateral agreement is not affected when a potential partner uses a distorting domestic support. On the other hand, note that $\Omega(\lambda_j) \to 0$ as $\lambda_j \to 1$. As a consequence, it is always possible to find a small enough $|\Omega(\lambda_j)|$ such as $\bar{\pi}_i(g+g_{ij})-\bar{\pi}_i(g) > 0$ when $\pi_i(g+g_{ij})-\pi_i(g) > 0$ as $\lambda_i \in (1,2] \subset \mathrm{R}^+$. This implies that the firm's incentive to support a bilateral agreement is not affected when the distorting effect of the policy adopted by the potential partner is relatively small. Finally, note that $\bar{\pi}_i(g+g_{ij})-\bar{\pi}_i(g) \to -1/(\eta_i(g) + 1)^2$ as $\lambda_i \to 2$. This implies that when the distorting

effect of the policy adopted by the potential partner is large enough, $\overline{\pi}_i(g+g_{ij}) < \overline{\pi}_i(g)$ even when $\pi_i(g + g_{ij}) > \pi_i(g)$. □

In this case the incentive of a domestic firm to reject a bilateral agreement is not reversed when a potential partner adopts a distorting domestic policy. In contrast, the incentive of a firm to support a bilateral agreement can be reversed when the distorting effect of the domestic policy is large enough. The reason is because the distorting policy reduces the marginal cost of the domestic firm of the potential partner country. This firm, in response to the decrease in marginal cost, increases production and this, in turn, reduces market power in the markets were this firm competes. This decrease in market power reduces the profits made by the other competitor firms. If this profit reduction is large enough, then the incentives of the latter to support a bilateral agreement is reversed.

4. INTERNATIONAL AGRICULTURAL TRADE EQUILIBRIUM

In order to determine the stability of the international network when a country adopts a distorting domestic policy, two extreme cases were considered: (*i*) governments are biased in favour of consumers (i.e. $a_i = 1$ and $b_i = 0$ in equation 2); and (*ii*) governments are biased in favour of their domestic firm (i.e. $a_i = 1$ and $b_i = 0$ in equation 2). They are discussed as follows. In the first case, governments only consider consumer surplus in the welfare function. Because $CS_i(g) = \eta_i(g)^2/2(\eta_i(g) + 1)^2$ and $\overline{CS}_i(g) = (\eta_i(g) + \lambda_j + 1)^2/2(\eta_i(g) + 1)^2$, it is concluded that $\partial CS_i(g)/\partial \eta_i(g) > 0$ and $\partial \overline{CS}_i(g)/\partial \eta_i(g) > 0$ for all $\lambda_i \in (1,2]$. This implies that the unique stable network is GFTA. This is exactly the same result that is obtained when no country uses distorting policies. Because the existence of a distorting policy does not reverse consumers' incentives to support bilateral agreements (see Proposition 1), it is concluded that when governments are biased in favour of these individuals, bilateral agreements can lead to GFTA independently of the existence of distorting domestic policies. On the other hand, it is easy to show that GFTA is not stable when governments are biased in favour of their domestic firms and when a country adopts a distorting domestic policy. To see that, note that $\pi_i(g^c) = N(2 - \lambda_j)/(N + 1)^2 < \pi_i(g^e) =$ ¼ for all $N > 0$ and all $\lambda_i \in (1,2]$. This implies that a country always prefers autarky to GFTA. According to Proposition 2, bilateral agreements cannot help to reach this condition because firms' incentives to reject bilateral agreements are not reversed.

These results reveal that any deviation from GFTA can only be explained by the incentives of domestic firms to reject bilateral agreements as consumers always prefer free trade. How could agricultural firms be motivated to support bilateral agreements? According to May (2011), this can be achieved by compensating them for trade losses with lump sum transfers financed from consumer. Could the same policy strategy be used in a world where countries use distorting domestic support? To answer this question, let us consider the following analysis. Let $T_i(g)$ be a lump sum transfer financed from the consumers of country *i* and given to the domestic firm of this country in network *g*. This transfer is Pareto improving if the following two conditions are both satisfied: (*i*) $\overline{CS}_i(g+g_{ij}) - T_i(g + g_{ij}) > \overline{CS}_i(g) - T_i(g)$; and (*ii*) $\overline{\pi}_i(g+g_{ij}) + T_i(g + g_{ij}) > \overline{\pi}_i(g) + T_i(g)$. Note that these conditions imply that

$\overline{CS}_i(g+g_{ij}) - \overline{CS}_i(g) > T_i(g + g_{ij}) - T_i(g) > \bar{\pi}_i(g) - \bar{\pi}_i(g+g_{ij})$. This, in turn, implies that $\overline{CS}_i(g+g_{ij}) + \bar{\pi}_i(g+g_{ij}) > \overline{CS}_i(g) + \bar{\pi}_i(g)$. In order to simplify notation, let $\bar{\theta}_i(g) = \overline{CS}_i(g) + \bar{\pi}_i(g)$. The last inequality can therefore be represented as $\bar{\theta}_i(g+g_{ij}) > \bar{\theta}_i(g)$. If this condition is satisfied in country *i*, then there exists a Pareto improving lump sum transfer that can be used to compensate the domestic firm of this country for trade losses and to promote, in this way, bilateral agreements. The following proposition shows that this inequality holds for any country whose government does not use distorting domestic policies (i.e. for any $i \in N - \{j\}$).

Proposition 3: *If country i does not use distorting domestic policies to protect its agricultural sector, then* $\bar{\theta}_i(g+g_{ij}) > \bar{\theta}_i(g)$ *for all* $g \in G$.

Proof: Note that that $\bar{\theta}_i(g+g_{ij}) > \bar{\theta}_i(g)$ is equivalent to $\overline{CS}_i(g+g_{ij}) - \overline{CS}_i(g) + \bar{\pi}^i_i(g+g_{ij}) - \bar{\pi}^i_i(g) + \bar{\pi}^i_j(g+g_{ij}) > 0$. Therefore, a sufficient condition to prove that $\bar{\theta}_i(g+g_{ij}) > \bar{\theta}_i(g)$ for all $g \in G$ is to show that $\overline{CS}_i(g+g_{ij}) - \overline{CS}_i(g) + \bar{\pi}^i_i(g+g_{ij}) - \bar{\pi}^i_i(g) > 0$. Since $\overline{CS}_i(g+g_{ij}) = \frac{1}{2}\frac{(\eta_i(g)+\lambda_j)^2}{(\eta_i(g)+2)^2}$; $\overline{CS}_i(g) = \frac{1}{2}\frac{\eta_i^2(g)}{(\eta_i(g)+1)^2}$; $\bar{\pi}^i_i(g+g_{ij}) = \frac{(2-\lambda_j)^2}{(\eta_i(g)+2)^2}$; and $\bar{\pi}^i_i(g) = \frac{1}{(\eta_i(g)+1)^2}$, this inequality holds when:

$$\frac{2\eta_i^3(\lambda_j-1)+\eta_i^2[\Gamma+4\lambda_j-5]+2\eta_i[\Gamma+\lambda_j-4]+\Gamma-8}{2(\eta_i+1)^2(\eta_i+2)^2} > 0$$

This inequality is verified for all $\lambda_i \in (1,2]$, where $\Gamma = \lambda_j^2 + 2(2-\lambda_j)^2$. Since g is an arbitrary network, it must be concluded, therefore, that $\bar{\theta}_i(g+g_{ij}) > \bar{\theta}_i(g)$ for all $g \in G$. □

According to this proposition, the use of compensatory payments can help the formation of bilateral agreements in countries that do not distort their agricultural sector. This is because consumer surplus is large enough to provide the sources that are needed to compensate farmers from trade losses with lump sum transfers.

Let us now consider the case of a country that uses a distorting domestic policy to protect its agricultural sector.

Proposition 4: *If country j protects its agricultural sector with a distorting domestic policy, then* $\bar{\theta}_j(g+g_{ij}) > \bar{\theta}_j(g)$ *for all* $\eta_j(g) > 2$. *If country j is a singleton, then* $\bar{\theta}_j(g+g_{ij}) > \bar{\theta}_j(g)$ *when the distorting effect of the domestic policy is large enough.*

Proof: First note that:

$$\bar{\theta}_j(g+g_{ij})-\bar{\theta}_j(g)=\theta_j(g+g_{ij})-\theta_j(g)+\frac{(\lambda_j-1)}{2}\left[\frac{2\eta_j(g)+\lambda_j+1}{(\eta_j(g)+2)^2}\right]$$
$$+\frac{(\eta_j(g)+1)^2(\lambda_j-1)^2+2(\eta_j(g)+1)(\lambda_j-1)}{(\eta_j(g)+2)^2}$$
$$+\frac{(\eta_i(g)+1)^2(\lambda_j-1)^2+2(\eta_i(g)+1)(\lambda_j-1)}{(\eta_i(g)+2)^2}$$
$$-\frac{\eta_j^2(g)(\lambda_j-1)^2+2\eta_j(g)(\lambda_j-1)}{(\eta_j(g)+1)^2}$$

From this expression and considering the fact that $\theta_j(g+g_{ij}) > \theta_j(g)$ for all $\eta_i(g) > 2$ (see Appendix A), it is possible to show that $\bar{\theta}_j(g+g_{ij}) > \bar{\theta}_j(g)$ holds for all $\eta_i(g) > 2$ by proving the following sufficient condition:

$$\frac{(\lambda_j-1)}{2}\left[\frac{2\eta_j(g)+\lambda_j+1}{(\eta_j(g)+2)^2}\right]+\frac{(\eta_j(g)+1)^2(\lambda_j-1)^2+2(\eta_j(g)+1)(\lambda_j-1)}{(\eta_j(g)+2)^2}$$
$$-\frac{\eta_j^2(g)(\lambda_j-1)^2+2\eta_j(g)(\lambda_j-1)}{(\eta_j(g)+1)^2}>0$$

By rearranging terms, this is equivalent to:

$$\frac{(\lambda_j-1)(2\eta_j^3(g)+\eta_j^2(g)(5\lambda_j-3)+2\eta_j(g)(5\lambda_j-12)+3(\lambda_j-1)+6)}{2(\eta_j(g)+1)^2(\eta_j(g)+2)^2}>0$$

This inequality is satisfied for all $\lambda_i \in (1,2]$ and all $\eta_i(g) > 2$. Suppose now that country *j* is a singleton. In this case:

$$\bar{\theta}_j(g+g_{ij})-\bar{\theta}_j(g)=\frac{(2+\lambda_j-1)^2}{18}-\frac{3\lambda_j^2}{8}+\frac{(2(\lambda_j-1)+1)^2}{9}-\frac{(\eta_i(g)(\lambda_j-1)+1)^2}{(\eta_i+2)^2}$$

By rearranging terms, $\theta_j(g+g_{ij}) > \theta_j(g)$ when the following expression is positive:

$$24(\lambda_j-1)^2(\eta_i+1)^2+(\eta_i+2)^2[(\lambda_j-1)(3\lambda_j-5)-1]+48(\lambda_j-1)(\eta_i+1)+24$$

It is easy to show that this expression is positive when $\lambda_j \to 2$ (*i.e.* when the distorting effect of the domestic policy is large enough). □

According to this proposition, lump sum transfers can also be used to promote bilateral agreements in countries whose governments use distorting policies to protect

their agricultural sectors. The only exception is given when these countries are a singletons and when the distorting effect of the policy is not large enough.

V. CONCLUSSIONS

This article studies the conditions that are needed to make bilateral agreements suitable political tools to reach global free trade in agriculture (GFTA) when partner countries protect their agricultural sector with a distorting domestic policy. It was found that bilateral agreements can lead to GFTA with the help of lump sum transfers financed by consumers and given to farmers to compensate them from trade losses. The advantage of these payments is that they are Pareto improving. A similar result was found by May (2011) for the case in which countries do not distort their agricultural sector. This finding implies that the results of May (2011) are robust.

Unfortunately the use of compensatory payments is restricted under the Uruguay Round Agreement in Agriculture because they are not fully decoupled from production. Moreover, some researchers have argued that direct payments should completely be eliminated in order to favour trade liberalisation (see, for example, Devadoss, 2006; and Khor, 2003). Contrary to this argument, the results found in this article show that compensatory payments are trade facilitators even in a world where countries distort their agricultural sector. It is for this reason that these payments should be considered as key political tools to help countries to reach GFTA by means of bilateral agreements.

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Appendix A

This Appendix shows the proof of the following statement:

For all $\eta_i(g) > 2$ *it holds that* $\theta_i(g + g_{ij}) > \theta_i(g)$.

Proof: Note that $\theta_j(g)$ is the welfare function when governments are politically unbiased (i.e. $a_i = b_i = 1$ in Equation 2). Proposition 1 of Goyal and Joshi (2006) shows that in this case there are two pairwise stable networks: (*i*) global free trade; and (*ii*) a network formed of one singleton and one complete component (i.e. a subset of countries in which all its members have an agreement with each other). The existence of these stable networks implies that $\theta_i(g + g_{ij}) > \theta_i(g)$ for all $\eta_i(g) > 2$ under pairwise stability. The same conclusion would hold if these networks were also strongly pairwise stable. Therefore, what is needed is to show that these networks are also strongly pairwise stable. This is shown as follows. Let us first consider the stability of the complete network. Note that $\theta_i(g^c) = (N^2 + 2N)/2(N + 1)^2$ and $\theta_i(g^e) = 3/8$. Because $\theta_i(g^c) \geq \theta_i(g^e)$ when $N^2 + 2N - 3 \geq 0$, it is concluded that no country in g^c has an incentive to break simultaneously all its links for all $N \geq 1$. Let us now consider welfare of a country when breaking h_i links from g^c. In this case $\theta_i(g^c - h_i) = (\eta_i(g^c - h_i)^2 + 2)/2(\eta_i(g^c - h_i)^2 + 1)^2 + (\eta_i(g^c - h_i) - 1)/(N + 1)^2$ and, therefore, $\partial\theta_i(g^c - h_i)/\partial\eta_i(g^c - h_i) = (\eta_i(g^c - h_i) - 2)/(\eta_i(g^c - h_i)^2 + 1)^3 + 1/(N + 1)^2$ which is positive for all $\eta_i(g^c - h_i) > 1$. It should be concluded, therefore, that the complete network is strongly pairwise stable. Regarding the second network, it is straightforward to show that no country of the complete component has an incentive to break existing international agreements using the same proof for the case of the complete network (this can be made by replacing N with $N - 1$). Regarding the singleton, this country is unwilling to sign an agreement with a country of the complete components (i.e. $\theta_i(g^e)$

$\geq \theta_i(g^e + g_{ij})$). Since $\theta_i(g^e) = 3/8$ and $\theta_i(g^e + g_{ij}) = 1/3 + 1/(N + 1)^2$, it is concluded that $\theta_i(g^e) \geq \theta_i(g^e + g_{ij})$ when $(N + 1)^2 > 24$ which is satisfied for all $N > 3$. It should be concluded, therefore, that the second network is also strongly pairwise stable when the size of the network is $N > 3$. □