

# Trade Agreements, Political Economy, and Endogenously Incomplete Contracts\*

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Preliminary Draft – Comments Welcome

## Abstract

We develop a political economy model of trade agreements following along the line of Grossman and Helpman (1995a) yet incorporating contracting costs, uncertainty and multiple policy instruments. We show that rent-seeking efforts do not affect tariff rates as they are offset by the substitution effect of domestic production subsidies. Similar to Horn et al (2010), we find the coexistence of uncertainty and contracting costs make optimal trade agreements incomplete contracts. Our model helps explain differential treatment on subsidies, countervailing duties, and the national treatment principle.

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## 1. Introduction

The divergence of trade policy from trade theory has justifiably drawn significant attention. Trade agreements have never been easy to negotiate (e.g. WTO Doha round) nor have they always been effectively enforced. Economists have provided frameworks/models that explain the structure of optimal trade agreements under somewhat restrictive assumptions. Two different avenues are prominent in the literature. The first approach takes trade agreements as incomplete contracts and utilizes contract theory (Copeland 1990, Battigalli and Maggi 2003, Horn 2006, Horn et al 2010). Along this avenue, Horn et al (2010) were the first to endogenously include the set of policy instruments thereby modeling trade agreements as endogenously incomplete contracts. They assume that production and consumption externalities, as opposed to rent-seeking behavior, are the rationale for policy intervention.<sup>1</sup>

The second approach considers rent-seeking behavior as the rationale for policy intervention. Putman (1988) utilizes a two-level game where at the national level, domestic interest groups compete while governments attempt to construct coalitions amongst those groups. At the international level, governments seek to maximize their own ability to satisfy domestic rent-seeking pressures while minimizing the adverse consequences from foreign counterparts. Grossman and Helpman(1995b) incorporated the two levels into one sequential game and derived the necessary conditions for a free trade agreement to be an equilibrium outcome. Along this vein, Maggi and Rodriguez-Clare's (1998, 2007) find that the optimal agreement that stipulates discretionary tariffs below the upper bound is identical to an incomplete contract which fails to specify the future contributions of a lobby. However, as they noted, their model does not capture other important factors such as uncertainty and contracting costs.

To summarize, the incomplete contract approach has not consider rent-seeking pressures as an incentive for trade agreements while the political economy literature has not considered essential elements of contracting incompleteness such as uncertainty and contracting costs. We attempt to develop a model which allows for rent-seeking pressures while accounting for uncertainty and contracting costs.<sup>2</sup> We follow Grossman and Helpman (1995a) by assuming that each lobby sets contribution schedules to maximize total net payoff of its members; and the incumbent government maximizes an expected weighted sum of aggregate social welfare and total political contributions received from the lobbies.<sup>3</sup> We follow an approach similar to Battigalli

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<sup>1</sup>Horn et al (2010) explored a political economy version of their model as well but utilized a reduced form for the politician's objective function and assumed that governments place a greater weight on producer surplus. However, as Grossman and Helpman (1994) noted in their paper, a reduced form would catch the effects of institutional changes on a government's willingness and ability to protect particular interest groups but not on the government's weighting of political contributions relative to national welfare.

<sup>2</sup>A clear example of the excessive contract costs was the WTO agreement itself which took approximately 8 years of negotiation and contains 24,000 pages of clauses. It has been argued that many of the negotiators, particularly in developing countries where resources may be limited, were very unclear about what they were negotiating.

<sup>3</sup>Others have chosen different government objective functions. For example, Limão and Pana-

and Maggi (2002) by assuming that contracting costs are increasing in the number of state variables and policies included in the agreement. Working within a competitive two-country setting, we characterize the choice of contract form endogenously. We find that if there is no contracting cost, it is in the best interest of both countries to impose trade policies that are equivalent to free trade. We derive three results consistent with Horn et al (2010) but within a political economy context: (i) it is not optimal to contract over domestic subsidies while leaving tariffs to discretion; (ii) it is optimal to leave subsidies to discretion if countries trade little or the substitutability between tariffs and domestic production subsidies is limited; and (iii) it is optimal to leave National Treatment (NT) based consumption taxes to discretion if countries trade little or the substitutability between tariffs and domestic consumption taxes is limited.

In the following section we develop our political economy model and find the optimal trade and domestic production policies resulting from both a noncooperative equilibrium and a costless trade agreement. Section III extends the model by accounting for uncertainty and contracting cost. Section IV further extends the model by characterizing the optimal NT-based trade agreement. Our conclusions are outlined in section V.

## 2. A Political Economy Model of Production Subsidies and Trade Policies

We consider trade between two countries (Home, Foreign) and denote Foreign by  $*$ . We assume that there is a numeraire good 0 which is not subject to any policy interventions and  $n$  other nonnumeraire goods in each country. Prior to policy intervention some of these  $n$  goods are imported while others may be exported. A representative individual of Home maximizes the following utility:

$$u = c_0 + \sum_{i=1}^n u_i(c_i), \quad (1)$$

where  $c_0$  is the consumption of numeraire good 0 and  $c_i$  is the consumption of good  $i$ . The sub-utility functions  $u_i(\cdot)$  are assumed differentiable, increasing and strictly concave. We let  $q_i$  denote the domestic consumer price of good  $i$  in Home, and  $d_i(q_i)$  denote the representative individual's demand for good  $i$ , which is the inverse of  $u'_i(\cdot)$ . Their indirect utility is given by

$$v(q, e) = e + S(q), \quad (2)$$

where  $e$  is total spending, and  $q = (q_1, q_2, \dots, q_n)$  is the vector of domestic consumer prices of the nonnumeraire goods and  $S(q) \equiv \sum_i u_i[d_i(q_i)] - \sum_i q_i d_i(q_i)$  is the consumer surplus associated with these goods.

The numeraire good 0 is produced using only labor, has constant returns to scale, and an input-output ratio of 1. We assume that the aggregate labor supply is large

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gariya (2007) assume that the governments objective function weighs social welfare and inequality not political contributions.

enough to maintain positive production of this good. The competitive wage is 1. Each of the other goods is produced from labor and an industry-specific input. Letting  $p_i$  represent domestic producer price, the aggregate profit accruing to the specific factor used in industry  $i$ , denoted by  $\Pi_i(p_i)$ , is an increasing function of  $p_i$ . The aggregate supply of good  $i$  is the slope of the profit function ( $X(p_i) = \Pi'_i(p_i) > 0$  for  $i = 1, 2, \dots, n$ .)

In this section we assume that each government can intervene in any of its non-numeraire sectors using a specific tariff/export subsidy and a specific domestic production subsidy/tax.<sup>4</sup> We denote an ad valorem tariff or export subsidy for industry  $i$  by  $\tau_i$  and thus

$$q_i \equiv \tau_i \omega_i, \quad (3)$$

where  $\omega_i$  represents the world price. If  $\tau_i > 1$  it represents the tariff on an import good or the export subsidy on an export good. Conversely, if  $\tau_i < 1$  it represents an import subsidy or an export tax. We introduce a domestic production subsidy/tax for industry  $i$  and denote by  $s_i$ . The pricing relationship between the Home producer price and the Home consumer price can be expressed as

$$p_i \equiv q_i + s_i. \quad (4)$$

Net imports of good  $i$  in Home are  $M_i = Nd_i(q_i) - X_i(p_i)$ , where  $N$  is the size of the population, which we henceforth normalize to 1. Similarly, net imports of good  $i$  in Foreign are  $M_i^* = d_i^*(q_i^*) - X_i^*(p_i^*)$ . Note that  $q_i = \tau_i \omega_i$ ,  $p_i = \tau_i \omega_i + s_i$ ,  $q_i^* = \tau_i^* \omega_i$  and  $p_i^* = \tau_i^* \omega_i + s_i^*$ . Clearing of the world market requires that

$$M_i(\tau_i \omega_i, s) + M_i^*(\tau_i^* \omega_i, s^*) = 0, \quad i = 1, 2, \dots, n. \quad (5)$$

Equation (5) allows us to solve for  $\omega_i$ , the world market clearing price of good  $i$ , as a function of  $\tau_i$ ,  $\tau_i^*$ ,  $s_i$  and  $s_i^*$ . We denote this functional relationship by  $\omega_i(\tau_i, \tau_i^*, s_i, s_i^*)$ .

The vector of trade policies  $\tau = (\tau_1, \tau_2, \dots, \tau_n)$ , the vector of domestic production subsidy policies  $s = (s_1, s_2, \dots, s_n)$ , and market clearing prices  $\omega = (\omega_1, \omega_2, \dots, \omega_n)$  generate government revenue of

$$R(\tau, s, \omega) = \sum_i (\tau_i - 1) \omega_i [d_i(\tau_i \omega_i) - X_i(\tau_i \omega_i + s_i)] - \sum_i s_i X_i(\tau_i \omega_i + s_i). \quad (6)$$

A representative individual obtains income from wages, possible claims (profits) to one of the industry-specific inputs, as well as government transfers. Individuals are assumed to own at most one type of claim to the industry-specific inputs (e.g. claims to industry-specific human capital). Changes in  $\tau_i$  and/or  $s_i$  affect an individual's utility through both changes in consumer prices and claims. However, an individual holding a claim in industry  $j$  will be primarily affected from  $\tau_j$  and  $s_j$  through their claim  $\Pi_j$ .

The owners of the specific factor used in industry  $i$ , with their common interest

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<sup>4</sup>We introduce consumption taxes as a policy instrument in section IV when analyzing the effect of an NT clause.

in protection or subsidies for that industry, may choose to create a lobby or join an existing lobby in an attempt to influence government policy. However, not all owners of specific factors succeed in organizing politically (free rider problems, transaction costs, etc.) and thus some industries have no means to effectively influence policy. The set of industries, denoted by  $L$ , where specific factor owners are organized is assumed exogenous. Following Grossman and Helpman (1994) we assume that lobby groups express their policy demands by means of political contribution schedules.

Each lobby group represents a certain industry  $i$  and sets contribution schedules  $C_i(\tau, s, \bullet)$  to maximize the joint welfare of its members.<sup>5</sup> Note that we have omitted arguments that represent Foreign policies thus allowing us to distinguish the case of a noncooperative equilibrium (where the contribution schedule depends only on the policies of the Home government) from that of cooperative equilibrium (where the contributions may also depend on policies implemented by the Foreign government). The objective of lobby group  $i$  can be expressed as

$$V_i = W_i(\tau, s, \omega) - C_i(\tau, s, \bullet), \quad (7)$$

where

$$W_i(\tau, s, \omega) \equiv l_i + \Pi_i(p_i) + \alpha_i[R(\tau, s, \omega) + S(\tau\omega)] \quad (8)$$

is its gross joint welfare. Note  $\alpha_i$  is the fraction of the voting population that owns the specific factor used in industry  $i$ ,  $l_i$  is the joint labor income of these factor owners and  $S(\bullet)$  is consumer surplus as previously defined.

We assume that governments maximize their political welfare which is equal to the weighted sum of the welfare of its representative voter and total political contributions received. The Home government's objective is

$$G = \sum_{i \in L} C_i(\tau, s, \bullet) + aW(\tau, s, \omega), \quad a \geq 0 \quad (9)$$

where  $a$  reflects the government's weighting of aggregate social welfare relative to political contributions. Note  $W$  represents the aggregate social welfare which is given by

$$W(\tau, s, \omega) \equiv l + \sum_i \Pi_i(p_i) + R(\tau, s, \omega) + S(\tau\omega), \quad (10)$$

where  $l$  is the aggregate labor income.

The sequence of actions by the various political forces in the two-level game are as follows. First, various lobbies in each country simultaneously and noncooperatively set contribution schedules that make the amount of political contributions contingent on possible policy outcomes. Each lobby takes as given the contribution schedules of all other lobbies at home and abroad. Second, both governments weigh net gains from acting cooperatively versus noncooperatively. In either case, the contribution schedules in one country are unobservable to the other. At this stage, costs of cooperation—drafting and negotiating a detailed trade agreement—which we refer

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<sup>5</sup>Those industries which do not organize have  $C_i(\tau, s, \bullet) = 0$ .

to as contracting costs, become important. We allow the relative weight of aggregate social welfare ( $a$ ), the fraction of population in industry  $i$  ( $\alpha_i$ ), and the volume of import demand in a certain industry ( $M_i$ ) to change during the lifetime of the agreement.<sup>6</sup> In addition some industries may create or dissolve a lobby during the lifetime of the agreement. An implicit assumption throughout is that trade agreements are perfectly enforceable. The two governments set their trade policies and domestic production policies either cooperatively or noncooperatively depending on the net gains from each.

### *The Noncooperative Equilibrium*

We derive the policy choices which occur in the absence of a trade agreement (i.e., a noncooperative equilibrium). Taking Foreign government's policies  $(\tau^*, s^*)$  as given, Home government's noncooperative policy vectors satisfy the following two conditions:

$$(\tau^0, s^0) = \arg_{\tau, s} \max G(\tau, s, \tau^*, s^*), \text{ and} \quad (11)$$

$$(\tau^0, s^0) = \arg_{\tau, s} \max [V_i(\tau, s, \tau^*, s^*) + G(\tau, s, \tau^*, s^*)] \text{ for every } i \text{ in } L. \quad (12)$$

The first condition states that Home government selects the policy vectors that maximize their own interest, given the contribution schedules offered by the domestic lobby groups and subject to the policy choices of Foreign government. The second condition stipulates that the equilibrium policy vectors must maximize the joint welfare of the government and each lobby  $i$ , taking the contribution schedules of all other lobbies as given. If this is not the case, lobby  $i$  could alter its contribution schedule to induce the government to choose the jointly optimal policy vectors and capture the majority of the surplus from the policy switch (Grossman and Helpman, 1994).

Let  $P^0 = (\tau^0, s^0)$  and  $P^{*0} = (\tau^{*0}, s^{*0})$  and assume that contribution schedules are differentiable around the equilibrium point. The first order conditions of equations (11) and (12) give

$$\sum_{j \in L} \nabla_P C_j^0(P^0, P^{*0}) + a \nabla_P W(P^0, P^{*0}) = 0, \text{ and} \quad (13)$$

$$\begin{aligned} & \nabla_P W_i(P^0, P^{*0}) - \nabla_P C_i^0(P^0, P^{*0}) \\ & + \sum_{j \in L} \nabla_P C_j^0(P^0, P^{*0}) + a \nabla_P W(P^0, P^{*0}) = 0 \text{ for all } i \text{ in } L. \end{aligned} \quad (14)$$

The system above implies

$$\nabla_P C_i^0(P^0, P^{*0}) = \nabla_P W_i(P^0, P^{*0}) \text{ for all } i \text{ in } L, \quad (15)$$

which stipulates a property of the equilibrium contribution schedules known as *local*

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<sup>6</sup>Technological and consumer taste changes can affect the level of net import demand ( $M_i$ ) and the number of employees remaining in a certain industry. Political circumstances can change significantly through time as different political parties may come into government, particularly in developing countries. Nordhaus (1975) noted the implicit weighting function on consumption has positive weight during the electoral period and zero (or small) weights in the future.

*truthfulness* (Grossman and Helpman, 1994).<sup>7</sup>

Summing equation (15) over all  $i$  and substituting into equation (13) gives

$$\sum_{i \in L} \nabla_P W_i(P^0, P^*) + a \nabla_P W(P^0, P^*) = 0. \quad (16)$$

This equation gives the equilibrium Home policy choices conditional on Foreign policy vector  $P^*$ . The equilibrium Home policy vectors maximize the weighted sum of aggregate social welfare and the lobbies' gross joint welfare. Similarly, we can obtain the following equilibrium Foreign policy vectors

$$\sum_{i \in L^*} \nabla_{P^*} W_i^*(P^{*0}, P) + a^* \nabla_{P^*} W^*(P^{*0}, P) = 0. \quad (17)$$

We characterize the noncooperative equilibrium policy vectors by substituting  $P^{*0}$  for  $P^*$  in equation (16) and  $P^0$  for  $P$  in equation (17) and treating these as a system of simultaneous equations. Substituting  $P^0 = (\tau^0, s^0)$  into equation (16) and taking derivatives (see appendix) give

$$(I_{iL} - \alpha_L)(\omega_i + \tau_i^0 \omega_{i1})X_i + (a + \alpha_L)[(\tau_i^0 - 1)\omega_i M_i'(\omega_i + \tau_i^0 \omega_{i1}) - \omega_{i1} M_i - s_i^0 X_i'(\omega_i + \tau_i^0 \omega_{i1})] = 0, \text{ and} \quad (18)$$

$$(I_{iL} - \alpha_L)(\tau_i^0 \omega_{i2} + 1)X_i + (a + \alpha_L)\{(\tau_i^0 - 1)\omega_i [d_i' \tau_i^0 \omega_{i2} - X_i'(\tau_i^0 \omega_{i2} + 1)] - \omega_{i2} M_i - s_i^0 X_i'(\tau_i^0 \omega_{i2} + 1)\} = 0. \quad (19)$$

where  $I_{iL}$  is an indicator variable that equals 1 if industry  $i$  is represented by a lobby and 0 otherwise, and  $\alpha_L \equiv \sum_{j \in L} \alpha_j$  is the fraction of voters who are represented by lobbies.

From equation (5) we find the partial derivatives of the world price functions,  $\omega_{i1} = \partial \omega_i / \partial \tau_i = -M_i' \omega_i / (M_i' \tau_i + M_i^{*'} \tau_i^*)$ ,  $\omega_{i2} = \partial \omega_i / \partial s_i = X_i' / (M_i' \tau_i + M_i^{*'} \tau_i^*)$ . Substituting them into Equation (18) and (19) yields an expression for Home's equilibrium policies given by

$$\tau_i^0 - 1 = -\frac{I_{iL} - \alpha_L}{a + \alpha_L} \frac{X_i}{\omega_i M_i'} + \frac{1}{e_i^*} + s_i^0 \frac{X_i'}{\omega_i M_i'}, \text{ and} \quad (20)$$

$$s_i^0 = \frac{I_{iL} - \alpha_L}{a + \alpha_L} \frac{X_i}{X_i'} - (\tau_i^0 - 1) \omega_i \frac{M_i^{*'} \tau_i^*}{d_i' \tau_i^0 + M_i^{*'} \tau_i^*} - \frac{M_i}{d_i' \tau_i^0 + M_i^{*'} \tau_i^*}. \quad (21)$$

where  $e_i^* \equiv \tau_i^* \omega_i M_i^{*'} / M_i^*$  is the elasticity of Foreign export supply or import demand (corresponding to  $M_i^*$  is negative or positive) in industry  $i$ . Equation (20) defines the noncooperative choice of  $\tau_i$  given domestic production policy  $s_i$  and Foreign policies ( $s_i^*$  and  $\tau_i^*$ ). The three terms on the right-hand side of equation (20) represent the *political support* motive, *terms-of-trade* motive, and *substitutability* of domestic pro-

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<sup>7</sup>*Local truthfulness* entails that each lobby  $i$  sets its contribution schedule so that the marginal change in the contribution for a small change in Home policy matches the marginal change in the lobby's gross welfare brought by the change in Home policy.

duction subsidies for trade policies respectively. The first two components consist of the expression for noncooperative trade policies in Grossman and Helpman (1995a). Thus, the noncooperative equilibrium trade policies defined by Grossman and Helpman (1995a) is a special case when the government cannot implement production policies ( $s_i^0 \equiv 0$ ). Equation (20) also shows that the *substitutability* of  $s_i$  is limited if the industry has low price sensitivity of supply ( $X'_i$  is small) or high price sensitivity of import demand ( $|M'_i|$  is large). Equation (21) defines the noncooperative choice of  $s_i$  given Home trade policy  $\tau_i$  and Foreign policies ( $s_i^*$  and  $\tau_i^*$ ).

Solving equations (20) and (21) yields Home's noncooperative policies

$$\tau_i^0 - 1 = \frac{1}{e_i^*}, \text{ and} \quad (22)$$

$$\frac{s_i^0}{p_i} = \frac{I_{iL} - \alpha_L}{a + \alpha_L} \frac{1}{\eta_i}, \quad (23)$$

where  $\eta_i \equiv p_i X'_i / X_i$  is the elasticity of supply in industry  $i$  in Home.<sup>8</sup> Not surprisingly, equation (22) illustrates that Home exploits any international markets power by exerting a tariff (or export tax) at the same level as Johnson's optimal tariff rate (the inverse of elasticity of Foreign export supply or import demand). This is because the *political support* motive and the production subsidy term counter each other. This observation suggests a possible cross-country prediction for uses of tariff policies. That is, developed countries which may be more capable of funding a domestic production subsidy as a substitute for a tariff may be less likely to exert high levels of tariffs in comparison to developing countries. Equation (23) reflects that, in a noncooperative equilibrium, the optimal production policies for each country is to tax industries not represented by lobbies while subsidizing domestic production in industries represented by lobbies. Note, as the fraction of voters represented by lobbies goes down, the rate of the production subsidy in politically organized industries increases while the rate of the production tax in politically unorganized industries decreases. The intuition is that as the number of members in lobbies decreases, the lump sum lobbies receive from government transfers also decreases and therefore account for a smaller fraction of the gross joint welfare. In turn, lobbies care less about the government transfer from production taxes on politically unorganized industries, but have more incentive to seek economic rents resulting from production subsidies. At the extreme case when population in lobbies constitutes a negligible fraction of the voters ( $\alpha_L = 0$ ), the rate of the production subsidies in organized industries would be the highest, while no industry would be taxed, all else equal. Another observation is that as the government places less weight on aggregate social welfare relative to political contributions, the rate of production subsidy/tax ( $|s_i|/p_i$ ) will increase.

### *The Costless Trade Agreement*

Assuming there is no contracting costs, global efficiency requires the two governments to choose policy vectors which maximize the global benefits as defined by the weighted

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<sup>8</sup>This result is consistent with Schleich and Orden (1996).

sum

$$a^*G + aG^* = a^* \sum_{j \in L} C_j(P; P^*) + a \sum_{j \in L^*} C_j^*(P; P^*) + a^*a[W(P, P^*) + W^*(P^*, P)]. \quad (24)$$

Note, the weight of each country's aggregate social welfare are equalized (to  $a^*a$ ) while the relative weights of aggregate social welfare and political contributions within each country are identical to that of the noncooperative case.<sup>9</sup>

Following the same derivations as the noncooperative case, we can show that the contribution schedules remain *locally truthful* and that the following two conditions are satisfied:

$$a^* \sum_{i \in L} \nabla_P W_i(P^0, P^{*0}) + a \sum_{i \in L^*} \nabla_P W_i^*(P^{*0}, P^0) + a^*a[\nabla_P W(P^0, P^{*0}) + \nabla_P W^*(P^{*0}, P^0)] = 0, \quad \text{and} \quad (25)$$

$$a^* \sum_{i \in L} \nabla_{P^*} W_i(P^0, P^{*0}) + a \sum_{i \in L^*} \nabla_{P^*} W_i^*(P^{*0}, P^0) + a^*a[\nabla_{P^*} W(P^0, P^{*0}) + \nabla_{P^*} W^*(P^{*0}, P^0)] = 0. \quad (26)$$

Hence, the equilibrium policy combinations maximize the Global Policy Preference function ( $\Omega$ ) which is defined as

$$\Omega = a^* \sum_{i \in L} W_i(P^0, P^{*0}) + a \sum_{i \in L^*} W_i^*(P^{*0}, P^0) + a^*a[W(P^0, P^{*0}) + W^*(P^{*0}, P^0)]. \quad (27)$$

Given the market clearing price in equation (5), we can establish that equations (25) and (26) are linearly dependent. As a result, only the relative values of  $P$  and  $P^*$  can be recovered.

It is convenient to begin with the case in which factor owners represented by lobby groups comprise a negligible fraction of the voters in each country, i.e.,  $a_L = a_L^* = 0$ . Substituting  $P^0 = (\tau^0, s^0)$  into equation (25) and solving yields the globally efficient policies defined by

$$\tau_i^0 - \tau_i^{*0} = \left( -\frac{I_{iL}}{a} \frac{X_i}{\omega_i M_i'} + s_i^0 \frac{X_i'}{\omega_i M_i'} \right) - \left( -\frac{I_{iL}^*}{a^*} \frac{X_i^*}{\omega_i M_i^{*'}} + s_i^{*0} \frac{X_i^{*'}}{\omega_i M_i^{*'}} \right), \quad \text{and} \quad (28)$$

$$a^*aX_i'[s_i^0(d_i'\tau_i^0 + M_i^{*'}\tau_i^{*0}) + s_i^{*0}X_i^{*'}\tau_i^{*0}] = a^*(d_i'\tau_i^0 + M_i^{*'}\tau_i^{*0})I_{iL}X_i + aX_i'\tau_i^{*0}I_{iL}^*X_i^* - a^*aX_i'(\tau_i^0 - \tau_i^{*0})\omega_i M_i^{*'}\tau_i^{*0}. \quad (29)$$

Equation (28) defines the ratio of the two countries' cooperative trade policies given

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<sup>9</sup>This function of global welfare follows Grossman and Helpman (1995a). Further research would consider alternative forms such as using different Nash weights reflecting relative bargaining abilities of the two governments.

their respective production policies. In contrast to equation (20), the *terms-of-trade* motives of both countries ( $1/e_i^*$  and  $1/e_i$ ) are removed because of cooperation. Note if we let  $s_i \equiv s_i^* \equiv 0$ , we can recover the result  $\tau_i - \tau_i^* = \left(-\frac{I_{iL}}{a} \frac{X_i}{\omega_i M_i'}\right) - \left(-\frac{I_{iL}^*}{a^*} \frac{X_i^*}{\omega_i M_i^{*'}}\right)$  in Grossman and Helpman (1995a). Therefore, the findings in Grossman and Helpman (1995a) again serve as a special case when policy instruments are restricted to joint trade policies. Equation (29) defines the ratio of the two countries' cooperative production policies given their respective trade policies. Solving the system of equations (see appendix) gives

$$s_i^e = \frac{I_{iL}}{a} \frac{X_i}{X_i'}. \quad (30)$$

Similarly, from equations (26) we get

$$s_i^{*e} = \frac{I_{iL}^*}{a^*} \frac{X_i^*}{X_i^{*'}}. \quad (31)$$

Substituting equations (31) and (32) into equation (28) yields

$$\tau_i^e - \tau_i^{*e} = 0. \quad (32)$$

We can extend the analysis to the more general case. When  $a_L \geq 0$  and  $a_L^* \geq 0$ , equation (32) still holds but with respect to production policies we find that

$$s_i^e = \frac{I_{iL} - \alpha_L p_i}{a + \alpha_L} \frac{1}{\eta_i}, \text{ and} \quad (33)$$

$$s_i^{*e} = \frac{I_{iL}^* - a_L^* p_i^*}{a^* + \alpha_L^*} \frac{1}{\eta_i^*}, \quad (34)$$

where  $\eta_i^* \equiv p_i^* X_i^{*'} / X_i^*$  is the elasticity of supply in industry  $i$  in Foreign.<sup>10</sup>

Comparing equation (33) with equation (23), we find that the expression for the noncooperative and globally efficient levels of  $s$  are the same. For a given state of the world, that is, fixing  $I_{iL}$ ,  $\alpha_L$ ,  $a$ ,  $\eta_i$ , the rate of production subsidy/tax ( $|s_i|/p_i$ ) is the same in both cases and thus global inefficiency can not be caused by domestic production policies. Consequently, an agreement that only constrains  $s$  cannot increase global welfare relative to the noncooperative equilibrium and thus is not an optimal agreement. On the other hand, equation (32) stipulates the following proposition:

**PROPOSITION 1:** *The tariff rate in the importing country is equal to the export subsidy rate in the exporting country in a costless trade agreement. In this case, domestic and world prices will remain the same as in free trade.*

Proposition 1 thus provides some rationale for WTO's countervailing duty law and confirms that a costless trade agreement removes inefficiency resulting from trade poli-

<sup>10</sup>Replace  $a^*$ ,  $a$ ,  $I_{iL}$  and  $I_{iL}^*$  with  $a^* + \alpha_L^*$ ,  $a + \alpha_L$ ,  $I_{iL} - \alpha_L$  and  $I_{iL}^* - \alpha_L^*$  in equations (28) and (29) and follow the process as the derivation of equation (30).

cies. Note the constraints on trade policies Proposition 1 stipulates is different from the findings in Grossman and Helpman (1995a) which rely on the assumption that domestic production subsidy policy are excluded from the trade agreements.<sup>11</sup>

### 3. The Optimal Trade Agreement

Before characterizing the optimal agreement we need to introduce two important assumptions. First, there are four sources of uncertainty during the lifetime of the agreement that may lead to an incomplete contract: the relative weight of aggregate social welfare ( $a$  and  $a^*$ ); the fraction of population that is represented by lobbies ( $\alpha_L$  and  $\alpha_L^*$ ); whether an industry organizes or dissolves its political lobby ( $I_{iL}$  and  $I_{iL}^*$ ), and the level of import demand ( $M_i$  and  $M_i^*$ ). Second, we assume that there are two categories of contracting costs: state variables (e.g.  $a$ ,  $\alpha_L$ ,  $I_{iL}$ ,  $M_i$  and their Foreign counterparts); and policy variables (e.g.  $\tau$  and  $s$  and their Foreign counterparts). Following Battigalli and Maggi (2002), we assume that contracting costs are increasing in the number of state variables and policies included in the trade agreement. We use the following function to denote contracting cost:

$$c = c(n_p, n_s), c'_{n_p} > 0, c'_{n_s} > 0, \quad (35)$$

where  $n_p$  and  $n_s$  are the number of policy and state variables in the agreement respectively.

The optimal agreement maximizes expected  $\Omega$  less contracting costs, defined as “Net Global Policy Preference”. An agreement of the form

$$A^0 = \left\{ \tau_i = \tau_i^*, s_i = \frac{I_{iL} - \alpha_L p_i}{a + \alpha_L \eta}, s_i^* = \frac{I_{iL}^* - \alpha_L^* p_i^*}{a^* + \alpha_L^* \eta^*} \right\},$$

which imposes the first-best policies derived in last section has  $n_p = 4$  and  $n_s = 6$  and therefore costs  $c(4, 6)$  and yields Net Global Policy Preference equal to  $E(\Omega^0) - c(4, 6)$ . It's easy to verify that if contracting costs are negligible,  $A^0$  is the optimal trade agreement. At the other extreme, if contracting costs are prohibitively high then the noncooperative equilibrium occurs. The interesting case is where contracting costs matter but do not prohibit a trade agreement.

We have previously shown that the inefficiency in the noncooperative equilibrium results from  $\tau$ , not  $s$ , and thus an optimal trade agreement should at least impose constraints on  $\tau$ . The question remaining is whether the agreement should also constrain  $s$ ?

Recall equation (21) solves  $\sum_{i \in L} \nabla_s W_i(P^0, P^*) + a \nabla_s W(P^0, P^*) = 0$  and gives the expression for  $s^N(\tau, \tau^*)$ , the noncooperative choice of  $s$  if  $\tau$  and  $\tau^*$  are constrained but  $s$  and  $s^*$  are left to discretion. That is

$$s^N(\tau, \tau^*) = \frac{I_{iL} - \alpha_L X_i}{a + \alpha_L X'_i} - (\tau_i - 1) \omega_i \frac{M_i^* \tau_i^*}{d'_i \tau_i + M_i^* \tau_i^*} - \frac{M_i}{d'_i \tau_i + M_i^* \tau_i^*}. \quad (36)$$

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<sup>11</sup>In equation (25) of Grossman and Helpman (1995a),  $\tau_i - \tau_i^* = \left( -\frac{I_{iL} - \alpha_L X_i}{a + \alpha_L \omega_i M'_i} \right) - \left( -\frac{I_{iL}^* - \alpha_L^* X_i^*}{a^* + \alpha_L^* \omega_i M_i^*} \right)$

Similarly, we can get

$$s^{*N}(\tau, \tau^*) = \frac{I_{iL}^* - \alpha_L^* X_i^*}{a^* + \alpha_L^* X_i^{*'}} - (\tau_i^* - 1)\omega_i \frac{M_i' \tau_i}{d_i^{*'} \tau_i^* + M_i' \tau_i} - \frac{M_i^*}{d_i^{*'} \tau_i^* + M_i' \tau_i}. \quad (37)$$

The efficient choice of  $s$  given  $\tau$  and  $\tau^*$ , denoted by  $s^E(\tau, \tau^*)$ , solves  $\nabla_s \Omega(P, P^*) = 0$ , and the efficient choice of  $s^*$  given  $\tau^*$  and  $\tau$ , denoted by  $s^{*E}(\tau, \tau^*)$ , solves  $\nabla_{s^*} \Omega(P, P^*) = 0$ .

Whether a trade agreement which binds  $\tau$  should also constrain  $s$  depends on the magnitude of the gain in expected  $\Omega$  implied by replacing  $s^N(\tau, \tau^*)$  with  $s^E(\tau, \tau^*)$ . If the expected gain is less than the contracting cost incurred by negotiating on  $s$ , then it is better to exclude  $s$  from the trade agreement. Assuming that  $s^N(\tau, \tau^*) > s^E(\tau, \tau^*)$  and  $s^{*N}(\tau, \tau^*) > s^{*E}(\tau, \tau^*)$  for a given state of the world, the gain of constraining  $s$  and  $s^*$  is given by

$$\begin{aligned} & \Omega(s^E(\tau, \tau^*), s^{*E}(\tau, \tau^*), \tau, \tau^*) - \Omega(s^N(\tau, \tau^*), s^{*N}(\tau, \tau^*), \tau, \tau^*) \\ &= \int_{s^N(\tau, \tau^*)}^{s^E(\tau, \tau^*)} \nabla_s \Omega(P, P^*) ds + \int_{s^{*N}(\tau, \tau^*)}^{s^{*E}(\tau, \tau^*)} \nabla_{s^*} \Omega(P, P^*) ds^*. \end{aligned} \quad (38)$$

Since  $\nabla_s \Omega(s^E(\tau, \tau^*), s^{*E}(\tau, \tau^*), \tau, \tau^*) = \nabla_{s^*} \Omega(s^E(\tau, \tau^*), s^{*E}(\tau, \tau^*), \tau, \tau^*) = 0$  and it is assumed that  $\Omega$  is concave in  $s$  and  $s^*$ , a sufficient condition for the right-hand side in equation (38) to be small is that  $|\nabla_s \Omega(s^N(\tau, \tau^*), s^{*N}(\tau, \tau^*), \tau, \tau^*)|$  and  $|\nabla_{s^*} \Omega(s^N(\tau, \tau^*), s^{*N}(\tau, \tau^*), \tau, \tau^*)|$  are small. Given  $\sum_{i \in L} \nabla_s W_i(s^N(\tau, \tau^*), \tau, P^*) + a \nabla_s W(s^N(\tau, \tau^*), \tau, P^*) = 0$ , we have

$$\begin{aligned} |\nabla_s \Omega(s^N(\tau, \tau^*), s^{*N}(\tau, \tau^*), \tau, \tau^*)| &= |a \sum_{i \in L^*} \nabla_s W_i^*(s^{*N}(\tau, \tau^*), \tau, \tau^*) \\ &\quad + a^* a \nabla_{s^*} W^*(s^{*N}(\tau, \tau^*), \tau, \tau^*)| \equiv B. \end{aligned} \quad (39)$$

After manipulating we find

$$B_i = \frac{aa^* X_i'}{|d_i^{*'} \tau_i^* + |M_i' \tau_i|} |M_i - (\tau_i^* - 1)\omega_i \tau_i^* |d_i^{*'}|. \quad (40)$$

Due to the possible state of the world and henceforth the ambiguity of the sign of the term of  $M_i - (\tau_i^* - 1)\omega_i \tau_i^* |d_i^{*'}|$  it is difficult to assess the effect of *trade volume* ( $|M_i|$ ). Nonetheless, with some realistic assumptions, we are able to shed light on circumstances under which it is desirable to exclude  $s$  and  $s^*$  from the trade agreement.

Suppose Home is the net importer in industry  $i$  and Foreign imposes an export subsidy not too high (in fact GATT/WTO prohibits export subsidies so  $(\tau_i^* - 1) \leq 0$ ) or exerts an export tax, then the term  $M_i - (\tau_i^* - 1)\omega_i \tau_i^* |d_i^{*'}|$  is positive, which we

refer to as an *effective constraint* on the Foreign export subsidy. We have

$$B_i = \frac{aa^* X_i'}{|d_i^{*'}| \tau_i^* + |M_i'| \tau_i} [M_i - (\tau_i^* - 1) \omega_i \tau_i^* |d_i^{*'}|].^{12} \quad (41)$$

Similarly, if Home exerts a tariff, or assuming an *effective constraint* on import subsidy in Home, we get

$$B_i^* = \frac{aa^* X_i^{*'}}{|d_i'| \tau_i + |M_i^{*'}| \tau_i^*} [|M_i^*| + (\tau_i - 1) \omega_i \tau_i |d_i'|]. \quad (42)$$

Looking closer at equations (41) and (42) leads the following proposition:

**PROPOSITION 2:** *It is optimal to leave discretion over  $s(s^*)$ , if: (i)  $M_i$  ( $|M_i^*|$ ) is sufficiently small, or (ii)  $X_i'$  ( $X_i^{*'}$ ) is sufficiently small, or (iii)  $|M_i'|$  ( $|M_i^{*'}|$ ) is sufficiently large.*

Proposition 2 summarizes three circumstances under which the benefits of restricting  $s$  and  $s^*$  are sufficiently small that they may not offset the accompanying contracting costs and thus may be omitted from the trade agreement. First,  $B_i$  ( $B_i^*$ ) will be small if  $M_i$  ( $|M_i^*|$ ) is sufficiently small. This is the case when Home (Foreign) has too little trade volume to manipulate the terms of trade. Second,  $B_i$  ( $B_i^*$ ) will be small if  $X_i'$  ( $X_i^{*'}$ ) is sufficiently small. This indicates low price sensitivity of supply which is a condition where a domestic production subsidy is a poor substitute for a tariff. Note, the domestic production subsidy only distorts the producer margin whereas a tariff distorts both the producer and the consumer margins. These two findings are consistent with those in Horn et al (2010). Third,  $B_i$  ( $B_i^*$ ) will be small if  $|M_i'|$  ( $|M_i^{*'}|$ ) is sufficiently large. This indicates high price sensitivity of import demand in Home (export supply in Foreign), also a condition where a production subsidy is a poor substitute for a tariff.

Proposition 2 may help to explain a noteworthy change from GATT to WTO. The use of subsidies, largely unconstrained in GATT, are disciplined by the WTO Agreement on Subsidies and Countervailing Measures (SCM Agreement). One possible explanation is that trade volumes have increased significantly over time thus raising the potential gains from removing distortions caused by domestic production subsidies. Our model also suggests differential treatment, across countries, with respect to production subsidies. Countries whose volume of imports are small, and whose market conditions limit the substitution of production subsidies for tariffs (e.g. developing countries), are more likely to benefit from a trade agreement that does not constrain production subsidies. Not surprisingly, the SCI agreement offers those countries preferential treatment with respect to subsidies.

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<sup>12</sup>This equation can also be written as  $B_i = \frac{aa^* X_i' |M_i'|}{|d_i^{*'}| \tau_i^* + |M_i'| \tau_i} \left( \frac{M_i}{|M_i'|} - \frac{(\tau_i^* - 1) \omega_i \tau_i^* |d_i^{*'}|}{|M_i'|} \right)$ , where  $M_i/|M_i'| = \tau_i \omega_i / |e_i^*|$  is the level of Johnson's optimal tariff and is referred to as *monopoly power effect* in Horn et al (2010). We conclude the *monopoly power effect* can be decomposed into trade volume effect and price sensitivity of import demand.

#### 4. The Optimal Trade Agreement Based on National Treatment Principle

We have assumed that consumption taxes are negligible in the two countries, however, they are an important policy instrument. National Treatment (NT), which stipulates equal consumption taxes on domestically produced and imported goods, is a basic principle of GATT/WTO. Assessing the effect of the NT principle requires a broader class of trade agreements which take into account consumption taxes.

Suppose without the NT provision, each country can implement an internal tax on the consumption of the domestically produced goods and an internal tax on the consumption of the imported goods, respectively,  $t_h$  and  $t_f$ . In this setting, pricing relationships can be expressed as

$$q_i = \tau_i \omega_i + t_i^f = \left( \tau_i + \frac{t_i^f}{\omega_i} \right) \omega_i, \text{ and} \quad (43)$$

$$p_i = \tau_i \omega_i + t_i^f + s_i - t_i^h = \left( \tau_i + \frac{t_i^f}{\omega_i} \right) \omega_i + (s_i - t_i^h). \quad (44)$$

Note that equations (43) and (44) are laid out such that the term  $\tau_i + t_i^f/\omega_i$  behaves like  $\tau_i$  and the term  $s_i - t_i^h$  behaves like  $s_i$  when no consumption taxes are present. Consequently, a non-NT agreement

$$A^1 = \left\{ \left( \tau_i + \frac{t_i^f}{\omega_i} \right) = \left( \tau_i^* + \frac{t_i^{f*}}{\omega_i} \right), s_i - t_i^h = \frac{I_{iL} - \alpha_L p_i}{a + \alpha_L \eta}, s_i^* - t_i^{h*} = \frac{I_{iL}^* - \alpha_L^* p_i^*}{a^* + \alpha_L^* \eta^*} \right\}$$

has  $n_p = 8$  and  $n_s = 6$  and therefore costs  $c(8, 6)$ .

When the NT provision is included in trade agreements, however, we have  $t_i^f = t_i^h = t_i$ . So these relationships become

$$q_i = \tau_i \omega_i + t_i, \text{ and} \quad (45)$$

$$p_i = \tau_i \omega_i + s_i. \quad (46)$$

Not surprisingly, the consumption tax does not affect the relationship between the world and producer prices but does affect the relationship between world and consumer prices. Therefore, while it is possible to reduce the wedge between producer and world prices (by reducing  $\tau$  and  $s$ ) and leave consumption taxes to discretion in a NT-based agreement, this is not true in the absence of the NT principle.

The question to be answered is under what circumstances is it desirable to include the NT provision while leaving consumption taxes to discretion. First, observing that an agreement

$$A^2 = \left\{ NT, \tau = \tau^*, s_i = \frac{I_{iL} - \alpha_L p_i}{a + \alpha_L \eta}, s_i^* = \frac{I_{iL}^* - \alpha_L^* p_i^*}{a^* + \alpha_L^* \eta^*}, t = t^* \right\},$$

where  $NT$  represents the NT principle and is equivalent to using four policy instru-

ments ( $t^h=t^f$  and  $t^{h^*}=t^{f^*}$ ), has  $n_p=10$  and  $n_s=6$  and therefore costs  $c(10,6)$ . The NT-based agreement  $A^2$  can realize the same  $E(\Omega)$  as non-NT agreement  $A^1$ , but costs more, so does not qualify as an optimal trade agreement. Consider the following NT-based agreement

$$A^3 = \left\{ NT, \tau = \tau^*, s_i = \frac{I_{iL} - \alpha_L p_i}{a + \alpha_L \eta}, s_i^* = \frac{I_{iL}^* - \alpha_L^* p_i^*}{a^* + \alpha_L^* \eta^*} \right\}.$$

$A^3$  saves on contracting costs as a result of excluding policy variables  $t$  and  $t^*$  but may result in a reduction of gains from the agreement because of possible distortions caused by not constraining  $t$  and  $t^*$ .

Again, we can denote the noncooperative choice of  $t$  conditional on  $P$  and  $P^*$  as  $t^N(P, P^*)$  and the efficient level of  $t$  conditional on  $P$  and  $P^*$  as  $t^E(P, P^*)$ . The gain in  $E(\Omega)$  implied by substituting  $t^E(P, P^*)$  and  $t^{*E}(P, P^*)$  for  $t^N(P, P^*)$  and  $t^{*N}(P, P^*)$  then is the extra gain of constraining consumption taxes in an NT-based trade agreement, and can be expressed as

$$\begin{aligned} & \Omega(t^E(P, P^*), t^{*E}(P, P^*), P, P^*) - \Omega(t^N(P, P^*), t^{*N}(P, P^*), P, P^*) \\ &= \int_{t^N(P, P^*)}^{t^E(P, P^*)} \nabla_t \Omega(t, t^*, P, P^*) dt + \int_{t^{*N}(P, P^*)}^{t^{*E}(P, P^*)} \nabla_{t^*} \Omega(t, t^*, P, P^*) dt^*. \end{aligned} \quad (47)$$

Following steps similar to those in last section, we observe that a sufficient condition for this gain in  $E(\Omega)$  to be small is that  $|\nabla_t \Omega(t^N(P, P^*), t^{*N}(P, P^*), P, P^*)|$  and  $|\nabla_{t^*} \Omega(t^N(P, P^*), t^{*N}(P, P^*), P, P^*)|$  are small. Letting

$$|\nabla_t \Omega(t^N(P, P^*), t^{*N}(P, P^*), P, P^*)| = Z \quad (48)$$

and after some manipulation we get

$$Z_i = \frac{a|d_i'|}{|M_i'| \tau_i + X_i^{*'} \tau_i^*} |I_{iL}^* X_i^* \tau_i^* - a^* X_i^{*'} \tau_i^* [(\tau_i^* - 1)\omega_i + s_i^*] + a^* M_i| \quad (49)$$

Based on equation (49), our discussion of whether  $t$  should be constrained by a NT-based trade agreement can be summarized by the following proposition:

**PROPOSITION 3:** *It is optimal to include the NT clause while leave  $t$  to discretion, if: (i)  $M_i$  ( $|M_i^*|$ ) is sufficiently small, or (ii)  $|d_i'|$  is sufficiently small, or (iii)  $|M_i'|$  ( $|M_i^{*'}|$ ) is sufficiently large.*

Firstly, if Home is the net importer in industry  $i$ , as equation (49) indicates,  $Z_i$  is small when  $|d_i'|$  is sufficiently small, meaning low price sensitivity of demand, or when  $|M_i'|$  is sufficiently large, meaning high price sensitivity of import demand.<sup>13</sup> In either case,  $t$  is a poor substitute for  $\tau$ , and the benefits of including  $t$  in the NT-based agreement may be too small to offset accompanying contracting costs and

<sup>13</sup>Using an externality framework, Horn et al (2010) also identified low price sensitivity of demand as a sufficient condition for excluding consumption tax in a NT-based trade agreement.

thus it is optimal to exclude  $t$  from the NT-based trade agreement.

Once again, due to the possible state of the world, the sign of the term  $I_{iL}^* X_i^* \tau_i^* - a^* X_i^{*'} \tau_i^* [(\tau_i^* - 1)\omega_i + s_i^*] + a^* M_i$  is ambiguous and therefore it is difficult to determine the *trade volume* ( $M_i$ ) effect. However, if we assume that  $s_i^*$  is constrained to be small enough such that  $I_{iL}^* X_i^* \tau_i^* - a^* X_i^{*'} \tau_i^* [(\tau_i^* - 1)\omega_i + s_i^*] + a^* M_i$  is positive (a situation which we refer to as an *effective constraint* on the production subsidy in Foreign) then

$$Z_i = \frac{a|d_i'|}{|M_i^*| \tau_i^* + X_i^{*'} \tau_i^*} \{I_{iL}^* X_i^* \tau_i^* - a^* X_i^{*'} \tau_i^* [(\tau_i^* - 1)\omega_i + s_i^*] + a^* M_i\}.^{14} \quad (50)$$

Note, if the trade volume  $M_i$  is small then in this situation it is optimal to exclude  $t$  from the NT-based trade agreement. Similarly, we can assume an *effective constraint* on the production tax ( $|s_i|$ ) in Home such that  $-I_{iL} X_i \tau_i + a X_i' \tau_i [(\tau_i - 1)\omega_i + s_i] + a |M_i^*|$  is positive, then

$$Z_i^* = \frac{a^* |d_i^*'|}{|M_i^*| \tau_i^* + X_i^{*'} \tau_i^*} \{-I_{iL} X_i \tau_i + a X_i' \tau_i [(\tau_i - 1)\omega_i + s_i] + a |M_i^*|\}. \quad (51)$$

Again, if trade volume  $|M_i^*|$  is small then it is optimal to exclude  $t$  from the NT-based trade agreement. Therefore, from equations (50) and (51), we know that an *effective constraint* on  $s^*$  ( $|s|$ ),  $Z_i$  ( $Z_i^*$ ) is small if trade volume  $M_i$  ( $|M_i^*|$ ) is sufficiently small, representing little trade volume to manipulate the terms of trade. This finding is also identified by Horn et al (2010) in their externality framework.

To summarize, Proposition 3 identifies a sufficient condition under which it is optimal to include an NT clause without specifying particular consumption taxes. This condition helps explain the existence of an NT clause in the current WTO, where significant constraints are placed on subsidies and tariffs while internal consumption taxes are largely left to discretion. For sectors where trade volumes are little, or consumption taxes are a poor substitute policy instrument for tariffs, it is attractive to leave consumption taxes to discretion while applying NT principle.

## 5. Conclusion

In this manuscript we have incorporated political pressures and contracting costs into the analysis of trade agreements. Like many previous studies in the political economy literature (Hillary 1982, Snyder 1990, Grossman and Helpman 1994, 1995a, 1995b), we view governments as agents that maximize their own interests in response to political pressures rather than as benevolent agents that maximize aggregate social welfare. What is distinctive in our political economy model is that we allow for both trade and domestic production policies. As a result, our findings regarding equilibrium policy

<sup>14</sup>This equation can also be reformulated as  $\frac{a|d_i'| |M_i^*|}{|M_i^*| \tau_i^* + X_i^{*'} \tau_i^*} \left\{ \frac{I_{iL}^* X_i^* \tau_i^* - a^* X_i^{*'} \tau_i^* [(\tau_i^* - 1)\omega_i + s_i^*]}{|M_i^*|} + \frac{a^* M_i}{|M_i^*|} \right\}$ , where  $M_i/|M_i^*| = \tau_i \omega_i / |e_i^*|$  is the level of Johnson's optimal tariff and is referred to as *monopoly power effect* in Horn et al (2010). So once again we conclude the *monopoly power effect* can be decomposed into trade volume effect and price sensitivity of import demand.

choices in noncooperative and cooperation settings are somewhat different.

When governments set their policies noncooperatively, our model shows that production subsidies will emerge in industries that are politically organized at the expense of those that are not. By including production subsidies as well as trade policies in our model, we find that production subsidies substitute for trade policies that would have otherwise resulted from rent-seeking efforts as in Grossman and Helpman (1995a). Rates of protection are equivalent to Johnson's optimal tariff rates, which represent international market power and are inversely affected by the sizes of the elasticities of export supply from foreign country. On the other hand, a costless trade agreement would lead to equal rates of import tax in the net importing country and export subsidy in net exporting country, a circumstance equivalent to free trade. We also find cooperative production subsidy rates are the same as those in a noncooperative equilibrium suggesting that a trade agreement which constrains production subsidies but not tariffs is not optimal.

Our model also yields predictions on the form of the optimal trade agreement and how it depends on uncertainty and contracting costs. We identify circumstances where it is optimal to leave domestic production subsidies to discretion and circumstances where it is optimal to leave consumption taxes to discretion in an NT-based trade agreement. If domestic market conditions are such that production subsidies or consumption taxes can not adequately substitute for tariffs, or if countries trade little, it is in their best interest for both countries to exclude production subsidies or consumption taxes from trade agreements.

## APPENDIX

### DERIVATION OF EQUATION (18)

We find from equation (8)

$$\frac{\partial W_i}{\partial \tau_j} = \frac{\partial \Pi_i}{\partial \tau_j} + \alpha_i \left( \frac{\partial R}{\partial \tau_j} + \frac{\partial S}{\partial \tau_j} \right), \quad (\text{A-1})$$

where

$$\frac{\partial \Pi_i}{\partial \tau_j} = \delta_{ij} x_j (\omega_j + \tau_j^0 \omega_{j1}),$$

where  $\delta_{ij}$  is an indicator variable that equals 1 if  $i = j$  and 0 otherwise;

$$\begin{aligned} \frac{\partial R}{\partial \tau_j} &= (\tau_j - 1) \omega_j M'_j (\omega_j + \tau_j^0 \omega_{j1}) + [\omega_j + (\tau_j^0 - 1) \omega_{j1}] M_j \\ &\quad + s_j X' (\omega_j + \tau_j^0 \omega_{j1}); \text{ and} \\ \frac{\partial S}{\partial \tau_j} &= -d_j (\omega_j + \tau_j^0 \omega_{j1}). \end{aligned}$$

So the sum of expressions in (A-1) for all  $i \in L$  is

$$\sum_{i \in L} \frac{\partial W_i}{\partial \tau_j} = (I_{jL} - \alpha_L)(\omega_j + \tau_j^0 \omega_{j1})X_j + \alpha_L[(\tau_j^0 - 1)\omega_j M'_i(\omega_j + \tau_j^0 \omega_{j1}) - \omega_{j1}M_j - s_j^0 X'_j(\omega_j + \tau_j^0 \omega_{j1})], \quad (\text{A-2})$$

where  $I_{jL} = \sum_{i \in L} \delta_{ij}$  is an indicator variable that equals 1 if industry  $j$  is organized and 0 otherwise. From equation (10) we can find

$$\frac{\partial W}{\partial \tau_j} = (\tau_j^0 - 1)\omega_j M'_i(\omega_j + \tau_j^0 \omega_{j1}) - \omega_{j1}M_j - s_j^0 X'_j(\omega_j + \tau_j^0 \omega_{j1}). \quad (\text{A-3})$$

Substituting equation (A-2) and (A-3) into equation (16) yields equation (18).

#### DERIVATION OF EQUATION (19)

We find from equation (8)

$$\frac{\partial W_i}{\partial s_j} = \frac{\partial \Pi_i}{\partial s_j} + \alpha_i \left( \frac{\partial R}{\partial s_j} + \frac{\partial S}{\partial s_j} \right), \quad (\text{A-4})$$

where

$$\begin{aligned} \frac{\partial \Pi_i}{\partial s_j} &= \delta_{ij}(\tau_j^0 \omega_{j2} + 1)X_j; \\ \frac{\partial R}{\partial s_j} &= (\tau_j^0 - 1)\omega_j [d'_j \tau_j^0 \omega_{j2} - X'_j(\tau_j^0 \omega_{j2} + 1)] + (\tau_j^0 - 1)\omega_{j2}M_j \\ &\quad - s_j^0 X'_j(\tau_j^0 \omega_{j2} + 1) - X_j; \text{ and} \\ \frac{\partial S}{\partial s_j} &= -d_j \tau_j^0 \omega_{j2}. \end{aligned}$$

So the sum of expressions in (A-1) for all  $i \in L$  is

$$\sum_{i \in L} \frac{\partial W_i}{\partial s_j} = (I_{jL} - \alpha_L)(\tau_j^0 \omega_{j2} + 1)x_j + \alpha_L \{ (\tau_j^0 - 1)\omega_j [d'_j \tau_j^0 \omega_{j2} - X'_j(\tau_j^0 \omega_{j2} + 1)] - s_j^0 X'_j(\tau_j^0 \omega_{j2} + 1) - \omega_{j2}M_j \}. \quad (\text{A-5})$$

From equation (10) we can find

$$\frac{\partial W}{\partial s_j} = (\tau_j^0 - 1)\omega_j [d'_j \tau_j^0 \omega_{j2} - X'_j(\tau_j^0 \omega_{j2} + 1)] - s_j^0 X'_j(\tau_j^0 \omega_{j2} + 1) - \omega_{j2}M_j. \quad (\text{A-6})$$

Substituting equation (A-5) and (A-6) into equation (16) yields equation (19).

#### DERIVATION OF EQUATION (30)

Substituting equation (28) into equation (29) yields

$$a^* a X'_i s_i d'_i \tau_i M'_i + a^* a X'_i s_i M_i^{*'} \tau_i^* M'_i = a^* d'_i \tau_i I_{iL} X_i M'_i + a^* M_i^{*'} \tau_i^* I_{iL} X_i M'_i \\ + a^* M_i^{*'} \tau_i^* I_{iL} X_i X'_i - a^* a X'_i s_i M_i^{*'} \tau_i^* X'_i.$$

As  $M'_i + X'_i = d'_i$ , we have

$$a^* a X'_i s_i d'_i (\tau_i M'_i + M_i^{*'} \tau_i^*) = a^* d'_i I_{iL} X_i (\tau_i M'_i + M_i^{*'} \tau_i^*).$$

If  $a^* d'_i (\tau_i M'_i + M_i^{*'} \tau_i^*) \neq 0$ , then

$$s_i = \frac{I_{iL} X_i}{a X'_i}.$$

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