On the Role of Trade Agreements in Imperfectly Competitive Markets
(Very Preliminary and Incomplete)

Kyle Bagwell
Columbia and NBER

Robert W. Staiger
Stanford and NBER

September 29, 2008

Abstract

1 Introduction

Governments have a reason to form a trade agreement when an international externality is associated with their trade-policy choices. When countries are large, if a government raises its import tariff, then the world (offshore) price of the imported good is reduced. The importing country then enjoys an improvement in its terms of trade, and the exporting country suffers a negative terms-of-trade externality. As Johnson (1954) argues, when governments maximize national welfare and markets are perfectly competitive, the associated non-cooperative equilibrium is inefficient, and governments can achieve greater welfare by forming an appropriately designed trade agreement. Bagwell and Staiger (1999) and Grossman and Helpman (1995) extend the modeling framework to allow that governments have political-economic preferences. Allowing for a wide range of possible political-economic motivations, Bagwell and Staiger (1999) show that the non-cooperative equilibrium is inefficient if and only if governments are motivated by the terms-of-trade consequences of their respective trade policies. Building from this finding, they then characterize the form that an efficiency-enhancing trade agreement might take. They show that the principles of reciprocity and non-discrimination (MFN) play a useful role in guiding governments toward efficient policies.

In this paper, we move beyond the competitive-markets paradigm and expand our analysis to include the realistic possibility that firms have market power. A firm with market power is itself "large," in the sense that it does not regard the market price as fixed; instead, such a firm recognizes that its decisions may influence the price at which its output sells. We focus here on the rationale for a trade agreement when markets are imperfectly competitive. The terms-of-trade externality arises as well in markets with imperfect competition, but the well-known "profit-shifting" role for trade policies in imperfectly competitive markets suggests that other international externalities might also be present. We consider a sequence of models, and in each case identify the reason that the non-cooperative equilibrium is inefficient. This work provides an important first step toward understanding the form that an efficiency-enhancing trade agreement might take when markets are imperfectly competitive.

When markets are imperfectly competitive, a government may be tempted to use trade policy as a means of extracting profit from foreign exporters. This temptation arises as well, at least in the short run, when markets are perfectly competitive; however, the consideration of imperfectly competitive markets introduces several novel features. First, an understanding of the impact of trade policy on the world price now requires a theory as to how price is determined when firms possess market power. Second, when domestic firms also participate in the oligopolistic market, trade policy may have strategic effects in so far as it alters the oligopolistic interaction between domestic and foreign firms. While trade policy can again shift foreign profits to the domestic treasury in the form of tariff revenue, it may now also shift some foreign profit to domestic firms. Third, when markets are imperfectly competitive, output levels are often distorted away from national or globally efficient levels. In the absence of domestic policies that directly target such distortions, trade policies may serve as second-best policies that diminish existing distortions.

We show that there are new international externalities that arise when market power is present:

in addition to the terms-of-trade externality that travels through the world price, there are also local price externalities that travel through domestic and foreign local prices. This indicates a more complex international policy environment when market power is present, and it seems to suggest that the task of a trade agreement may be more complicated in this environment as a result. Nevertheless, the fundamental question for our purposes here is whether governments would make unilateral policy choices that internalize these international externalities – whatever form these externalities might take – in an appropriate fashion from a world-wide perspective, and if not, why not. To answer this question, we need to examine the non-cooperative and efficient policy choices in detail and evaluate the precise reasons for any divergence between them.

To determine the reason for the inefficiency of the Nash tariff choices, we follow Bagwell and Staiger (1999) and evaluate *politically optimal* tariffs, defined as those tariffs that would hypothetically be chosen by governments unilaterally if they did not value the pure international rent-shifting associated with the terms-of-trade movements induced by their unilateral tariff choices. With politically optimal tariffs defined in this way, we may then ask whether politically optimal tariffs are efficient in a particular environment under study, and thereby explore whether the Nash inefficiencies that arise in the presence of particular forms of market power can be given a terms-of-trade interpretation, according to which the fundamental problem faced by governments in designing their trade agreement is to find a way to eliminate terms-of-trade manipulation.

In the sections that follow, we consider various combinations of market structures in which firms possess market power. The different settings serve to unveil and isolate key effects. In each setting, we compare the optimal unilateral trade policies with the policies that would arise in an efficient agreement between governments. The divergence between the unilateral and efficient policies arises when an international externality is present. For each setting, we then derive the politically optimal policies and evaluate their efficiency properties, and thereby determine whether the Nash inefficiencies that arise under a particular market structure can be given a terms-of-trade interpretation

We begin our formal analysis in section 2 with a simple 2-country partial equilibrium setting in which the product under consideration is produced by a monopolist in the domestic country and consumed in both the domestic and foreign countries, and in which exports of the product therefore flow from the domestic country to the foreign country. We focus mainly on the case where the domestic and foreign markets are integrated, so that the domestic monopolist cannot price discriminate across the two markets and any difference in prices across the two markets is therefore attributable to trade policies. At the end of the section, however, we also show how the analysis extends when the markets are segmented.

We establish that import tariffs can be attractive for the importing country as a means of capturing monopoly export profits in the form of tariff revenue, while export taxes can be attractive to the exporting country as a means to reduce monopoly distortions in the domestic market, and we show that inefficiencies arise when these policies are chosen non-cooperatively. Our main finding, however, is to characterize the politically optimal tariffs and establish that these policies are efficient.

We thereby confirm that, if governments were not motivated by the terms-of-trade consequences of their trade policies, then their policies would be efficient and a trade agreement would not be needed. The model with export-sector market power thus shares an important feature with the competitive-markets benchmark model: in both settings, the *only* rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume.

We next extend the analysis to allow for two-sided market power. Specifically, in section 3 we examine the situation in which a single domestic firm sells at home and abroad and competes in the foreign market with a single foreign firm which sells the same good. We thus now introduce the possibility of international oligopoly competition. As before, we focus mainly on the case where the domestic and foreign markets are integrated, so that firms cannot price discriminate across the two markets and any difference in prices across the two markets is therefore attributable to trade policies. At the end of the section, however, we also show how the analysis extends when the markets are segmented.

In a setting with international oligopoly competition, trade policy may play a "strategic" role by altering the nature of oligopolistic competition, as the seminal papers of Brander and Spencer (1983, 1985) have shown. In particular, an important role for domestic export policy in such a setting may be to shift profits from the foreign firm to the domestic firm. Likewise, foreign import policy may shift profits from the domestic firm to the foreign firm. Here, we extend our analysis of two-country models to include international oligopoly competition and thus strategic trade policies. As before, we are primarily interested in understanding the rationale for a trade agreement in the model under consideration. This focus again directs our attention toward the identification of an international externality. For the model of strategic trade policies, and whether markets are integrated or segmented, our main finding is that the terms-of-trade externality continues to provide the only rationale for a trade agreement. In the Appendix, we consider as well an extension to three-country models along the lines of the Brander-Spencer (1985) and Eaton-Grossman (1986) strategic export policy analyses, and show that our findings apply to those settings as well.

The analysis described thus far maintains the assumption that the number of producers in each country is fixed and invariant to trade policy. This gives rise to the existence of profitable firms in the models we have described above, and it is the pursuit of those profits – either converted into tariff revenue as in the monopoly exporter model of section 2, or shifted from one firm to another as in the duopoly profit-shifting model of section 3 – combined with the relaxation of the assumption of price-taking behavior that provides the novel role for government tariff intervention in these models. An alternative role for government intervention can arise when free entry conditions serve to eliminate profits in equilibrium even though firms are not price-takers. Our final task is to consider this alternative by exploring models in which firms are not price takers but where entry is free, and we again ask whether a novel role for trade agreements can be identified. We take this up in section 4.

We first consider the case where markets are segmented. As Helpman and Krugman (1989) describe, the case for trade policy in the presence of Cournot firms and free entry when markets are segmented is analyzed by Venables (1985), who builds from the model of Brander and Krugman (1983) to identify a firm "delocation" effect of trade policy intervention that could enhance the welfare of the intervening country: by triggering foreign exit and domestic entry, a domestic import tariff can lead to greater competition in the domestic market and therefore lower prices for domestic consumers. We first consider a model along these lines. We then turn to the case where markets are integrated. Here, as Venables (1987) shows building on the model of Krugman (1980), an alternative manifestation of the delocation effect of trade policy intervention can arise in a monopolistically competitive setting if there are large transport costs associated with trade in differentiated products. We consider a version of this model along the lines of that developed in Helpman and Krugman (1989). As before, in each case we are primarily interested in understanding the rationale for a trade agreement in the models under consideration. This focus again directs our attention toward the identification of an international externality. For the models of firm delocation, and whether markets are integrated or segmented, our main finding is that the terms-of-trade externality continues to provide the only rationale for a trade agreement.

2 Trade Policies and Market Power

In this section we consider a simple 2-country partial equilibrium setting in which the product under consideration is produced by a monopolist in the domestic country and consumed in both the domestic and foreign countries, and in which exports of the product therefore flow from the domestic country to the foreign country. We focus mainly on the case where the domestic and foreign markets are integrated, so that the domestic monopolist cannot price discriminate across the two markets and any difference in prices across the two markets is therefore attributable to trade policies. At the end of the section, however, we also show how the analysis extends when the markets are segmented.

We establish that import tariffs can be attractive for the importing country as a means of capturing monopoly export profits in the form of tariff revenue, while export taxes can be attractive to the exporting country as a means to reduce monopoly distortions in the domestic market, and we show that inefficiencies arise when these policies are chosen non-cooperatively. Our main task, however, is to characterize the "politically optimal" tariffs and establish that these policies are efficient. We thereby confirm that, if governments were not motivated by the terms-of-trade consequences of their trade policies, then their policies would be efficient and a trade agreement would not be needed. The model with export-sector market power thus shares an important feature with the competitive-markets benchmark model: in both settings, the *only* rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume.

2.1 Integrated Markets

We consider the following model. The domestic country has a monopolist, which sells good y to domestic consumers and also exports good y to foreign consumers. The local price in the domestic market is P and the domestic demand function is $D(P)$; likewise, the local price in the foreign country is P^* and the foreign demand function is $D^*(P^*)$. Both demand functions are downward sloping. The government of the domestic country has an export policy, t, where $t > 0$ indicates an export tariff; and the government of the foreign country has an import policy, t^*, where $t^* > 0$ corresponds to an import tariff. In this subsection we assume that the markets are integrated. This means that any wedge between the prices P and P^* must equal the sum of the export and import tariffs for non-prohibitive trade taxes: $P^* = P + t + t^*$. Let us define the world (i.e., offshore) price as $P^w = P + t = P^* - t^*$. Since both governments may use trade policies, the world price is distinct from both local prices.

When markets are integrated and trade policies t and t^* are given, the monopolist chooses P (and thereby $P^* = P + t + t^*$) to maximize profit in the domestic and foreign markets:

$$\Pi(P, t + t^*) = [P - c]D(P) + [P - c]D^*(P + t + t^*),$$

where c is the constant marginal cost of production for the monopolist. Under appropriate concavity conditions, the associated first-order condition balances the effect of a price increase across the integrated markets and may be written as follows:

$$\Pi_P(P, t + t^*) = [P - c]D'(P) + D(P) + [P - c]D^{*\prime}(P + t + t^*) + D^*(P + t + t^*) = 0. \tag{1}$$

We observe from (1) that the profit-maximizing or monopoly price depends on $t + t^*$, the total tariff on trade flows from the domestic to the foreign country, and so we represent the monopoly price function as $P(t + t^*)$. Given downward-sloping demand functions, we see that the monopoly price function must entail a positive markup over unit production costs: $P(t + t^*) > c$. Since $P^w = P + t = P^* - t^*$, we may use $P^*(t + t^*) = P(t + t^*) + t + t^*$ to denote the corresponding monopoly price function for foreign sales. Similarly, we may use the function $P^w(t, t^*)$ to represent the corresponding world price function.

For a large family of demand functions, including linear demand functions, $P(t + t^*)$ declines as the total tariff rises. In this case of incomplete pass through, the monopolist absorbs some of the incidence of trade taxes and thus reduces the price at which it sells. Under general conditions, the final price paid by foreign consumers, $P^*(t + t^*)$, rises with the total tariff. In what follows we therefore assume P^* rises and P falls with the total tariff. Finally, we note that our assumptions ensure that the world price, $P^w(t, t^*)$, rises with the export tariff t and falls with the import tariff t^*. The domestic country thus enjoys a terms-of-trade improvement when the domestic export tariff is increased or when the foreign import tariff is reduced, whereas the foreign country enjoys a terms-of-trade gain when the domestic export tariff is reduced or the foreign import tariff is increased.

With the monopoly pricing problem now characterized, our next step is to consider the welfare function that the domestic government maximizes. To begin, we assume that the domestic government maximizes domestic country welfare. We can write domestic country welfare as

$$[P - c]D(P) + CS(P) + [P^* - (c + t + t^*)]D^*(P^*) + tD^*(P^*),$$

where $CS(P)$ denotes domestic consumer surplus. The first two terms represent domestic welfare on domestically sold units, the third term captures (post-tariff) profit on exported units, and the final term is domestic tariff revenue. We may now simplify and represent domestic country welfare as

$$W(P, P^*, P^w) = [P - c]D(P) + CS(P) + [P^w - c]D^*(P^*). \quad (2)$$

Domestic country welfare is ultimately a function of the underlying tariffs; however, for our purposes, it is more useful to write the welfare function as a function of prices (which are themselves determined by tariffs), as we can then identify the specific channels through which trade policies affect welfare.

Notice from (2) that domestic welfare depends on the foreign local price, P^*, since the domestic monopolist has market power and selects P and thus P^*, with the units exported at the price P^* then determined by the foreign demand function. This feature distinguishes the current setting from one in which domestic production takes place under conditions of perfect competition. In that case, with price-taking firms, domestic welfare can again be written as the sum of producer surplus, consumer surplus and tariff revenue. But the domestic local price P then determines the levels of domestic production and domestic consumption, and so P determines as well domestic export volume, domestic producer surplus and domestic consumer surplus. Given that $t = P^w - P$, it is then possible to express domestic tariff revenue as a function of P and P^w. As a consequence, with a competitive domestic production sector, *all* components of domestic welfare are determined once P and P^w are given, and so domestic welfare can be written as $W(P, P^w)$ in that case.

Hence, as (2) confirms, there is a new international externality present for the domestic government when market power is present in the domestic export sector: in addition to the terms-of-trade externality that travels through P^w, there is also a (foreign) local price externality that runs through P^*. This indicates a more complex international policy environment when market power is present, and it seems to suggest that the task of a trade agreement may be more complicated in this environment as a result. Nevertheless, the fundamental question for our purposes here is whether governments would make unilateral policy choices that internalize these international externalities – whatever form these externalities might take – in an appropriate fashion from a world-wide perspective, and if not, why not. To answer this question, we need to go further and fully characterize the remaining features of the model, so that we may then examine the non-cooperative and efficient policy choices in detail and evaluate the precise reasons for any divergence between them.

To this end, we next consider the foreign country. Foreign country welfare takes the following simple form:

$$W^*(P^*, P^w) = CS^*(P^*) + [P^* - P^w]D^*(P^*), \quad (3)$$

where $CS^*(P^*)$ denotes foreign consumer surplus. As with domestic welfare, we express foreign welfare as a function of prices in order to isolate the price channels through which trade policies affect welfare.

We may now characterize the Nash policy choices, which we take to be the optimal policies that the governments would choose unilaterally in the absence of a trade agreement. Using the expressions for domestic and foreign welfare that we have developed above, the first-order conditions that jointly define the Nash choices of t and t^*, which we denote by t^N and t^{*N}, are given by:

$$\begin{aligned} W_P \frac{dP}{dt} + W_{P^*} \frac{dP^*}{dt} + W_{P^w} \frac{dP^w}{dt} &= 0, \text{ and} \\ W^*_{P^*} \frac{dP^*}{dt^*} + W^*_{P^w} \frac{dP^w}{dt^*} &= 0. \end{aligned} \tag{4}$$

Evaluating the Nash conditions in (4) using the explicit expressions for welfare in (2) and (3) and the monopolist's first-order condition (1), it is direct to show that the foreign government imposes an import tariff in the Nash equilibrium, while the domestic government may impose either an export tax or an export subsidy in the Nash equilibrium depending on demand conditions.

Intuitively, the Nash export policy t^N for the domestic country maximizes $W(P, P^*, P^w)$ and thus internalizes the effects of the induced changes in P, P^* and P^w on domestic welfare. If domestic demand were nonexistent, then the Nash export tax would be zero, because in that case the objectives of the domestic monopolist would coincide with domestic welfare. In the presence of domestic demand, however, two additional considerations arise. On the one hand, an export tax has a beneficial effect in lessening the existing monopoly distortion in the domestic market (i.e., it pushes P down toward c), and if this consideration dominates then the Nash export policy is an export tax. On the other hand, under an export subsidy foreign consumers pay a lower price than domestic consumers, and given appropriate demand conditions it is possible that facilitating the implied price discrimination across markets for the domestic monopolist has a sufficiently beneficial effect on domestic welfare that the Nash export policy is an export subsidy.[1]

The Nash import tariff t^{*N} for the foreign country maximizes $W^*(P^*, P^w)$ and thus internalizes the effects of the induced changes in P^* and P^w on foreign welfare. The foreign local price determines the level of foreign demand. It thereby determines consumer surplus in the foreign country and also impacts foreign tariff revenue. The world price affects welfare in the foreign country through its effect on foreign tariff revenue. The Nash import tariff for the foreign country weighs the tariff revenue collected from the domestic monopolist against the loss in foreign consumer surplus, and it is positive provided that the demand function is such that the exporting monopolist does not pass through the full tariff (as we have assumed).

To evaluate the efficiency properties of the Nash tariff choices, we first need to characterize the

[1] In particular, we find that $t^N \geq 0$ if and only if $[-D(P)\frac{dP}{dt}] \geq [(P-c)D'(P) + D(P)]$. The left-hand-side of this condition is strictly positive. By examining the monopoly first-order condition (1), it can be seen that the right-hand-side of this condition is zero when the monopolist has no incentive to price-discriminate across markets, and so the condition is met in that case; and it is negative when the monopolist would like to price-discriminate in favor of the domestic market, and so the condition is met in that case as well; but the right-hand-side is positive when the monopolist would like to price-discriminate in favor of the foreign market, and under appropriate demand conditions it can be sufficiently positive to violate the condition above and imply $t^N < 0$.

trade policy choices that would be internationally efficient in this environment. Consider, then, an efficient or joint-welfare maximizing agreement that would maximize the sum of W and W^*. The world price cancels from this summation: the world price affects the distribution of rents across countries but does not in itself affect efficiency. This observation provides one simple way of understanding why tariff policies that are motivated by terms-of-trade effects lead to inefficiencies. But we may still ask whether any other sources of inefficiency are present. To address this question, we express joint welfare as

$$J(P,P^*) = W(P,P^*,P^w)+W^*(P^*,P^w) = [P-c]D(P)+CS(P)+[P^*-c]D^*(P^*)+CS^*(P^*). \quad (5)$$

As inspection of (5) confirms, the local prices which maximize joint welfare are thus the perfectly competitive prices: $P = P^* = c$.[2] Governments, however, are unable to deliver these prices using only their export and import tariffs. If governments adopt free trade policies, then the monopolist sets $P = P^* > c$, and deadweight loss results. Using a positive total tariff, governments could steer supply toward the domestic market and push the domestic local price down to c. But a positive total tariff introduces a wedge between P and P^*, making it impossible that P^* could also be set equal to c. An efficient tariff pair would balance efficiency objectives across markets with the final outcome satisfying $c < P$ and $c < P^*$.[3]

We next characterize the efficient tariffs at a more formal level. At the efficient tariffs, it is impossible to increase joint welfare by changing the domestic export tariff or the foreign export tariff. Recalling that the world price cancels from the joint welfare expression, the corresponding first-order conditions that define efficient choices of t and t^* are thus given by:

$$\begin{aligned} W_P\frac{dP}{dt} + W_{P^*}\frac{dP^*}{dt} + W^*_{P^*}\frac{dP^*}{dt} &= 0, \text{ and} \\ W_P\frac{dP}{dt^*} + W_{P^*}\frac{dP^*}{dt^*} + W^*_{P^*}\frac{dP^*}{dt^*} &= 0. \end{aligned} \quad (6)$$

We now recall that only the sum of t and t^* matters for P and for P^*; hence, we have that $\frac{dP}{dt} = \frac{dP}{dt^*}$ and $\frac{dP^*}{dt} = \frac{dP^*}{dt^*}$. This implies in turn that the two efficiency conditions in (6) are really just one independent condition: if the first efficiency condition in (6) is satisfied, then the second must be as well, and vice versa. And as a consequence, efficiency requires only that the total tariff $t + t^*$ satisfy the first (or second) condition in (6).

Observe that the Nash tariff choices are indeed inefficient. This can be confirmed by adding

[2] If all units of good y were sold domestically, then the domestic welfare function would take the form $[P-c]D(P)+CS(P)$. In this setting, as is well known, domestic country welfare is maximized at the perfect-competition outcome (i.e., when $P = c$). The same logic applies as well for the foreign country.

[3] Suppose, for example, that $t+t^* > 0$ delivers $P = c$. The term $[P-c]D(P)+CS(P)$ is then maximized; thus, by reducing the total tariff and raising P slightly, the reduction in this term would only be second order. At the same time, a lower total tariff would reduce P^* and thus facilitate a first order increase in the term $[P^*-c]D^*(P^*)+CS^*(P^*)$. Likewise, if $t + t^* < 0$, then it would not be efficient to drive P^* to or below c.

the two Nash conditions in (4) together to obtain

$$W_P \frac{dP}{dt} + W_{P^*} \frac{dP^*}{dt} + W^*_{P^*} \frac{dP^*}{dt} + D^*(P^*)[\frac{dP^w}{dt} - \frac{dP^w}{dt^*}] = 0, \tag{7}$$

where in writing (7) we have used the fact that $\frac{dP^*}{dt} = \frac{dP^*}{dt^*}$, as well as the fact that (2) implies $W_{P^w} = D^*(P^*)$ and (3) implies $W^*_{P^w} = -D^*(P^*)$. The term $D^*(P^*)[\frac{dP^w}{dt} - \frac{dP^w}{dt^*}]$ is strictly positive, and so (7) implies that $W_P \frac{dP}{dt} + W_{P^*} \frac{dP^*}{dt} + W^*_{P^*} \frac{dP^*}{dt}$ must be negative when evaluated at Nash tariff choices. But then (6) implies that the sum of the Nash tariffs is above that required for efficiency: in the Nash equilibrium, trade volume $(D^*(P^*))$ is inefficiently low.

To determine the reason for the inefficiency of the Nash tariff choices, we now follow Bagwell and Staiger (1999) and define *politically optimal* tariffs as those tariffs that would hypothetically be chosen by governments unilaterally if they did not value the pure international rent-shifting associated with the terms-of-trade movements induced by their unilateral tariff choices. Specifically, we suppose that the home government acts as if $W_{P^w} \equiv 0$ when choosing its politically optimal tariff, while the foreign government acts as if $W^*_{P^w} \equiv 0$ when choosing its politically optimal tariff. We therefore define politically optimal tariffs as those tariffs that satisfy the following two conditions:

$$\begin{aligned} W_P \frac{dP}{dt} + W_{P^*} \frac{dP^*}{dt} &= 0, \text{ and} \\ W^*_{P^*} \frac{dP^*}{dt^*} &= 0. \end{aligned} \tag{8}$$

With politically optimal tariffs defined in this way, we may ask whether politically optimal tariffs are efficient, and thereby explore whether the Nash inefficiencies identified above can be given a terms-of-trade interpretation, according to which the fundamental problem faced by governments in designing their trade agreement is to find a way to eliminate terms-of-trade manipulation.

Before proceeding to evaluate the efficiency of the political optimum, it is useful to pause and consider further the nature of the thought experiment envisioned in the politically optimal tariffs. To fix ideas, let us begin at an initial level of t and t^* and consider the domestic-country government, whose welfare at these trade taxes is given by $W(P(t+t^*), P^*(t+t^*), P^w(t,t^*))$ as defined in (2). Now consider a slight change in t to $t+\epsilon$ for ϵ positive but small, and define $P(\epsilon) \equiv P(t+\epsilon+t^*)$, $P^*(\epsilon) \equiv P^*(t+\epsilon+t^*)$ and $P^w(\epsilon) \equiv P^w(t+\epsilon, t^*)$. When evaluating this tariff change, the home government does not value the pure international rent-shifting associated with the terms-of-trade movements implied by this tariff change – and therefore acts "as if" $W_{P^w} \equiv 0$ – if it evaluates this tariff change according to the alternative welfare function

$$\begin{aligned} \tilde{W}(P(\epsilon), P^*(\epsilon), P^w(\epsilon)) &= [P(\epsilon) - c]D(P(\epsilon)) + CS(P(\epsilon)) + [P^w(\epsilon) - c]D^*(P^*(\epsilon)) \\ &\quad - \int_{P^w(0)-P(0)}^{P^w(\epsilon)-P(\epsilon)} \frac{\partial P^w(x)}{\partial x} D^*(P^*(x))dx. \end{aligned} \tag{9}$$

The first three terms in (9) are together just $W(P, P^*, P^w)$, while the last term subtracts the value of the pure international rent-shifting associated with the terms-of-trade movements implied by the tariff change under consideration.

To confirm that the domestic government acts "as if" $W_{P^w} \equiv 0$ when it evaluates a tariff change according to the alternative welfare function in (9), we may differentiate $\tilde{W}$ with respect to ϵ to get

$$\begin{aligned} \frac{d\tilde{W}}{d\epsilon} &= [P(\epsilon) - c]D'(P(\epsilon))P'(\epsilon) + [P^w(\epsilon) - c]D^{*\prime}(P^*(\epsilon))P^{*\prime}(\epsilon) \\ &\quad + P^{w\prime}(\epsilon)D^*(P^*(\epsilon))[P'(\epsilon) + 1 - P^{w\prime}(\epsilon)] \\ &= [P(\epsilon) - c]D'(P(\epsilon))P'(\epsilon) + [P^w(\epsilon) - c]D^{*\prime}(P^*(\epsilon))P^{*\prime}(\epsilon) \\ &= W_P P'(\epsilon) + W_{P^*} P^{*\prime}(\epsilon), \end{aligned} \tag{10}$$

where the second equality in (10) follows from the fact that $P + t = P^w$ and therefore $[P'(\epsilon) + 1 - P^{w\prime}(\epsilon)] = 0$, and the final equality in (10) reflects the valuation of the tariff change according to the welfare function $W(P, P^*, P^w)$ but with $W_{P^w} \equiv 0$. A similar interpretation can be given for the politically optimal tariffs of the foreign government.

With regard to the nature of the thought experiment envisioned in the politically optimal tariffs, there is an important distinction between the perfectly competitive environment considered in Bagwell and Staiger (1999) and the imperfectly competitive setting that we analyze here. In the perfectly competitive setting, domestic welfare can be written as $W(P, P^w)$ as we have observed above, and so in that case the politically optimal tariff for the domestic government satisfies $W_P \frac{dP}{dt} = 0$. In the case of perfect competition, then, it is immaterial whether the thought experiment associated with politically optimal tariffs is interpreted to mean that the government acts "as if" $W_{P^w} \equiv 0$ or rather that the government acts "as if" $\frac{dP^w}{dt} \equiv 0$, because either way the term $W_{P^w} \frac{dP^w}{dt} \equiv 0$; and under the second interpretation, politically optimal tariffs are the tariffs that governments would choose unilaterally if they were "small" in world markets.[4] In the presence of imperfectly competitive firms, however, this second interpretation is not valid, because the domestic welfare function now includes P^* as we have emphasized, and because the relationship $P^w = P^* - t^*$ implies $\frac{dP^*}{dt} = \frac{dP^w}{dt}$; and as a consequence, if the domestic government were to act "as if" $\frac{dP^w}{dt} \equiv 0$, its unilaterally chosen tariff would satisfy $W_P \frac{dP}{dt} = 0$, which differs from the expression for the politically optimal domestic tariff in (8) above. In effect, in the presence of imperfect competition, it no longer makes sense to think of a hypothetical situation in which governments act as if they were small in world markets, because their firms are not small.

We now proceed to evaluate the efficiency properties of politically optimal tariffs defined by (8). Recalling that $\frac{dP^*}{dt} = \frac{dP^*}{dt^*}$, this is easily done: the two conditions in (8), when summed together, imply the first condition in (6). Therefore, if governments could be induced not to value the pure international rent-shifting associated with the terms-of-trade movements induced by their unilateral tariff choices, then they would set efficient tariffs.

The politically optimal tariffs take an intuitive form. At the political optimum, we see from

[4] Bagwell and Staiger (1999, footnote 11) stress the first of these interpretations in their formal analysis, but both interpretations are valid in the competitive markets setting.

(8) that $W^*_{P^*} = 0$. This condition implies in turn that $P^* = P^w$, from which we conclude that the politically optimal tariff for the foreign country is free trade: $t^*_{PO} = 0$.[5] The politically optimal export policy is sensitive to market characteristics. When the domestic government imposes a higher export tariff, it reduces the price in the domestic country, which has the beneficial effect of reducing the domestic markup, $P - c$. At the same time, a higher export tariff also raises the local price in the foreign country and thereby increases the foreign markup, $P^* - c$. For the domestic government, the lost foreign sales are valued at rate $P^w - c$ per unit; however, when the foreign government applies its politically optimal tariff of free trade, we have that $P^* = P^w$ and the domestic government then experiences the full cost of a higher foreign markup. The domestic government thus sets its politically optimal export policy so as to achieve an optimal balance in its attempt to diminish both markups. The politically optimal export policy is thus sensitive to the relative slopes of the domestic and foreign demand functions. In sum, politically optimal tariffs are efficiently deployed to lessen existing distortions associated with monopoly pricing.

We can now extend the model slightly to allow that the foreign country is the mirror image of the domestic country. Thus, while the domestic country has a monopolist that sells good y in domestic and foreign markets, the foreign country likewise has a monopolist that sells good x in the foreign and domestic markets. If the governments of these countries set their unilateral policies so as to maximize their respective country welfare, then a trade agreement between the two governments would offer scope for mutual gains if and only if the unilateral policies give rise to an inefficient outcome. As we argue above, when governments are motivated by the terms-of-trade consequences of their trade policies and set their unilaterally optimal tariffs, an inefficiency is created in the resulting Nash equilibrium. And we have further shown that, if governments were not motivated by the terms-of-trade consequences of their trade policies, then the resulting politically optimal trade policies would be efficient. Thus, in the model with export sector monopoly power, if each government maximizes the welfare of its country, we conclude that the *only* rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume.

We next show that this conclusion continues to hold even when governments have political-economic objectives. To this end, we now allow that the domestic government may value profit more heavily than consumer surplus and tariff revenue. Formally, we now suppose that the domestic government maximizes a political-economic welfare function of the form

$$\gamma[P - c]D(P) + CS(P) + \gamma[P^* - (c + t + t^*)]D^*(P^*) + tD^*(P^*),$$

where $\gamma \geq 1$ is a political-economy weight (see, e.g., Baldwin, 1987, and Grossman and Helpman, 1994). The domestic government thus maximizes domestic country welfare when $\gamma = 1$ and values profit more heavily than consumer surplus and tariff revenue when $\gamma > 1$. As before, we may

[5] Given $W^*(P^*, P^w) = CS^*(P^*) + [P^* - P^w]D^*(P^*)$ and the fact that the derivative of $CS^*(P^*)$ equals $-D^*(P^*)$, we see that $W^*_{P^*} = -[P^* - P^w]D^{*\prime}(P^*)$. Since $D^*(P^*)$ is a downward-sloping demand function, we conclude that $W^*_{P^*} = 0$ if and only if $P^* = P^w$. We note that the foreign country's politically optimal tariff is thus independent of the home country's export tariff. As we establish in the next section, this independence property disappears when we allow for production in the foreign country.

substitute for tariffs and rewrite the government's welfare function as a function of local and world prices:

$$W(P, P^*, P^w; \gamma) = \gamma[P - c]D(P) + CS(P) + \gamma[P - c]D^*(P^*) + [P^w - P]D^*(P^*). \qquad (11)$$

Holding fixed the volumes of domestic and foreign consumption, an increase in P transfers surplus from domestic consumers (on domestically traded units) and tariff revenue (on internationally traded units) to profit. This redistribution has no effect on domestic country welfare, but it raises the welfare of the domestic government when $\gamma > 1$. The welfare of the foreign government is again given by the sum of foreign consumer surplus and tariff revenue as defined in (3): in the foreign country, no firms produce good y, and so we do not include a political-economy parameter for the foreign government.

A key observation from (11) and (3) is that joint welfare (i.e., the sum of $W(P, P^*, P^w; \gamma)$ and $W^*(P^*, P^w)$) is again independent of the world price. Whether or not the domestic government has political-economic motivations, a change in the world price amounts to a pure transfer across governments with the associated rent moving from one treasury to the other. We thus may again represent joint welfare as a function of local prices only:

$$J(P, P^*; \gamma) = W(P, P^*, P^w; \gamma) + W^*(P, P^*). \qquad (12)$$

We may define efficient tariffs relative to $J(P, P^*; \gamma)$ as those satisfying the conditions in (6), and politically optimal tariffs relative to $W(P, P^*, P^w; \gamma)$ and $W^*(P, P^*)$ as those satisfying the conditions in (8). Exactly as before, we may then show that politically optimal tariffs are efficient. Thus, in the model with export sector monopoly power, for governments with political-economic preferences, we conclude that the *only* rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume.

Notice the important role played by both import and export policies for this result. If, for example, governments were assumed only to have import tariffs (t^* for the foreign government, with the home government passive in its export sector) at their disposal, then it is still the case that efficiency would be defined as in (6) above, owing to the redundancy of the instruments t and t^* in terms of their impacts on P and P^*. The efficient total tariff would then be achieved entirely through the import tariff, t^*. But as can be seen from the conditions for the political optimum in (8), the politically optimal setting of t^* alone could not in general achieve efficiency. In the absence of political-economy motivations, for example, the political optimum when only import tariffs are available entails free trade, which is generally not efficient in the presence of a monopoly exporter.[6] Therefore, the efficiency of the political optimum – and hence the ability to interpret

[6] A second possibility is that governments have available only export policies. In this case, the foreign import tariff is fixed at free trade, and efficiency must be achieved through the setting of the domestic export policy. Recall now that, in the absence of political-economy motivations, the politically optimal setting of the import tariff is free trade; thus, in this case, the efficiency of the political optimum does not require that import tariffs be available. However, when political-economy motives are present, and more generally for other market structures as we show in

the problem that a trade agreement can solve as a terms-of-trade problem – hinges importantly on the assumption that governments have sufficient trade-tax instruments at their disposal. If they did not, then other non-terms-of-trade problems might also be addressed by a trade agreement (in this setting, just as more generally). But viewed in this way, it is also clear what the associated non-terms-of-trade problem would be: a trade agreement could help substitute for missing trade policy instruments (e.g., export policies) which, if available, would then convert the role of a trade agreement back to the standard terms-of-trade driven Prisoners' Dilemma.

We summarize the results of this section with

Proposition 1 *In the model with export sector monopoly power, and for governments with or without political-economic preferences, the only rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume.*

2.2 Segmented Markets

Up to this point, we have focused on integrated markets. We now relax this assumption and consider the possibility that the export monopolist can segment the domestic and foreign markets. We find that the main conclusion established above for integrated markets carries over as well for segmented markets.

We begin our discussion of segmented markets by considering the monopolist's pricing problem. When markets are segmented, the monopolist is free to select different prices in the domestic and foreign markets, without worrying about international arbitrage. Formally, when markets are segmented, the problem for the monopolist is to choose P and P^* to maximize profit in the domestic and foreign markets:

$$\Pi(P, P^*, t + t^*) = [P - c]D(P) + [P^* - (c + t + t^*)]D^*(P^*),$$

where $D(P)$ and $D^*(P^*)$ are the downward-sloping domestic and foreign demand functions, respectively. Notice that P^* can now be set independently of P, due to the assumption of market segmentation. The first-order conditions for profit maximization are:

$$\begin{aligned} \Pi_P(P, P^*, t + t^*) &= [P - c]D'(P) + D(P) = 0, \text{ and} \\ \Pi_{P^*}(P, P^*, t + t^*) &= [P^* - (c + t + t^*)]D^{*\prime}(P^*) + D^*(P^*) = 0. \end{aligned}$$

With segmented markets, the domestic price set by the monopoly exporter is independent of the policies t and t^*. On the other hand, the profit-maximizing foreign price is a function of the total tariff and may thus be represented as $P^*(t + t^*)$. Under general conditions, $P^*(t + t^*)$ rises with the total tariff. We also note that $P > c$ and $P^*(t + t^*) > c$ is required by the monopoly first-order conditions.

later sections, this special feature of politically optimal tariffs does not hold, and both import and export policies must be available to ensure the efficiency of the political optimum.

We consider next the domestic and foreign welfare functions. We can still write domestic welfare as

$$[P-c]D(P)+CS(P)+[P^*-(c+t+t^*)]D^*(P^*)+tD^*(P^*).$$

Letting $P^w = P^* - t^*$, we may thus again represent domestic country welfare as

$$W(P,P^*,P^w) = [P-c]D(P)+CS(P)+[P^w-c]D^*(P^*).$$

Foreign welfare is denoted as $W^*(P^*, P^w)$ and once more takes the following form:

$$W^*(P^*,P^w) = CS^*(P^*)+[P^*-P^w]D^*(P^*).$$

Joint welfare is the sum of $W(P, P^*, P^w)$ and $W^*(P^*, P^w)$, and an important observation is that joint welfare is again independent of the world price.

An efficient or joint-welfare maximizing agreement would maximize joint welfare. We may formally express joint welfare as

$$J(P,P^*) \equiv W(P,P^*,P^w)+W^*(P^*,P^w) = [P-c]D(P)+CS(P)+[P^*-c]D^*(P^*)+CS^*(P^*).$$

Recalling that P is independent of t and t^*, we may express the first-order conditions that define efficient choices of t and t^* as

$$\begin{aligned} W_{P^*}\frac{dP^*}{dt}+W^*_{P^*}\frac{dP^*}{dt} &= 0, \text{ and} \\ W_{P^*}\frac{dP^*}{dt^*}+W^*_{P^*}\frac{dP^*}{dt^*} &= 0. \end{aligned} \tag{13}$$

Since the profit-maximizing foreign price is a function of the total tariff, we have that $\frac{dp^*}{dt} = \frac{dp^*}{dt^*}$. This implies in turn that the two efficiency conditions in (13) are really just one independent condition: the satisfaction of either condition implies the satisfaction of the other.

Let us now consider the politically optimal tariffs. We again define the politically optimal tariffs as the tariffs that the domestic and foreign government would choose unilaterally if they did not value the pure international rent-shifting associated with the terms-of-trade movements induced by their unilateral tariff choices. Specifically, we suppose that the domestic government acts as if $W_{P^w} \equiv 0$ when choosing its politically optimal tariff, while the foreign government acts as if $W^*_{P^w} \equiv 0$. Recalling once again that P is independent of t and t^*, we observe that politically optimal tariffs are defined by

$$\begin{aligned} W_{P^*}\frac{dP^*}{dt} &= 0, \text{ and} \\ W^*_{P^*}\frac{dP^*}{dt^*} &= 0. \end{aligned} \tag{14}$$

We may now immediately confirm from (14) that politically optimal tariffs satisfy the efficiency conditions in (13). We conclude that politically optimal tariffs are efficient.

It is interesting to consider the form that politically optimal tariffs take in segmented markets. The first condition for political optimality $W_{P^*}\frac{dP^*}{dt} = 0$ implies $[P^w - c]D^{*\prime}(P^*) = 0$, which could only happen if $P^w = c$. Likewise, the second condition for political optimality $W^*_{P^*}\frac{dP^*}{dt^*} = 0$ implies $P^* = P^w$. Together, the two conditions imply that $P^* = P^w = c$; thus, the political optimum amounts to a large export subsidy from the exporting country and then free trade by the importing country. Intuitively, if governments could be induced not to value the pure international rent-shifting associated with the terms-of-trade movements induced by their tariff choices, they would set efficient tariffs. Once again, an exactly analogous result applies when governments have political-economic objectives.

In summary, in the model with export sector monopoly power, whether governments maximize national welfare or have political-economic preferences, we again conclude that the *only* rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume. The introduction of segmented markets does not change this main conclusion.

3 Trade Policies and Profit-Shifting

In the previous section, we consider import and export policies when market power exists on one side of the trading relationship. In this section, we extend the analysis to allow for two-sided market power. Specifically, we examine the situation in which a single domestic firm sells at home and abroad and competes in the foreign market with a single foreign firm which sells the same good. We thus now introduce the possibility of international oligopoly competition. As before, we focus mainly on the case where the domestic and foreign markets are integrated, so that firms cannot price discriminate across the two markets and any difference in prices across the two markets is therefore attributable to trade policies. At the end of the section, however, we also show how the analysis extends when the markets are segmented.

In a setting with international oligopoly competition, trade policy may play a "strategic" role by altering the nature of oligopolistic competition, as the seminal papers of Brander and Spencer (1983, 1985) have shown. In particular, an important role for domestic export policy in such a setting may be to "shift profits" from the foreign firm to the domestic firm. Likewise, foreign import policy may shift profits from the domestic firm to the foreign firm. Here, we extend our analysis of two-country models to include international oligopoly competition and thus strategic trade policies. As before, we are primarily interested in understanding the rationale for a trade agreement in the model under consideration. This focus again directs our attention toward the identification of an international externality. For the model of strategic trade policies, and whether markets are integrated or segmented, our main finding below is that the terms-of-trade externality continues to provide the only rationale for a trade agreement. In the Appendix, we consider as well an extension to three-country models along the lines of the Brander-Spencer (1985) and Eaton-Grossman (1986) strategic export policy analyses, and show that our findings apply to those settings as well.

3.1 Integrated Markets

We consider the following model. The domestic country has a single firm, and the foreign country also has a single firm. The firms produce the same good, and oligopoly competition between the two firms takes the form of Cournot competition. If this good sells domestically at price P, then domestic consumers demand $D(P)$ units, where $D(P)$ is a downward-sloping demand function. Likewise, if this good sells in the foreign country at price P^*, then foreign consumers demand $D^*(P^*)$ units, where $D^*(P^*)$ is a downward-sloping demand function. In this section, we assume that the markets are integrated. In general, trade occurs in only one direction when markets are integrated. If the domestic firm exports to the foreign country, then the relationship between P and P^* implied by market integration is given by $P^* = P + t + t^*$, where t is the export tariff imposed by the domestic country and t^* is the import tariff imposed by the foreign country. Without loss of generality, we suppose that trade occurs in this direction. Finally, we define the world price as $P^w = P + t = P^* - t^*$.

We begin by defining the market-clearing condition in the integrated market. Suppose that domestic and foreign tariffs are given as t and t^*, and suppose as well that the domestic firm produces q units of output while the foreign firm's output level is q^*. The industry output $Q \equiv q+q^*$ then determines P and thereby $P^* = P+t+t^*$ through the (integrated) market-clearing condition

$$q + q^* = D(P) + D^*(P + t + t^*). \tag{15}$$

Using this market-clearing condition, we may define $P(q + q^*, t + t^*)$ or equivalently $P(Q, t + t^*)$ and thereby represent the market-clearing domestic price as a function of the total output and tariff levels, respectively. Likewise, we may define the associated market-clearing foreign price as $P^*(Q, t+t^*) \equiv P(Q, t+t^*)+t+t^*$. Given our assumption of downward-sloping demand functions, we can easily show that $P(Q, t+t^*)$ is decreasing in both Q and the total tariff, $t+t^*$. Intuitively, when the total tariff is raised, the foreign price is directly elevated and aggregate demand (i.e., the right-hand side of (15)) is thus reduced. Market-clearing can be restored only when the domestic price P is lowered so that aggregate demand can be expanded back to the original level. In the end, an increase in the total tariff results in a lower domestic price P, a higher foreign local price P^* and a larger wedge between the two prices.

We next consider the optimal output choice for the domestic firm. Facing domestic and foreign tariffs t and t^*, the problem for the domestic firm is to choose its output q to maximize its profit in light of the foreign firm's output choice q^*. Using the market-clearing condition, we may define the domestic firm's profit as:

$$\Pi(q, q^*, t + t^*) = [P(q + q^*, t + t^*) - c]q.$$

The first-order condition that defines the domestic firm's optimal output choice equates the marginal revenue and marginal cost that are associated with a slight increase in its output:

$$\Pi_q(q, q^*, t + t^*) = [\frac{\partial P}{\partial Q} q + P(\cdot)] - c = 0,$$

where we use $P(\cdot)$ to denote $P(q+q^*, t+t^*)$ to reduce notation. The domestic-firm reaction function is derived from this equation and indicates the profit-maximizing quantity choice for the domestic firm when the foreign firm is expected to supply q^* units and the total tariff is $t + t^*$.[7] Using (15) to derive $\frac{\partial P}{\partial Q} = \frac{1}{D'(P)+D^{*\prime}(P+t+t^*)}$, we note that the first-order condition can be rewritten as

$$q + [P(\cdot) - c][D'(P(\cdot)) + D^{*\prime}(P(\cdot) + t + t^*)] = 0.$$

It thus follows that the markup for the domestic firm is positive: $P(\cdot) > c$.

Similarly, for given tariff policies t and t^*, the problem for the foreign firm is to choose its output q^* to maximize its profit in light of the domestic firm's output choice q. The foreign firm's profit is:

$$\Pi^*(q, q^*, t + t^*) = [P^*(q + q^*, t + t^*) - c^*]q^*,$$

where $P^*(q + q^*, t + t^*) \equiv P(q + q^*, t + t^*) + t + t^*$ is the market-clearing foreign price. The first-order condition that defines the foreign firm's optimal output choice equates the associated marginal revenue and marginal cost for the foreign firm:

$$\Pi^*_{q^*}(q, q^*, t + t^*) = [\frac{\partial P^*}{\partial Q} q^* + P^*(\cdot)] - c^* = 0,$$

where we use $P^*(\cdot)$ to denote $P^*(q+q^*, t+t^*)$ to reduce notation. The foreign-firm reaction function is derived from this equation and indicates the profit-maximizing quantity choice for the foreign firm when the domestic firm is expected to supply q units and the total tariff is $t + t^*$.[8] Again we may use (15) to derive $\frac{\partial P^*}{\partial Q} = \frac{1}{D'(P)+D^{*\prime}(P+t+t^*)}$, and so the first-order condition can be rewritten as

$$q^* + [P^*(\cdot) - c^*][D'(P(\cdot)) + D^{*\prime}(P^*(\cdot))] = 0.$$

Thus, the markup for the foreign firm is also positive: $P^*(\cdot) > c^*$.

At the Nash equilibrium of the Cournot game, both the domestic and foreign firms are on their respective reaction curves. Let $q^N(t + t^*)$ denote the Cournot-Nash output choice of the domestic firm and $q^{*N}(t + t^*)$ denote the Cournot-Nash output choice of the foreign firm. We can then represent the total output in the Cournot equilibrium as $Q^N(t + t^*) \equiv q^N(t + t^*) + q^{*N}(t + t^*)$. From here, we may define the Cournot-Nash prices as functions of the total tariff. Specifically, let $P^N(t+t^*) \equiv P(Q^N(t+t^*), t+t^*)$, $P^{*N}(t+t^*) \equiv P^N(t+t^*)+t+t^*$, and $P^{wN}(t, t^*) \equiv P^N(t+t^*)+t = P^{*N}(t+t^*) - t^*$ denote the Cournot-Nash domestic, foreign and world price functions, respectively.

In this model, an increase in the total tariff results in a reduction in the market-clearing domestic

[7] We assume that the second-order condition holds.

[8] Once again we assume that the second-order condition holds.

price. In turn, this reduction lowers the marginal revenue from output expansion for the domestic firm. We thus expect that the domestic firm's reaction function may shift in as the total tariff is raised.[9] Similarly, an increase in the total tariff results in an increase in the market-clearing foreign price, which has the effect of raising the marginal revenue from output expansion for the foreign firm. On this basis, we may expect that the foreign firm's reaction function may shift out when the total tariff is increased. The Cournot-Nash equilibrium occurs at the quantities at which the two reaction functions intersect. In light of the expected effects of the total tariff on the respective reaction functions, we anticipate that an increase in the total tariff may cause $q^N(t+t^*)$ to decrease and $q^{*N}(t+t^*)$ to increase. Since markups are positive, such quantity adjustments may be interpreted as shifting profit from the domestic to the foreign firm. The quantity adjustments are expected to moderate but not reverse the price effects associated with a total tariff increase; thus, we expect that an increase in the total tariff would raise the Cournot-Nash foreign price, $P^{*N}(t+t^*)$, and decrease the Cournot-Nash domestic price, $P^N(t+t^*)$. In the discussion that follows we assume that P^{*N} rises and P^N falls with the total tariff, although our main results do not depend on this assumption. Finally, we note that our assumptions ensure that the world price, $P^w(t,t^*)$, rises with the export tariff t and falls with the import tariff t^*: a higher tariff by one country improves its own terms of trade and diminishes the terms of trade of its trading partner.[10]

Let us now consider a particular experiment in which t is increased and t^* is decreased to an equal degree so that the total tariff $t+t^*$ is unchanged. With the total tariff held constant, the domestic and foreign respective Cournot-Nash outputs and local prices are all also unchanged. The proposed change does, however, generate an improved terms of trade for the domestic country and a diminished terms of trade for the foreign country. The terms-of-trade movement in this scenario generates a pure rent transfer; in particular, the proposed tariff adjustments have no effect other than to transfer tariff revenue from the foreign treasury to the domestic treasury. Clearly, all else equal, an improved terms of trade raises a country's welfare.

We now consider the domestic welfare function in detail. In the integrated market, any wedge between the foreign and domestic local prices is attributable to the total tariff. This property must hold in particular at the Cournot-Nash equilibrium; thus, we have that $t+t^* = P^{*N} - P^N$, where to ease the notational burden we now suppress the dependence of the Cournot-Nash prices on the total tariff. We next may write $q^{*N}(t+t^*) = q^{*N}(P^{*N} - P^N)$ and thereby express the foreign firm's Cournot-Nash output as a function of the price wedge in the Cournot-Nash equilibrium. At this point, we can represent domestic welfare as

$$[P^N - c]D(P^N) + CS(P^N) + [P^{*N} - (c+t+t^*)][D^*(P^{*N}) - q^{*N}(P^{*N} - P^N)] + t[D^*(P^{*N}) - q^{*N}(P^{*N} - P^N)].$$

[9] In the Appendix, we develop a version of the model in which domestic and foreign demand functions are linear. For that model, all of the properties described in this subsection hold.

[10] Helpman and Krugman (1989, Chapter 6) consider a model in which a single firm produces but no consumers demand the export good in the exporting country. Under Cournot competition, they argue that when a firm also produces the good in the importing country, it is more likely that a higher import tariff results in a terms-of-trade gain for the importing country than would be the case if there were no firm in the importing country.

The first two terms correspond to domestic producer and consumer surplus on domestically traded units, the third term represents the (post-tariff) profit to the domestic firm on units sold abroad, and the last term is the tariff revenue retained by the domestic treasury on those exported units. Since tariff revenue is simply an internal transfer within the domestic country, we may simplify and represent domestic country welfare as

$$W(P^N, P^{*N}, P^{wN}) = [P^N - c]D(P^N) + CS(P^N) + [P^{wN} - c][D^*(P^{*N}) - q^{*N}(P^{*N} - P^N)]. \quad (16)$$

The third term in (16) can now be understood as "true" exporting profit for the domestic country. We notice that domestic welfare depends on the foreign local price, P^{*N}. This is because the domestic firm does not simply "take" the domestic local price but rather has some market power with respect to the determination of domestic and foreign local prices. The resulting foreign local price affects the level of domestic exports by affecting both the level of foreign demand and the level of foreign supply.

Foreign welfare is denoted as $W^*(P^{*N}, P^{wN})$ and takes the following form:

$$W^*(P^{*N}, P^N, P^{wN}) = CS^*(P^{*N}) + [P^{*N} - c^*]q^{*N}(P^{*N} - P^N) + [P^{*N} - P^{wN}][D^*(P^{*N}) - q^{*N}(P^{*N} - P^N)]. \quad (17)$$

Foreign country welfare is thus the sum of foreign consumer surplus, foreign profit and tariff revenue enjoyed on imported units. Notice from (17) that now, due to the presence of the foreign duopolist, foreign welfare depends not only on P^{*N} and P^{wN}, but also on P^N. The reason is analogous to the reason that domestic welfare depends on P^{*N} when the domestic firm exerts market power, as we have explained above.

In the absence of a trade agreement, governments would set their Nash tariff policies, t^N and t^{*N}. These policies are jointly defined by the following respective first-order conditions:

$$\begin{aligned} W_{P^N}\frac{dP^N}{dt} + W_{P^{*N}}\frac{dP^{*N}}{dt} + W_{P^{wN}}\frac{dP^{wN}}{dt} &= 0, \text{ and} \\ W^*_{P^N}\frac{dP^N}{dt^*} + W^*_{P^{*N}}\frac{dP^{*N}}{dt^*} + W^*_{P^{wN}}\frac{dP^{wN}}{dt^*} &= 0. \end{aligned} \quad (18)$$

As these expressions indicate, when setting its optimal trade policy, each government is mindful of the effect of its policy on its own local price, the local price in the other country, and its terms-of-trade.

To better understand these expressions, we consider first the government of the domestic country. If this government were to increase t, then the domestic price P^N would fall as domestic output is redirected to the domestic market. This price change has the beneficial effect of diminishing the markup in the domestic market. A higher value for t also raises P^{*N}. Due to the decrease in P^N and the increase in P^{*N}, the price wedge, $P^{*N} - P^N$, must rise. This implies in turn that the total output of the domestic firm, $q^N(P^{*N} - P^N)$, falls and the total output of the foreign firm, $q^N(P^{*N} - P^N)$, rises. The higher foreign price also causes foreign demand, $D^*(P^{*N})$, to fall. The domestic export volume, $D^*(P^{*N}) - q^{*N}(P^{*N} - P^N)$, is thus reduced, both because foreign demand falls and because foreign production expands. In the foreign market, the increase in t thus shifts some (true) profit from the domestic to the foreign firm, and this profit-shifting effect represents a cost to the domestic government of a higher value for t. Finally, when t is increased, the world price, P^{wN}, rises, and the domestic country enjoys a terms-of-trade gain. This gain amounts to a transfer of tariff revenue from the foreign treasury to the domestic treasury and represents a benefit to the domestic government from a higher value for t. Thus, when considering whether to raise t, the domestic government balances the benefits of a reduced domestic markup and an improved terms of trade against the profit-shifting cost in the foreign market.

In a similar manner, if the government of the foreign country were to increase its import tariff t^*, then P^{*N} would rise, P^N would fall, and the price wedge would thus increase. The increase in P^{*N} would cause a reduction in foreign demand, and this reduction would correspond to a fall in import volume that is not fully offset by a rise in production by the foreign firm. The overall reduction in volume corresponds to a higher foreign markup and represents a cost to the foreign country that is experienced as a reduction in consumer surplus and tariff revenue. At the same time, a higher import tariff ensures that some of the lost import volume is replaced by an increase in the production by the foreign firm, and this profit-shifting effect generates a gain for the foreign government. Finally, a higher import tariff causes a reduction in the world price. The associated terms-of-trade gain for the foreign country amounts to a transfer from the domestic treasury to the foreign treasury and represents a further gain to the foreign government from an increase in its import tariff. Thus, when evaluating whether to raise its import tariff, the foreign government balances the cost of a higher foreign markup against the profit-shifting and terms-of-trade benefits.

An efficient or joint-welfare maximizing agreement would maximize the sum of W and W^*. As before, the world price cancels from this summation: the world price affects the distribution of rents across countries, but it does not in itself affect efficiency. Intuitively, and as explained above, when local prices are held fixed, an increase in the world price simply transfers tariff revenue from the foreign country to the domestic country. In order to effect a favorable transfer of this kind, a government may select a higher tariff and thereby alter not just the world price but also local prices. Efficiency is affected by local prices. Policies that are motivated by the prospect of a terms-of-trade gain thus represent a source of inefficiency.

But if governments were not motivated by the terms-of-trade implications of their respective policies, would there by any other sources of inefficiency? To address this question, we express joint welfare as

$$\begin{aligned} J(P^N, P^{*N}) &\equiv W(P^N, P^{*N}, P^{wN}) + W^*(P^{*N}, P^N, P^{wN}) \\ &= [P^N - c]D(P^N) + CS(P^N) + [P^{*N} - c][D^*(P^{*N}) - q^{*N}(P^{*N} - P^N)] \\ &+ CS^*(P^{*N}) + [P^{*N} - c^*]q^{*N}(P^{*N} - P^N). \end{aligned} \tag{19}$$

As (19) indicates, joint welfare can thus be understood as capturing domestic country producer and consumer surplus on units sold domestically, domestic producer surplus on units sold abroad, foreign country consumer surplus enjoyed on units produced in both countries, and foreign country producer surplus.

We provide next a formal characterization of the efficient export and import tariffs. The conditions that define efficient choices of t and t^* are given by

$$\begin{aligned} W_{P^N}\frac{dP^N}{dt} + W_{P^{*N}}\frac{dP^{*N}}{dt} + W^*_{P^{*N}}\frac{dP^{*N}}{dt} + W^*_{P^N}\frac{dP^N}{dt} &= 0, \text{ and} \\ W_{P^N}\frac{dP^N}{dt^*} + W_{P^{*N}}\frac{dP^{*N}}{dt^*} + W^*_{P^{*N}}\frac{dP^{*N}}{dt^*} + W^*_{P^N}\frac{dP^N}{dt^*} &= 0. \end{aligned} \tag{20}$$

As before, only the sum of t and t^* matters for the local domestic and foreign prices; hence, we have that $\frac{dP^N}{dt} = \frac{dP^N}{dt^*}$ and $\frac{dP^{*N}}{dt} = \frac{dP^{*N}}{dt^*}$. The two efficiency conditions in (20) are thus again equivalent: if the first efficiency condition is satisfied, then the second must be as well, and vice versa.

Our next step is to consider the politically optimal tariffs, which we again define as the tariffs that the domestic and foreign governments would choose unilaterally if they did not value the pure international rent-shifting associated with the terms-of-trade movements induced by their unilateral tariff choices. Specifically, the domestic government acts as if $W_{P^{wN}} \equiv 0$ when choosing its politically optimal tariff, while the foreign government acts as if $W^*_{P^{wN}} \equiv 0$. Accordingly, politically optimal tariffs are defined by

$$\begin{aligned} W_{P^N}\frac{dP^N}{dt} + W_{P^{*N}}\frac{dP^{*N}}{dt} &= 0, \text{ and} \\ W^*_{P^{*N}}\frac{dP^{*N}}{dt^*} + W^*_{P}\frac{dP^N}{dt^*} &= 0. \end{aligned} \tag{21}$$

As (21) indicates, when the domestic country determines its politically optimal tariff, it considers the fact that a higher export tariff would lower the local domestic price and thereby increase the level of welfare that is associated with domestically sold units. At the same time, a higher export tariff would raise the total tariff and thus the wedge between the domestic and foreign local prices. This would have the effect of reducing exports from the domestic country, with some of the lost sales being shifted to the foreign firm. Given positive markups, the reduction in export volume represents a profit-shifting cost to the domestic country of a higher export tariff. The politically optimal tariff achieves a balance between these considerations. Similarly, for the foreign country, the politically optimal import tariff reflects a balance between the beneficial effect on profit of greater production by the foreign firm and the negative effect on foreign tariff revenue and consumer surplus of a lower volume of imports.

As before, a simple comparison of the efficiency conditions in (20) and the definition of politically optimal tariffs in (21) leads immediately to the conclusion that the politically optimal tariffs are efficient. In other words, if governments could be induced not to value the pure international rent-shifting associated with the terms-of-trade movements induced by their tariff choices, then they would set efficient tariffs and there would be nothing left for a trade agreement to do.

It is interesting to reflect on the role of profit shifting in this model. Certainly, when markups are positive and one government undertakes a policy that has the effect of raising the output of firms from its country while lowering the output of firms from a different country, then profit may be shifted from the latter country to the former country. Such profit shifting in itself represents a benefit to one country and a loss to the other. In the model studied here, however, the Cournot-Nash equilibrium output levels are functions of the total tariff, which in turn equals the wedge between the local price in the importing country and that in the exporting country. In short, profit-shifting is triggered by adjustments in local prices. Of course, local-price adjustments do not generate pure (i.e., zero-sum) transfers from one country to another; rather, they affect trade volumes and thereby consumer surplus, tariff revenue and profit. Now, if it were the case that governments did not value the terms-of-trade consequences of their trade policies, then each government would set its unilateral policy so that any induced movement in local prices would offer no first-order benefit to its country's welfare. At the associated political optimum, therefore, each government would have already set its policy so that the local price changes necessary to generate any profit-shifting benefit would generate other offsetting welfare costs. At this point, any international externality that travels through local prices would be removed, and the resulting politically optimal tariffs are therefore efficient.

As before, the model can be generalized. We can include a second (mirror-image) good x, which the foreign country exports to the domestic country. We can also allow that governments have political-economic objectives and value producer surplus more heavily than consumer surplus and tariff revenue. As in the previous section, these extensions do not alter our basic conclusion that a rationale for a trade agreement arises if and only if governments are motivated by the terms-of-trade implications of their trade policies.

We summarize the results of this section with

Proposition 2 *In the duopoly profit-shifting model, and for governments with or without political-economic preferences, the only rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume.*

We develop this conclusion in a general model, but it is possible to gather further insights about the Nash, politically optimal and efficient trade policies once additional structure is added. In the Appendix, we consider a linear demand specification, under which $D(P) = \alpha - \beta P$ and $D^*(P^*) = \alpha^* - BP^*$, where $\alpha^* > \alpha \geq \beta c^* \geq \beta c$. There we derive closed-form solutions for the Nash trade policies, finding that the Nash import tariff is positive while the Nash export policy may be positive (an export tariff) or negative (an export subsidy), depending on the relative sizes of parameters. Intuitively, the terms-of-trade and profit-shifting benefits for the foreign government are both served by a higher import tariff, whereas the domestic government achieves a terms-of-trade gain from an export tariff but enjoys a profit-shifting benefit from an export subsidy. The politically optimal export policy is an export subsidy, and the politically optimal import tariff is positive if the difference between c and c^* is not too large. While the politically optimal tariffs are efficient, the Nash total tariff is inefficiently high, with the result being that too little trade occurs in the absence of an agreement. For this model, we also show that the Nash and politically optimal tariffs generate the same world price. This means that a policy of reciprocity, whereby the foreign government lowers its import tariff while the domestic government lowers its export tariff (or expands its export subsidy) in a reciprocal manner that preserves the terms of trade, would serve to move governments from the Nash tariff policies to the politically optimal tariff policies.

3.2 Segmented markets

We now assume that the domestic and foreign markets are segmented rather than integrated. As above, the home country has a single firm, the foreign country has a single firm, and the firms interact as Cournot competitors. The good is demanded in the home and foreign markets, with the respective downward sloping demand curves again represented as $D(P)$ and $D^*(P^*)$. When markets are segmented, the home and foreign local prices P and P^* are determined by separate home and foreign market-clearing conditions. The problem of output choice for each firm is then separable across the home and foreign markets.

As shown by Brander (1981), an implication of the segmented markets setting is that in general trade now occurs in both directions.[11] We let t_h^* and t_f^* denote the home and foreign trade taxes on trade flows destined for the foreign market (i.e., for exports from the home country to the foreign country, t_h^* is the export tax imposed by the home country and t_f^* is the import tariff imposed by the foreign country), and we let t_h and t_f denote the home and foreign trade taxes on trade flows destined for the home market (i.e., for exports from the foreign country to the home country, t_h is the import tariff imposed by the home country and t_f is the export tax imposed by the foreign country).

In the home market, the home firm chooses output q_h to maximize its home-market profit in light of the foreign firm's output choice q_f for the home market. The industry output destined for the home market $Q \equiv q_h + q_f$ then determines P through the home market-clearing condition:

$$q_h + q_f = D(P). \tag{22}$$

Using the home market-clearing condition (22), we may therefore define $P(q_h + q_f)$ or equivalently $P(Q)$. Notice from (22) that, owing to the segmented-market assumption, P does not depend on trade taxes directly but may depend indirectly on trade taxes to the extent that they alter Q.

The home firm also chooses output q_h^* to maximize its foreign-market profit in light of the foreign firm's foreign output choice q_f^*. The industry output destined for the foreign market $Q^* \equiv q_h^* + q_f^*$ then determines P^* through the foreign market-clearing condition:

$$q_h^* + q_f^* = D^*(P^*). \tag{23}$$

[11] For analyses of trade policies in two-country models with segmented markets and a fixed number of firms, see Brander and Spencer (1984) and Dixit (1984). We focus here on the rationale for a trade agreement in such a model.

As before, we may use the foreign market-clearing condition (23) and define $P^*(q_h^* + q_f^*)$ or equivalently $P^*(Q^*)$. Again, notice from (23) that under the segmented market assumption, P^* does not depend on trade taxes directly but may depend indirectly on trade taxes insofar as they alter Q^*.

We may now write the home firm's home-and-foreign-market profit as:

$$\Pi^h(q_h, q_f, q_h^*, q_f^*, t_h^* + t_f^*) = [P(q_h + q_f) - c]q_h + [P^*(q_h^* + q_f^*) - (c + t_h^* + t_f^*)]q_h^*.$$

For each market, the home firm's first-order condition equates the marginal revenue generated from a slight increase in the home firm's output in that market with its marginal cost of delivery to that market:

$$\begin{aligned} \Pi^h_{q_h} &= [\frac{dP}{dQ}q_h + P(Q)] - c = 0, \text{ and} \\ \Pi^h_{q_h^*} &= [\frac{dP^*}{dQ^*}q_h^* + P^*(Q^*)] - (c + t_h^* + t_f^*) = 0. \end{aligned}$$

Using (22) to derive $\frac{dP}{dQ} = \frac{1}{D'(P)}$ and using (23) to derive $\frac{dP^*}{dQ^*} = \frac{1}{D^{*\prime}(P^*)}$, we may rewrite the first-order conditions as

$$\begin{aligned} q_h + [P(Q) - c]D'(P(Q)) &= 0, \text{ and} \\ q_h^* + [P^*(Q^*) - (c + t_h^* + t_f^*)]D^{*\prime}(P^*(Q^*)) &= 0. \end{aligned}$$

These conditions determine the home-firm reaction curves for the home and foreign markets, respectively.[12] Given our assumption that demand functions are downward sloping, we see that the home firm's markups (inclusive of trade tariffs) must be positive: $P(Q) > c$ and $P^*(Q^*) > c + t_h^* + t_f^*$.

The foreign firm faces analogous conditions. The foreign firm's home-and-foreign-market profit is:

$$\Pi^f(q_h, q_f, q_h^*, q_f^*, t + t^*) = [P(q_h + q_f) - (c^* + t_h + t_f)]q_f + [P^*(q_h^* + q_f^*) - c^*)]q_f^*.$$

As before, in each market, the first-order condition equates the marginal revenue generated from a slight increase in the foreign firm's output in that market with its marginal cost of delivery to that market:

$$\begin{aligned} \Pi^f_{q_f} &= [\frac{dP}{dQ}q_f + P(Q)] - (c^* + t_h + t_f) = 0, \text{ and} \\ \Pi^f_{q_f^*} &= [\frac{dP^*}{dQ^*}q_f^* + P^*(Q^*)] - c^*) = 0. \end{aligned}$$

Using $\frac{dP}{dQ} = \frac{1}{D'(P)}$ and $\frac{dP^*}{dQ^*} = \frac{1}{D^{*\prime}(P^*)}$, we may rewrite the first-order conditions as

$$\begin{aligned} q_f + [P(Q) - (c^* + t_h + t_f)]D'(P(Q)) &= 0, \text{ and} \\ q_f^* + [P^*(Q^*) - c^*]D^{*\prime}(P^*(Q^*)) &= 0. \end{aligned}$$

[12] We assume that second-order conditions hold.

These conditions determine the foreign-firm reaction curves for the home and foreign markets, respectively.[13] As before, we see that the foreign firm's markups (inclusive of trade tariffs) must be positive: $P^*(Q^*) > c^*$ and $P(Q) > c^* + t_h + t_f$.

For the segmented markets model, a Cournot-Nash equilibrium is a set of four quantity levels such that the home and foreign firms are on their respective reaction curves in each market. In the home market, we denote the Cournot-Nash output levels for the home and foreign firms as functions of the total tariff that confronts imports into the home market: $q_h^N(t_h+t_f)$ and $q_f^N(t_h+t_f)$, respectively. The total Cournot-Nash output in the home market is represented as $Q^N(t_h + t_f) \equiv q_h^N(t_h + t_f) + q_f^N(t_h + t_f)$, and we may thus denote the corresponding Cournot-Nash price as $P^N(t_h+t_f) \equiv P(Q^N(t_h+t_f))$. Similarly, in the foreign market, the Cournot-Nash output levels for the home and foreign firms are functions of the total tariff that confronts imports into the foreign markets: $q_h^{*N}(t_h^*+t_f^*)$ and $q_f^{*N}(t_h^*+t_f^*)$, respectively. For the foreign market, the total Cournot-Nash output is represented as $Q^{*N}(t_h^* + t_f^*) \equiv q_h^{*N}(t_h^* + t_f^*) + q_f^{*N}(t_h^* + t_f^*)$, and we may thus denote the associated Cournot-Nash price as $P^{*N}(t_h^* + t_f^*) \equiv P^*(Q^{*N}(t_h^* + t_f^*))$.

In the home market, a higher total tariff raises the marginal cost of delivery for the foreign firm. We thus expect that $q_f^N(t_h + t_f)$ decreases as the total tariff rises. For a broad class of demand functions (including linear demand functions), reaction curves in the Cournot model are negatively sloped. A higher total tariff then shifts in the foreign firm reaction curve and thereby generates a higher level of output for the home firm. In other words, we expect that $q_h^N(t_h + t_f)$ increases as the total tariff rises. A higher total tariff thus lowers foreign output in the home market and shifts some of this output to the home firm. The overall level of output $Q^N(t_h + t_f)$ is expected to fall, however, as the total tariff increases. Accordingly, an increase in the total tariff leads to an increase in the price in the home market, $P^N(t_h + t_f)$. Exactly analogous conditions apply in the foreign market: an increase in the total tariff $t_h^* + t_f^*$ raises the marginal cost of the home firm for sales in the foreign market and thereby lowers $q_h^{*N}(t_h^*+t_f^*)$, raises $q_f^{*N}(t_h^*+t_f^*)$, lowers $Q^{*N}(t_h^*+t_f^*)$ and raises $P^{*N}(t_h^*+t_f^*)$. In the discussion that follows we assume that P^{*N} rises and P^N falls with the total tariff, although our main results do not depend on this assumption.

We are now ready to consider the domestic welfare function. Domestic welfare is given by

$$[P^N - c]q_h^N(t_h + t_f) + CS(P^N) + [P^{*N} - (c + t_h^* + t_f^*)]q_h^{*N}(t_h^* + t_f^*) + t_h^* q_h^{*N}(t_h^* + t_f^*) + t_h q_f^N(t_h + t_f),$$

where to ease the notational burden we suppress the dependence of Nash prices on the corresponding total tariffs. At the Cournot-Nash equilibrium, we now denote the world price for exports to the foreign market by $P^{*wN}(t_h^*, t_f^*) = P^{*N}(t_h^* + t_f^*) - t_f^*$ and the world price for exports to the home market by $P^{wN}(t_h, t_f) = P^N(t_h + t_f) - t_h$. We may also define $R^N(t_h^* + t_f^*) = P^{*wN}(t_h^*, t_f^*) - t_h^*$ as the price received by the home firm for foreign sales, and $R^{*N}(t_h + t_f) = P^{wN}(t_h, t_f) - t_f$ as the price received by the foreign firm for domestic sales. Notice now that $P^N - R^{*N} = t_h + t_f$ and $P^{*N} - R^N = t_h^* + t_f^*$. We may thus regard the Cournot-Nash quantities as functions of local price

[13] Again we assume that second-order conditions hold.

differences. With this observation in place, we may represent domestic country welfare as

$$\begin{aligned} & W(P^N, R^N, P^{wN}, P^{*N}, R^{*N}, P^{*wN}) \\ = \; & [P^N - c]q_h^N(P^N - R^{*N}) + CS(P^N) \\ & +[P^{*wN} - c]q_h^{*N}(P^{*N} - R^N) + [P^N - P^{wN}]q_f^N(P^N - R^{*N}), \end{aligned} \tag{24}$$

where in deriving (24) we also utilize the fact that the tariff revenue generated from the home export tariff has no effect on domestic welfare since it amounts to an internal transfer from home producer surplus.

Next consider the foreign welfare function. Foreign welfare is given by

$$[P^{*N} - c^*]q_f^{*N}(t_h^* + t_f^*) + CS^*(P^{*N}) + [P^N - (c^* + t_h + t_f)]q_f^N(t_h + t_f) + t_f q_f^N(t_h + t_f) + t_f^* q_h^{*N}(t_h^* + t_f^*),$$

where we again suppress the dependence of Cournot-Nash prices on tariffs. Proceeding as above, we can rewrite foreign welfare as

$$\begin{aligned} & W^*(P^{*N}, R^{*N}, P^{*wN}, P^N, R^N, P^{wN}) \\ = \; & [P^{*N} - c^*]q_f^{*N}(P^{*N} - R^N) + CS^*(P^{*N}) \\ & +[P^{wN} - c^*]q_f^N(P^N - R^{*N}) + [P^{*N} - P^{*wN}]q_h^{*N}(P^{*N} - R^N). \end{aligned} \tag{25}$$

The presence of segmented markets accounts for the proliferation of prices in the preceding discussion. When markets are segmented, identical products may trade in two directions. If the configuration of tariffs is different along one direction of trade than the other, then the associated world prices may differ as well. Thus, we may have that $P^{wN} \neq P^{w*N}$. The segmentation of markets also implies that in general the (pre-tariff) price that a firm receives for a unit destined for export may differ from the price that a firm receives when the unit is sold locally. In other words, when markets are segmented, we generally have that $R^N \neq P^N$ and $R^{*N} \neq P^{*N}$. Finally, we note that all local (i.e., non-world) prices depend on the associated total tariff. Thus, for example, if t_f were increased and t_h were decreased so as to keep the total tariff $t_f + t_h$ constant, then the price received by the foreign exporter and the price paid by the domestic consumer would be unaltered. The world price, P^{wN}, would rise, however. This terms-of-trade change represents a pure transfer from the home to the foreign country, as is evident from the welfare functions presented above.

An efficient or joint-welfare maximizing agreement would maximize the sum of W and W^*. We note once again that, according to (24) and (25), the world prices (P^{wN} and P^{*wN}) cancel from this summation. As just noted, world prices affect the distribution of rents across countries, but they do not directly affect efficiency. Tariff policies that are motivated by terms-of-trade effects thus lead to inefficient outcomes. To explore whether any other sources of inefficiency are present, we express joint welfare as

$$\begin{aligned} J(P^N, R^N, P^{*N}, R^{*N}) &\equiv W(P^N, R^N, P^{wN}, P^{*N}, R^{*N}, P^{*wN}) + W^*(P^{*N}, R^{*N}, P^{*wN}, P^N, R^N, P^{wN}) \\ &= [P^N - c] q_h^N (P^N - R^{*N}) + CS(P^N) + [P^{*N} - c] q_h^{*N} (P^{*N} - R^N) + \\ &\quad [P^N - c^*] q_f^N (P^N - R^{*N}) + [P^{*N} - c^*] q_f^{*N} (P^{*N} - R^N) + CS^*(P^{*N}). \end{aligned}$$

Joint welfare can again be understood as capturing consumer surplus in each country as well as true producer surplus for each firm on units sold locally as well as those sold abroad.

We consider next the conditions that characterize an efficient set of trade policies. Recalling that P^N and R^{*N} are independent of t_h^* and t_f^* while P^{*N} and R^N are independent of t_h and t_f, we can express the conditions that define efficient choices of t_h, t_h^*, t_f and t_f^* as

$$\begin{aligned} W_{P^N} \frac{dP^N}{dt_h} + W_{R^{*N}} \frac{dR^{*N}}{dt_h} + W^*_{P^N} \frac{dP^N}{dt_h} + W^*_{R^{*N}} \frac{dR^{*N}}{dt_h} &= 0, \\ W_{P^N} \frac{dP^N}{dt_f} + W_{R^{*N}} \frac{dR^{*N}}{dt_f} + W^*_{P^N} \frac{dP^N}{dt_f} + W^*_{R^{*N}} \frac{dR^{*N}}{dt_f} &= 0, \\ W_{P^{*N}} \frac{dP^{*N}}{dt_h^*} + W_{R^N} \frac{dR^N}{dt_h^*} + W^*_{P^{*N}} \frac{dP^{*N}}{dt_h^*} + W^*_{R^N} \frac{dR^N}{dt_h^*} &= 0, \text{ and} \\ W_{P^{*N}} \frac{dP^{*N}}{dt_f^*} + W_{R^N} \frac{dR^N}{dt_f^*} + W^*_{P^{*N}} \frac{dP^{*N}}{dt_f^*} + W^*_{R^N} \frac{dR^N}{dt_f^*} &= 0. \end{aligned} \tag{26}$$

As noted above, only the sum of t_h^* and t_f^* matters for P^{*N} and R^N, and similarly only the sum of t_h and t_f matters for P^N and R^{*N}. It thus follows that $\frac{dP^N}{dt_h} = \frac{dP^N}{dt_f}$ and $\frac{dR^{*N}}{dt_h} = \frac{dR^{*N}}{dt_f}$, and similarly $\frac{dP^{*N}}{dt_h^*} = \frac{dP^{*N}}{dt_f^*}$ and $\frac{dR^N}{dt_h^*} = \frac{dR^N}{dt_f^*}$. Consequentially, the four efficiency conditions in (26) reduce to two independent conditions: if the first and third efficiency conditions are satisfied, then the second and fourth must be as well, and vice versa.

Once again, we define the politically optimal tariffs as the tariffs that the home and foreign government would choose unilaterally if they did not value the pure international rent-shifting associated with the terms-of-trade movements induced by their unilateral tariff choices. Specifically, when choosing the politically optimal tariffs, the home government acts as if $W_{P^{wN}} \equiv 0$ and $W_{P^{*wN}} \equiv 0$, and the foreign government acts as if $W^*_{P^{wN}} \equiv 0$ and $W^*_{P^{*wN}} \equiv 0$. Accordingly, politically optimal tariffs are defined by

$$\begin{aligned} W_{P^N} \frac{dP^N}{dt_h} + W_{R^{*N}} \frac{dR^{*N}}{dt_h} &= 0, \\ W_{P^{*N}} \frac{dP^{*N}}{dt_h^*} + W_{R^N} \frac{dR^N}{dt_h^*} &= 0, \\ W^*_{P^N} \frac{dP^N}{dt_f} + W^*_{R^{*N}} \frac{dR^{*N}}{dt_f} &= 0, \text{ and} \\ W^*_{P^{*N}} \frac{dP^{*N}}{dt_f^*} + W^*_{R^N} \frac{dR^N}{dt_f^*} &= 0. \end{aligned} \tag{27}$$

But it is now immediate from a comparison of (27) with (26) that politically optimal tariffs satisfy the efficiency conditions above, and are hence efficient. Just as in the previous subsections, we conclude that if governments could be induced not to value the pure international rent-shifting associated with the terms-of-trade movements induced by their tariff choices, they would set efficient tariffs and there would be nothing left for a trade agreement to do.

4 Trade Policies and Delocation

Thus far we have maintained the assumption that the number of producers in each country is fixed and invariant to trade policy. This has given rise to the existence of profitable firms in the models we have analyzed above, and it is the pursuit of those profits – either converted into tariff revenue as in the monopoly exporter model of section 2, or shifted from one firm to another as in the duopoly profit-shifting model of section 3 – combined with the relaxation of the assumption of price-taking behavior that has provided the novel role for government tariff intervention in these models. An alternative role for government intervention can arise when free entry conditions serve to eliminate profits in equilibrium even though firms are not price-takers. In the present section we consider this alternative by exploring models in which firms are not price takers but where entry is free, and we again ask whether a novel role for trade agreements can be identified.

We first consider the case where markets are segmented. As Helpman and Krugman (1989) describe, the case for trade policy in the presence of Cournot firms and free entry when markets are segmented is analyzed by Venables (1985), who builds from the model of Brander and Krugman (1983) to identify a firm "delocation" effect of trade policy intervention that could enhance the welfare of the intervening country: by triggering foreign exit and domestic entry, a domestic import tariff can lead to greater competition in the domestic market and therefore lower prices for domestic consumers. In the next subsection, we consider a model along these lines. We then turn to the case where markets are integrated. Here, as Venables (1987) shows building on the model of Krugman (1980), an alternative manifestation of the delocation effect of trade policy intervention can arise in a monopolistically competitive setting if there are large transport costs associated with trade in differentiated products. In the last subsection, we consider a version of this model along the lines of that developed in Helpman and Krugman (1989). As before, in each case we are primarily interested in understanding the rationale for a trade agreement in the models under consideration. This focus again directs our attention toward the identification of an international externality. For the models of firm delocation, and whether markets are integrated or segmented, our main finding below is that the terms-of-trade externality continues to provide the only rationale for a trade agreement.

4.1 Segmented Markets

We consider the following model. The domestic country has n_h Cournot firms, and the foreign country has n_f Cournot firms, all producing the same good under conditions of free entry. To prevent free entry from leading to perfect competition, we now introduce a fixed cost of production for domestic firms $F > 0$ and a fixed cost of production $F^* > 0$ for foreign firms. If the good sells domestically at price P, then domestic consumers demand $D(P)$; likewise, if the good sells in the foreign country at price P^*, then foreign consumers demand $D^*(P^*)$. As before, we assume that $D(P)$ and $D^*(P^*)$ are downward sloping.

The markets are segmented, so that the domestic and foreign market prices P and P^* are determined by separate domestic and foreign market-clearing conditions, and the problem of output choice for each firm is separable across the home and foreign markets. As we have previously discussed, an implication of the segmented markets setting is that in general trade will now occur in both directions. We let t_h^* and t_f^* denote the home and foreign trade taxes on trade flows destined for the foreign market (i.e., for exports from the home country to the foreign country, t_h^* is the export tax imposed by the home country and t_f^* is the import tariff imposed by the foreign country), and we let t_h and t_f denote the home and foreign trade taxes on trade flows destined for the home market (i.e., for exports from the foreign country to the home country, t_h is the import tariff imposed by the home country and t_f is the export tax imposed by the foreign country).

In the domestic market, and for fixed n_h and n_f, the problem for home firm i is to choose output destined for the domestic market q_h^i to maximize its domestic-market profit in light of the $(n_h - 1)$ other (symmetric) domestic firms' domestic output choices $(n_h - 1)q_h$ and the n_f other (symmetric) foreign firms' domestic output choices $n_f q_f$. The industry output destined for the domestic market is $Q \equiv q_h^i + (n_h - 1)q_h + n_f q_f$, and Q then determines P through the domestic market-clearing condition

$$q_h^i + (n_h - 1)q_h + n_f q_f = D(P). \tag{28}$$

Using the domestic market-clearing condition (28), we may therefore define $P(q_h^i + (n_h - 1)q_h + n_f q_f)$ or equivalently $P(Q)$. Once again, owing to the segmented market assumption, P does not depend on trade taxes directly, but may depend indirectly on trade taxes to the extent that they alter Q.

The home firm i must also choose output destined for the foreign market q_h^{i*} to maximize its foreign-market profit in light of the $(n_h - 1)$ other (symmetric) domestic firms' foreign output choices $(n_h - 1)q_h^*$ and the n_f other (symmetric) foreign firms' foreign output choices $n_f q_f^*$. The industry output destined for the foreign market $Q^* \equiv q_h^{i*} + (n_h - 1)q_h^* + n_f q_f^*$ then determines P^* through the foreign market clearing condition

$$q_h^{i*} + (n_h - 1)q_h^* + n_f q_f^* = D^*(P^*). \tag{29}$$

Using the foreign market clearing condition (29), we may therefore define $P^*(q_h^{i*} + (n_h - 1)q_h^* + n_f q_f^*)$ or equivalently $P^*(Q^*)$. Notice again that, owing to the segmented market assumption, P^* does not depend on trade taxes directly, but may depend indirectly on trade taxes to the extent that they alter Q^*.

We may now write home firm $i's$ domestic-and-foreign-market profits as:

$$\begin{aligned}\Pi^{hi}(q_h^i, q_h, q_f, q_h^{*i}, q_h^*, q_f^*, n_h, n_f, t_h^* + t_f^*) &= [P(q_h^i + (n_h - 1)q_h + n_f q_f) - c]q_h^i \\ &\quad + [P^*(q_h^{i*} + (n_h - 1)q_h^* + n_f q_f^*) - (c + t_h^* + t_f^*)]q_h^{*i} - F.\end{aligned}$$

For each market, the home firm $i's$ first-order condition equates the marginal revenue generated from a slight increase in its output in that market with its marginal cost of delivery to that market:

$$\begin{aligned}\Pi^{hi}_{q_h^i}(q_h^i, q_h, q_f, q_h^{*i}, q_h^*, q_f^*, n_h, n_f, t_h^* + t_f^*) &= [\frac{dP}{dQ}q_h^i + P(\cdot)] - c = 0, \text{ and} \\ \Pi^{hi}_{q_h^{i*}}(q_h^i, q_h, q_f, q_h^{*i}, q_h^*, q_f^*, n_h, n_f, t_h^* + t_f^*) &= [\frac{dP^*}{dQ^*}q_h^{i*} + P^*(\cdot)] - (c + t_h^* + t_f^*) = 0,\end{aligned}$$

where we use $P(\cdot)$ to denote $P(q_h^i+(n_h-1)q_h+n_f q_f)$ and $P^*(\cdot)$ to denote $P^*(q_h^{i*}+(n_h-1)q_h^*+n_f q_f^*)$ to reduce notation. Using (28) to derive $\frac{dP}{dQ} = \frac{1}{D'(P)}$ and using (29) to derive $\frac{dP^*}{dQ^*} = \frac{1}{D^{*\prime}(P^*)}$, the first-order conditions can be rewritten as

$$\begin{aligned}q_h^i + [P(\cdot) - c]D'(P(\cdot)) &= 0, \text{ and} \\ q_h^{i*} + [P^*(\cdot) - (c + t_h^* + t_f^*)]D^{*\prime}(P^*(\cdot)) &= 0.\end{aligned}$$

These conditions define home-firm $i's$ reaction curve for the domestic and foreign markets, respectively.[14] Under our assumption that demand functions are downward sloping, we may observe that domestic firm i's markups (inclusive of trade tariffs) must be positive.

With analogous steps, we may write foreign firm $i's$ domestic-and-foreign-market profits as:

$$\begin{aligned}\Pi^{fi}(q_h^i, q_h, q_f, q_h^{*i}, q_h^*, q_f^*, n_h, n_f, t_h + t_f) &= [P^*(q_f^{i*} + (n_f - 1)q_f^* + n_h q_h^*) - c^*]q_f^{i*} \\ &\quad + [P(q_f^i + (n_f - 1)q_f + n_h q_h) - (c^* + t_h + t_f)]q_f^i - F^*.\end{aligned}$$

As before, in each market, the foreign firm $i's$ first-order condition equates the marginal revenue generated from a slight increase in its output in that market with its marginal cost of delivery to that market:

$$\begin{aligned}\Pi^{fi}_{q_f^{i*}}(q_h^i, q_h, q_f, q_h^{*i}, q_h^*, q_f^*, n_h, n_f, t_h + t_f) &= [\frac{dP^*}{dQ^*}q_f^{i*} + P^*(\cdot)] - c^* = 0, \text{ and} \\ \Pi^{fi}_{q_f^i}(q_h^i, q_h, q_f, q_h^{*i}, q_h^*, q_f^*, n_h, n_f, t_h + t_f) &= [\frac{dP}{dQ}q_f^i + P(\cdot)] - (c^* + t_h + t_f) = 0,\end{aligned}$$

Again, noting that $\frac{dP}{dQ} = \frac{1}{D'(P)}$ and $\frac{dP^*}{dQ^*} = \frac{1}{D^{*\prime}(P^*)}$, the first-order conditions can be rewritten as

$$\begin{aligned}q_f^{i*} + [P^*(\cdot) - c^*]D^{*\prime}(P^*(\cdot)) &= 0, \text{ and} \\ q_f^i + [P(\cdot) - (c^* + t_h + t_f)]D'(P(\cdot)) &= 0.\end{aligned}$$

[14] We assume that the second-order conditions hold.

These conditions define foreign-firm $i's$ reaction curve for the foreign and domestic markets, respectively.[15] Given our assumption that demand functions are downward sloping, we see that foreign firm i's markups (inclusive of trade tariffs) must be positive.

Finally, when all home and foreign firms are on their respective reaction curves, we have the Cournot-Nash equilibrium. After imposing symmetry across domestic firms ($q_h^i = q_h$ and $q_h^{i*} = q_h^*$) and across foreign firms ($q_f^i = q_f$ and $q_f^{i*} = q_f^*$), we may solve for the domestic-market output levels for a representative home firm and a representative foreign firm. We denote these Nash quantities in the domestic market by $q_h^N(n_h, n_f, t_h+t_f)$ and $q_f^N(n_h, n_f, t_h+t_f)$, respectively, with $Q^N(n_h, n_f, t_h+t_f) \equiv n_h q_h^N + n_f q_f^N$. Similarly, we may solve for the foreign-market output levels for a representative domestic firm and a representative foreign firm. We denote these Nash quantities in the foreign market by $q_h^{*N}(n_h, n_f, t_h^* + t_f^*)$ and $q_f^{*N}(n_h, n_f, t_h^* + t_f^*)$, respectively, with $Q^{*N}(n_h, n_f, t_h^* + t_f^*) \equiv n_h q_h^{*N} + n_f q_f^{*N}$.

We may now write the maximized profits of a representative home firm as

$$\begin{aligned} \Pi^h(n_h, n_f, t_h^* + t_f^*, t_h + t_f) &= [P(Q^N(n_h, n_f, t_h + t_f)) - c]q_h^N(n_h, n_f, t_h + t_f) \\ &\quad +[P^*(Q^{*N}(n_h, n_f, t_h^* + t_f^*)) - (c + t_h^* + t_f^*)]q_h^{*N}(n_h, n_f, t_h^* + t_f^*) - F. \end{aligned} \tag{30}$$

And similarly, we may write the maximized profits of a representative foreign firm as

$$\begin{aligned} \Pi^f(n_h, n_f, t_h + t_f, t_h^* + t_f^*) &= [P^*(Q^{*N}(n_h, n_f, t_h^* + t_f^*)) - c^*]q_f^{*N}(n_h, n_f, t_h^* + t_f^*) \\ &\quad +[P(Q^N(n_h, n_f, t_h + t_f)) - (c^* + t_h + t_f)]q_f^N(n_h, n_f, t_h + t_f) - F^*. \end{aligned} \tag{31}$$

Finally, under free entry, n_h and n_f adjust to ensure that the maximized profits of home and foreign firms defined in (30) and (31) respectively are equal to zero, or

$$\Pi^h(n_h, n_f, t_h^* + t_f^*, t_h + t_f) = 0 = \Pi^f(n_h, n_f, t_h^* + t_f^*, t_h + t_f), \tag{32}$$

which then defines $n_h^N(t_h^* + t_f^*, t_h + t_f)$ and $n_f^N(t_h^* + t_f^*, t_h + t_f)$. We may hence write the domestic and foreign market prices respectively as

$$\begin{aligned} P^N(t_h^* + t_f^*, t_h + t_f) &\equiv P(Q^N(n_h^N(t_h^* + t_f^*, t_h + t_f), n_f^N(t_h^* + t_f^*, t_h + t_f), t_h + t_f)), \text{ and} \\ P^{*N}(t_h^* + t_f^*, t_h + t_f) &\equiv P^*(Q^{*N}(n_h^N(t_h^* + t_f^*, t_h + t_f), n_f^N(t_h^* + t_f^*, t_h + t_f), t_h^* + t_f^*)). \end{aligned}$$

Similarly, we may write the domestic and foreign market sales of a representative home and foreign

[15] Again we assume that the second-order conditions hold.

firm as

$$\begin{aligned}
q_h^N(t_h^*+t_f^*,t_h+t_f) &\equiv q_h^N(n_h^N(t_h^*+t_f^*,t_h+t_f),n_f^N(t_h^*+t_f^*,t_h+t_f),t_h+t_f),\\
q_f^N(t_h^*+t_f^*,t_h+t_f) &\equiv q_f^N(n_h^N(t_h^*+t_f^*,t_h+t_f),n_f^N(t_h^*+t_f^*,t_h+t_f),t_h+t_f),\\
q_h^{*N}(t_h^*+t_f^*,t_h+t_f) &\equiv q_h^{*N}(n_h^N(t_h^*+t_f^*,t_h+t_f),n_f^N(t_h^*+t_f^*,t_h+t_f),t_h^*+t_f^*), \text{ and}\\
q_f^{*N}(t_h^*+t_f^*,t_h+t_f) &\equiv q_f^{*N}(n_h^N(t_h^*+t_f^*,t_h+t_f),n_f^N(t_h^*+t_f^*,t_h+t_f),t_h^*+t_f^*).
\end{aligned}$$

Now consider the domestic welfare function. Because the free-entry condition (32) ensures that oligopoly profits are zero, we can write domestic welfare as the sum of consumer surplus and trade tax revenue, or

$$CS(P^N)+t_hn_f^Nq_f^N+t_h^*n_h^Nq_h^{*N}.$$

At the Cournot-Nash equilibrium, let us denote the world price for exports to the foreign market by $P^{*wN}(t_h^*,t_f^*,t_h+t_f)=P^{*N}(t_h^*+t_f^*,t_h+t_f)-t_f^*$ and the world price for exports to the home market by $P^{wN}(t_h^*+t_f^*,t_h,t_f)=P^N(t_h^*+t_f^*,t_h+t_f)-t_h$ (a distinction that only arises with the two-way trade in identical products made possible by market segmentation). We may also define $R^N(t_h^*+t_f^*,t_h+t_f)=P^{*wN}(t_h^*,t_f^*,t_h+t_f)-t_h^*$ as the price received by the home firm for foreign sales (the segmentation of markets implies that in general $R^N\neq P^N$), and similarly $R^{*N}(t_h^*+t_f^*,t_h+t_f)=P^{wN}(t_h^*+t_f^*,t_h,t_f)-t_f$ as the price received by the foreign firm for domestic sales (the segmentation of markets implies that in general $R^{*N}\neq P^{*N}$). Notice now that $P^N-R^{*N}=t_h+t_f$ and $P^{*N}-R^N=t_h^*+t_f^*$. We may thus regard the Cournot-Nash quantities as functions of local price differences. With these observations in place, we may represent domestic country imports M and exports E respectively as

$$\begin{aligned}
M(P^N,R^N,P^{*N},R^{*N}) &= n_f^N(P^{*N}-R^N,P^N-R^{*N})q_f^N(P^{*N}-R^N,P^N-R^{*N}), \text{ and}\\
E(P^N,R^N,P^{*N},R^{*N}) &= n_h^N(P^{*N}-R^N,P^N-R^{*N})q_h^N(P^{*N}-R^N,P^N-R^{*N}),
\end{aligned}$$

allowing domestic country welfare to be expressed as

$$\begin{aligned}
W(P^N,R^N,P^{wN},P^{*N},R^{*N},P^{*wN}) &= CS(P^N)+[P^N-P^{wN}]M(P^N,R^N,P^{*N},R^{*N})\\
&\quad+[P^{*wN}-R^N]E(P^N,R^N,P^{*N},R^{*N}).
\end{aligned}$$

Next consider the foreign welfare function. Foreign welfare is given by:

$$CS^*(P^{*N})+t_fn_f^Nq_f^N+t_f^*n_h^Nq_h^N.$$

We may therefore represent foreign country welfare by

$$\begin{aligned}
W^*(P^{*N},R^{*N},P^{*wN},P^N,R^N,P^{wN}) &= CS^*(P^{*N})+[P^{wN}-R^{*N}]M(P^N,R^N,P^{*N},R^{*N})\\
&\quad+[P^{*N}-P^{*wN}]E(P^N,R^N,P^{*N},R^{*N}).
\end{aligned}$$

An efficient or joint-welfare maximizing agreement would maximize the sum of W and W^*. We note once again that the world prices (P^{wN} and P^{*wN}) cancel from this summation: the world price affects the distribution of rents across countries, but does not in itself affect efficiency, and so it is clear that tariff policies that are motivated by terms-of-trade effects lead to inefficiencies. But we may still ask whether any other sources of inefficiency are present. To this end, we express joint welfare as

$$\begin{aligned} J(P^N, R^N, P^{*N}, R^{*N}) &\equiv W(P^N, R^N, P^{wN}, P^{*N}, R^{*N}, P^{*wN}) + W^*(P^{*N}, R^{*N}, P^{*wN}, P^N, R^N, P^{wN}) \\ &= CS(P^N) + [P^N - R^{*N}]M(P^N, R^N, P^{*N}, R^{*N}) + \\ &\quad [P^{*N} - R^N]E(P^N, R^N, P^{*N}, R^{*N}) + CS^*(P^{*N}). \end{aligned}$$

Using the expression for joint welfare above, and noting that P^N, R^N, P^{*N} and R^{*N} are each functions of the total tariffs $t_h^* + t_f^*$ and $t_h + t_f$ only, it follows as before that there are only two independent conditions that define efficient choices of t_h, t_h^*, t_f and t_f^*, and they may be expressed as:

$$\begin{gathered} W_{P^N}\frac{dP^N}{dt_h} + W_{R^N}\frac{dR^N}{dt_h} + W_{P^{*N}}\frac{dP^{*N}}{dt_h} + W_{R^{*N}}\frac{dR^{*N}}{dt_h} + \\ W^*_{P^N}\frac{dP^N}{dt_h} + W^*_{R^N}\frac{dR^N}{dt_h} + W^*_{P^{*N}}\frac{dP^{*N}}{dt_h} + W^*_{R^{*N}}\frac{dR^{*N}}{dt_h} = 0, \text{ and} \end{gathered} \tag{33}$$

$$\begin{gathered} W_{P^N}\frac{dP^N}{dt_h^*} + W_{R^N}\frac{dR^N}{dt_h^*} + W_{P^{*N}}\frac{dP^{*N}}{dt_h^*} + W_{R^{*N}}\frac{dR^{*N}}{dt_h^*} + \\ W^*_{P^N}\frac{dP^N}{dt_h^*} + W^*_{R^N}\frac{dR^N}{dt_h^*} + W^*_{P^{*N}}\frac{dP^{*N}}{dt_h^*} + W^*_{R^{*N}}\frac{dR^{*N}}{dt_h^*} = 0. \end{gathered} \tag{34}$$

Let us now consider the politically optimal tariffs, defined as the tariffs that the home and foreign government would choose unilaterally if they did not value the pure international rent-shifting associated with the terms of trade movements induced by their unilateral tariff choices. Specifically, we suppose that the home government acts as if $W_{p^w} \equiv 0$ and $W_{p^{*w}} \equiv 0$ when choosing its politically optimal tariff, while the foreign government acts as if $W^*_{p^w} \equiv 0$ and $W^*_{p^{*w}} \equiv 0$. Accordingly, politically optimal tariffs are defined by

$$\begin{aligned} W_{P^N}\frac{dP^N}{dt_h} + W_{R^N}\frac{dR^N}{dt_h} + W_{P^{*N}}\frac{dP^{*N}}{dt_h} + W_{R^{*N}}\frac{dR^{*N}}{dt_h} &= 0, \\ W_{P^N}\frac{dP^N}{dt_h^*} + W_{R^N}\frac{dR^N}{dt_h^*} + W_{P^{*N}}\frac{dP^{*N}}{dt_h^*} + W_{R^{*N}}\frac{dR^{*N}}{dt_h^*} &= 0, \\ W^*_{P^N}\frac{dP^N}{dt_f} + W^*_{R^N}\frac{dR^N}{dt_f} + W^*_{P^{*N}}\frac{dP^{*N}}{dt_f} + W^*_{R^{*N}}\frac{dR^{*N}}{dt_f} &= 0, \text{ and} \\ W^*_{P^N}\frac{dP^N}{dt_f^*} + W^*_{R^N}\frac{dR^N}{dt_f^*} + W^*_{P^{*N}}\frac{dP^{*N}}{dt_f^*} + W^*_{R^{*N}}\frac{dR^{*N}}{dt_f^*} &= 0. \end{aligned} \tag{35}$$

But it is now immediate that the first and third conditions in (35) together imply (33) while the second and fourth conditions in (35) together imply (34). Hence, politically optimal tariffs are efficient: if governments could be induced not to value the pure international rent-shifting associated with the terms of trade movements induced by their tariff choices, they would set efficient tariffs and there would be nothing left for a trade agreement to do.

We summarize the results of this section with

Proposition 3 *In the segmented-markets Cournot model of firm delocation, the only rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume.*

4.2 Integrated Markets and Monopolistic Competition

We now consider a variant of the model in Venables (1987) which is similar to that developed in Helpman and Krugman (1989), in which there is free entry of firms in both home and foreign countries, but where firms produce differentiated varieties and compete according to monopolistic competition. We also allow for the presence of transport costs on the trade in differentiated products between countries, and indeed in this model it is the savings on transport costs implied by the firm-delocation effects of a tariff that can enhance the welfare of the intervening country. By construction, this model has some very special features: it displays no terms-of-trade impacts of import tariffs, though as we will see the terms-of-trade impacts of export taxes exist and are somewhat extreme. Our main purpose is once again to ask whether politically optimal policies are efficient.

There are two countries, each endowed with a large amount of labor, which is the only factor of production. Consumer utility in the domestic and foreign country is given, respectively, by

$$\begin{aligned} U &= \theta^{-1}C^{\theta} + C_Y, \quad \text{and} \\ U^* &= \theta^{-1}(C^*)^{\theta} + C_Y^*, \end{aligned} \tag{36}$$

where C is an index of consumption of a basket of differentiated goods, which for the moment we treat as a single (composite) good referred to as good D, C_Y is consumption of a homogenous good Y, '$*$' denotes a foreign-country variable, and where $0 < \theta < 1$ is a parameter of the utility function. Good Y is produced with labor alone according to a constant-returns-to-scale production function common across countries (1 unit of labor produces 1 unit of good Y), and it is always produced in each country (due to the large supply of labor in each country) and freely traded across countries so that its price (and hence the wage of labor) is fixed and equalized everywhere in the world. We treat good Y as the numeraire, and so normalize its price to 1.

Notice from the utility function U that the marginal utility of consuming another unit of good Y is 1, while the marginal utility of consuming another unit of D is $C^{\theta-1}$, and analogously for the utility function U^*. Utility maximization in each country requires that quantities demanded are chosen so that the ratio of marginal utilities for D and Y is set equal to the ratio of prices for D and Y. Recalling that the price of Y is normalized to 1, and letting P denote the price of good D

faced by consumers in the domestic country and P^* the price of good D faced by consumers in the foreign country, utility maximization then implies

$$\begin{aligned} C &= P^{-\epsilon}, \text{ and} \\ C^* &= (P^*)^{-\epsilon}, \end{aligned}$$

where $\epsilon = \frac{1}{1-\theta}$ is the elasticity of (home or foreign country) demand for good D. The indirect utility functions of the two countries may then be written as

$$\begin{aligned} V(P, I) &= (\epsilon\theta)^{-1} P^{-\epsilon\theta} + I, \quad \text{and} \\ V^*(P^*, I^*) &= (\epsilon\theta)^{-1} (P^*)^{-\epsilon\theta} + I^*, \end{aligned}$$

where I denotes domestic income and I^* denotes foreign income, each measured in units of the numeraire Y.

As mentioned above, the quantity C is an index of domestic-country consumption of differentiated goods. This index is assumed to take a CES form, and hence exhibits "love of variety." Specifically, we assume that

$$C = [\sum_i (c^i)^\alpha]^{\frac{1}{\alpha}},$$

where c^i is domestic consumption of variety i of the differentiated good and α is a preference parameter with $0 < \alpha < 1$. Note that all varieties i enter symmetrically into this index. It can be shown (see Dixit and Stiglitz, 1977) that the associated domestic-country price index is

$$P = [\sum_i (p^i)^{\frac{\alpha}{\alpha-1}}]^{\frac{\alpha-1}{\alpha}},$$

where p^i is the price for variety i paid by domestic-country consumers. Analogously, for the foreign country, we have

$$C^* = [\sum_i (c^{*i})^\alpha]^{\frac{1}{\alpha}},$$

and associated foreign-country price index

$$P^* = [\sum_i (p^{*i})^{\frac{\alpha}{\alpha-1}}]^{\frac{\alpha-1}{\alpha}},$$

where p^{*i} is the price for variety i paid by foreign-country consumers.

The domestic-country demand for an individual variety i of the differentiated good then takes the form

$$c^i = C \cdot \left(\frac{p^i}{P}\right)^{-\sigma},$$

where $\sigma = \frac{1}{1-\alpha}$. Plugging in the expression for C and simplifying yields

$$c^i = (p^i)^{-\sigma} P^{\sigma-\epsilon} \equiv c^i(p^i, P).$$

We assume that $\sigma > \epsilon$, which is to say we assume that the elasticity of substitution between varieties within the differentiated product sector (σ) is greater than the overall price elasticity (ϵ). An analogous expression may be derived for the foreign-country demand for an individual variety i of the differentiated good:

$$c^{*i} = (p^{*i})^{-\sigma} (P^*)^{\sigma-\epsilon} \equiv c^{*i}(p^{*i}, P^*).$$

Technology for producing individual varieties is the same across varieties and available everywhere in the world: any individual variety i can be produced with a fixed cost of labor F and a constant marginal cost in terms of labor c (recall that the wage of labor is fixed at 1 everywhere in the world). In light of the fixed cost of production, no variety will be produced by more than one firm or in more than one location, and each firm will be the monopoly supplier of its variety.

If a domestic firm wishes to sell to foreign consumers, we assume that it must confront the following trade costs: an "iceberg" transport cost ϕ according to which a fraction ϕ of the good is used up in shipment; an ad valorem export tax imposed by the domestic government at rate τ_h^*; and an ad valorem import tariff imposed by the foreign government at rate τ_f^*. We assume that markets are integrated, so that the wedge between the domestic market price for a domestically produced variety i and the price at which that variety sells in the foreign market is given by $p_h^{*i} = (1 + \phi + \tau_h^* + \tau_f^*)p_h^i$, where p_h^i (p_h^{*i}) denotes the domestic-market (foreign-market) price of a home-produced good.

Similarly, if a foreign firm wishes to sell to domestic consumers, we assume that it must confront the following trade costs: the iceberg transport cost ϕ according to which a fraction ϕ of the good is used up in shipment; an ad valorem export tax imposed by the foreign government at rate τ_f; and an ad valorem import tariff imposed by the domestic government at rate τ_h. Again, because we assume that markets are integrated, the wedge between the foreign market price for a foreign produced variety i and the price at which that variety sells in the domestic market is given by $p_f^i = (1 + \phi + \tau_f + \tau_h)p_f^{*i}$, where p_f^{*i} (p_f^i) denotes the foreign-market (domestic-market) price of a foreign-produced good.

We may now write down the profits for a domestic firm producing variety i who sets a price p_h^i:

$$\pi^i = (p_h^i - c) \cdot [c^i(p_h^i, P) + c^{*i}(p_h^{*i}, P^*)] - F.$$

When choosing a price for its single variety i, the firm is assumed to take the price indexes P and P^* as fixed. Using $p_h^{*i} = (1 + \phi + \tau_h^* + \tau_f^*)p_h^i$ and the particular functional forms of $c^i(p_h^i, P)$ and $c^{*i}(p_h^{*i}, P^*)$, it may then be shown that equating marginal revenue to marginal cost and thereby maximizing profits implies the price choice

$$p_h^i = \frac{\sigma}{\sigma - 1} c \equiv \hat{p}$$

for a domestic firm producing any variety i. We now record $p_h^* = (1+\phi+\tau_h^*+\tau_f^*)\hat{p} \equiv p_h^*(\phi+\tau_h^*+\tau_f^*)$.

Similarly, the profits for a foreign firm producing variety i who sets a price p_f^{*i} are given by:

$$\pi^{*i} = (p_f^{*i} - c) \cdot [c^{*i}(p_f^{*i}, P^*) + c^i(p_f^i, P)] - F.$$

Again when choosing a price for its single variety i, the firm is assumed to take the price indexes P and P^* as fixed. Using $p_f^i = (1+\phi+\tau_f+\tau_h)p_f^{*i}$ and the particular functional forms of $c^i(p_f^i, P)$ and $c^{*i}(p_f^{*i}, P^*)$, it may then be shown that equating marginal revenue to marginal cost and thereby maximizing profits implies the price choice

$$p_f^{*i} = \frac{\sigma}{\sigma - 1} c \equiv \hat{p}$$

for a foreign firm producing any variety i. We now record $p_f = (1+\phi+\tau_f+\tau_h)\hat{p} \equiv p_f(\phi+\tau_f+\tau_h)$.

Hence, if there are n_h domestic firms producing differentiated varieties and n_f foreign firms, then the domestic and foreign price indexes are given respectively by

$$\begin{aligned} P &= \hat{p}[n_h + (1+\phi+\tau_f+\tau_h)^{\frac{\alpha}{\alpha-1}} n_f]^{\frac{\alpha-1}{\alpha}} \equiv P(n_h, n_f, \phi+\tau_f+\tau_h), \text{ and} \\ P^* &= \hat{p}[n_f + (1+\phi+\tau_h^*+\tau_f^*)^{\frac{\alpha}{\alpha-1}} n_h]^{\frac{\alpha-1}{\alpha}} \equiv P^*(n_h, n_f, \phi+\tau_h^*+\tau_f^*). \end{aligned}$$

Finally, free entry implies that n_h and n_f adjust to ensure

$$\begin{aligned} \hat{\pi} &\equiv (\hat{p} - c) \cdot [c(\hat{p}, P(n_h, n_f, \phi+\tau_f+\tau_h)) + c^*(p_h^*(\phi+\tau_h^*+\tau_f^*), P^*(n_h, n_f, \phi+\tau_h^*+\tau_f^*))] - F = 0 \\ \hat{\pi}^* &\equiv (\hat{p} - c) \cdot [c^*(\hat{p}, P^*(n_h, n_f, \phi+\tau_h^*+\tau_f^*)) + c(p_f(\phi+\tau_f+\tau_h), P(n_h, n_f, \phi+\tau_f+\tau_h))] - F = 0. \end{aligned}$$

These two zero-maximized-profit conditions determine $n_h(\phi+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)$ and $n_f(\phi+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)$. Plugging these into the expressions for P and P^* then yields $P(\phi+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)$ and $P^*(\phi+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)$.

Turning now to income, note that our assumption of labor as the only factor of production and the fixed wage at 1, in combination with free entry ensuring that profits are zero, implies that income in each country is given by the labor force in the country plus the country's trade tax revenue, or

$$\begin{aligned} I &= L + \tau_h^*\hat{p}n_h(\phi+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)c^*(p_h^*(\phi+\tau_h^*+\tau_f^*), P^*(\phi^*+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)) \\ &\quad +\tau_h\hat{p}n_f(\phi+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)c(p_f(\phi+\tau_f+\tau_h), P(\phi+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)), \quad \text{and} \\ I^* &= L^* + \tau_f\hat{p}n_f(\phi+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)c(p_f(\phi+\tau_f+\tau_h), P(\phi+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)) \\ &\quad +\tau_f^*\hat{p}n_h(\phi+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)c^*(p_h^*(\phi+\tau_h^*+\tau_f^*), P^*(\phi+\tau_f+\tau_h, \phi+\tau_h^*+\tau_f^*)). \end{aligned}$$

We next define the world price for exports to the foreign market by $p^{*w} = (1 + \tau_h^*)\hat{p}$, implying that $\tau_h^* \hat{p} = p^{*w} - \hat{p}$. Using $p_h^* = (1 + \phi + \tau_h^* + \tau_f^*)\hat{p}$, it then follows also that $\tau_f^* \hat{p} = p_h^* - \phi\hat{p} - p^{*w}$. And similarly, we define the world price for exports to the domestic market by $p^w = (1 + \tau_f)\hat{p}$, implying that $\tau_f \hat{p} = p^w - \hat{p}$. Using $p_f = (1 + \phi + \tau_f + \tau_h)\hat{p}$, it then follows also that $\tau_h \hat{p} = p_f - \phi\hat{p} - p^w$. With these pricing relationships, we may rewrite the expressions for income as

$$\begin{aligned}
I &= L + [p^{*w} - \hat{p}] n_h(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*) c^*(p_h^*(\phi + \tau_h^* + \tau_f^*), P^*(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*)) \quad (37) \\
&\quad + [p_f - \phi\hat{p} - p^w] n_f(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*) c(p_f(\phi + \tau_f + \tau_h), P(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*)) \\
&\equiv I(P(\cdot), P^*(\cdot), p_h^*(\cdot), p_f(\cdot), p^w(\cdot), p^{*w}(\cdot), n_h(\cdot), n_f(\cdot)), \quad \text{and} \\
I^* &= L^* + [p^w - \hat{p}] n_f(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*) c(p_f(\phi + \tau_f + \tau_h), P(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*)) \\
&\quad + [p_h^* - \phi\hat{p} - p^{*w}] n_h(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*) c^*(p_h^*(\phi + \tau_h^* + \tau_f^*), P^*(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*)) \\
&\equiv I^*(P(\cdot), P^*(\cdot), p_h^*(\cdot), p_f(\cdot), p^w(\cdot), p^{*w}(\cdot), n_h(\cdot), n_f(\cdot)).
\end{aligned}$$

Finally, using the expressions for I and I^* in (37), we may write the indirect utility functions of the two countries as

$$\begin{aligned}
V(P(\cdot), P^*(\cdot), p_h^*(\cdot), p_f(\cdot), p^w(\cdot), p^{*w}(\cdot), n_h(\cdot), n_f(\cdot)) &= (\epsilon\theta)^{-1}[P(\cdot)]^{-\epsilon\theta} + \\
&\quad I(P(\cdot), P^*(\cdot), p_h^*(\cdot), p_f(\cdot), p^w(\cdot), p^{*w}(\cdot), n_h(\cdot), n_f(\cdot)), \quad \text{and}
\end{aligned}$$

$$\begin{aligned}
V^*(P(\cdot), P^*(\cdot), p_h^*(\cdot), p_f(\cdot), p^w(\cdot), p^{*w}(\cdot), n_h(\cdot), n_f(\cdot)) &= (\epsilon\theta)^{-1}[P^*(\cdot)]^{-\epsilon\theta} + \\
&\quad I^*(P(\cdot), P^*(\cdot), p_h^*(\cdot), p_f(\cdot), p^w(\cdot), p^{*w}(\cdot), n_h(\cdot), n_f(\cdot)).
\end{aligned}$$

We now note that each of the prices $P(\cdot)$, $P^*(\cdot)$, $p_h^*(\cdot)$ and $p_f(\cdot)$ depend only on the total tariffs $\tau_f + \tau_h$ and/or $\tau_h^* + \tau_f^*$. In addition, the number of home and foreign firms $n_h(\cdot)$ and $n_f(\cdot)$ depend only on the total tariffs $\tau_f + \tau_h$ and $\tau_h^* + \tau_f^*$ as well. On the other hand, the world prices satisfy the following derivative properties:

$$\begin{aligned}
\frac{dp^{*w}}{d\tau_h} &= 0 = \frac{dp^w}{d\tau_f^*}, \quad \text{and} \\
\frac{dp^{*w}}{d\tau_h^*} &= \hat{p} = \frac{dp^w}{d\tau_f}.
\end{aligned}$$

In words, neither country can alter the world price with its import tariff ($\frac{dp^{*w}}{d\tau_h} = 0 = \frac{dp^w}{d\tau_f^*}$), because marginal cost (c) is tied down by free trade in the numeraire good Y and the CES demand specification ensures that firms in the differentiated product sector do not alter their price markup over marginal cost in response to ad valorem trade taxes. On the other hand, each country *can* alter the world price with its export tax ($\frac{dp^{*w}}{d\tau_h^*} = \hat{p} = \frac{dp^w}{d\tau_f}$), and can do so in a rather extreme fashion, precisely because firms in the differentiated product sector do not alter their price markup over marginal cost in response to ad valorem trade taxes.

Consider now the efficient policy choices. These are the choices of τ_h^*, τ_f^*, τ_f and τ_h that maximize $V + V^*$. We note that

$$
\begin{aligned}
&I(\cdot) + I^*(\cdot) \\
&= L + L^* + \\
&[p_h^*(\phi + \tau_h^* + \tau_f^*) - \phi\hat{p} - \hat{p}]n_h(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*)c^*(p_h^*(\phi + \tau_h^* + \tau_f^*), P^*(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*)) + \\
&[p_f(\phi + \tau_f + \tau_h) - \phi\hat{p} - \hat{p}]n_f(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*)c(p_f(\phi + \tau_f + \tau_h), P(\phi + \tau_f + \tau_h, \phi + \tau_h^* + \tau_f^*)) \\
&\equiv K(P(\cdot), P^*(\cdot), p_h^*(\cdot), p_f(\cdot), n_h(\cdot), n_f(\cdot)),
\end{aligned}
$$

and so the world prices p^w and p^{*w} drop out of the sum of domestic and foreign incomes, permitting this sum to be expressed as $K(P(\cdot), P^*(\cdot), p_h^*(\cdot), p_f(\cdot), n_h(\cdot), n_f(\cdot))$. But this in turn implies that we may express .

$$
\begin{aligned}
V(\cdot) + V^*(\cdot) &= (\epsilon\theta)^{-1}[P(\cdot)]^{-\epsilon\theta} + \\
&\quad (\epsilon\theta)^{-1}[P^*(\cdot)]^{-\epsilon\theta} + \\
&\quad K(P(\cdot), P^*(\cdot), p_h^*(\cdot), p_f(\cdot), n_h(\cdot), n_f(\cdot)) \\
&\equiv G(P(\cdot), P^*(\cdot), p_h^*(\cdot), p_f(\cdot), n_h(\cdot), n_f(\cdot)).
\end{aligned}
$$

As can be seen, changes in the world prices induced by trade taxes play no role in determining the efficient setting of trade tax policies, because these changes correspond to pure international rent shifting.

Using the expression for joint welfare above, and recalling that $P(\cdot)$, $P^*(\cdot)$, $p_h^*(\cdot)$, $p_f(\cdot)$, $n_h(\cdot)$ and $n_f(\cdot)$ depend only on the total tariffs $\tau_f + \tau_h$ and/or $\tau_h^* + \tau_f^*$, it follows as before that there are only two independent conditions that define efficient choices of τ_h^*, τ_f^*, τ_f and τ_h, and they may be expressed as:

$$
\begin{aligned}
V_P \frac{dP}{d\tau_f^*} + V_{P^*} \frac{dP^*}{d\tau_f^*} + V_{p_h^*} \frac{dp_h^*}{d\tau_f^*} + V_{n_h} \frac{dn_h}{d\tau_f^*} + V_{n_f} \frac{dn_f}{d\tau_f^*} + \\
V_P^* \frac{dP}{d\tau_f^*} + V_{P^*}^* \frac{dP^*}{d\tau_f^*} + V_{p_h^*}^* \frac{dp_h^*}{d\tau_f^*} + V_{n_h}^* \frac{dn_h}{d\tau_f^*} + V_{n_f}^* \frac{dn_f}{d\tau_f^*} = 0, \text{ and}
\end{aligned} \tag{38}
$$

$$
\begin{aligned}
V_P \frac{dP}{d\tau_h} + V_{P^*} \frac{dP^*}{d\tau_h} + V_{p_f} \frac{dp_f}{d\tau_h} + V_{n_h} \frac{dn_h}{d\tau_h} + V_{n_f} \frac{dn_f}{d\tau_h} + \\
V_P^* \frac{dP}{d\tau_h} + V_{P^*}^* \frac{dP^*}{d\tau_h} + V_{p_f}^* \frac{dp_f}{d\tau_h} + V_{n_h}^* \frac{dn_h}{d\tau_h} + V_{n_f}^* \frac{dn_f}{d\tau_h} = 0.
\end{aligned} \tag{39}
$$

Let us now consider the politically optimal tariffs, defined as the tariffs that the home and foreign government would choose unilaterally if they did not value the pure international rent-shifting associated with the terms of trade movements induced by their unilateral tariff choices. Specifically, we suppose that the home government acts as if $V_{p^w} \equiv 0$ and $V_{p^{*w}} \equiv 0$ when choosing its politically optimal tariff, while the foreign government acts as if $V^*_{p^w} \equiv 0$ and $V^*_{p^{*w}} \equiv 0$. Of course, we have already noted that in the special environment we consider here, the domestic government has no ability to alter p^{*w} with its tariff choices while the foreign government has no ability to alter p^w with its tariff choices, but for completeness and consistency with our earlier discussions we assume that governments do not value any world price movements in the political optimum. Accordingly, politically optimal tariffs are defined by

$$\begin{aligned}
V_P \frac{dP}{d\tau_h^*} + V_{P^*} \frac{dP^*}{d\tau_h^*} + V_{p_h^*} \frac{dp_h^*}{d\tau_h^*} + V_n \frac{dn_h}{d\tau_h^*} + V_{n^*} \frac{dn_f}{d\tau_h^*} &= 0, \\
V_P \frac{dP}{d\tau_h} + V_{P^*} \frac{dP^*}{d\tau_h} + V_{p_f} \frac{dp_f}{d\tau_h} + V_n \frac{dn_h}{d\tau_h} + V_{n^*} \frac{dn_f}{d\tau_h} &= 0, \\
V_P^* \frac{dP}{d\tau_f^*} + V_{P^*}^* \frac{dP^*}{d\tau_f^*} + V_{p_h^*}^* \frac{dp_h^*}{d\tau_f^*} + V_n^* \frac{dn_h}{d\tau_f^*} + V_{n^*}^* \frac{dn_f}{d\tau_f^*} &= 0, \text{ and} \\
V_P^* \frac{dP}{d\tau_f} + V_{P^*}^* \frac{dP^*}{d\tau_f} + V_{p_f}^* \frac{dp_f}{d\tau_f} + V_n^* \frac{dn_h}{d\tau_f} + V_{n^*}^* \frac{dn_f}{d\tau_f} &= 0.
\end{aligned} \tag{40}$$

But it is now immediate that the first and third conditions in (40) together imply (38) while the second and fourth conditions in (40) together imply (39). Hence, politically optimal tariffs are efficient: if governments could be induced not to value the pure international rent-shifting associated with the terms of trade movements induced by their tariff choices, they would set efficient tariffs and there would be nothing left for a trade agreement to do.

Intuitively, in the Nash equilibrium governments use import tariffs in this model for the purpose of delocating firms from the markets of their trading partners to their own market, and thereby lowering their price index; an additional impact arises as the trade volume of the firms that remain located in their trading partners is reduced; and as we have already noted, there is no terms of trade impact of import tariffs in the model. But governments also use export policies, and here there is an offsetting incentive: an export subsidy could similarly help to delocate firms; but an export tax is warranted for terms-of-trade purposes in this model; and this terms-of-trade motive keeps export subsidies lower than they would otherwise be. Notice, though, that an export subsidy *could* be set so as to neutralize delocation that might otherwise occur as a result of the import tariff of a trading partner, and it could also be set so as to neutralize any trade volume reduction for surviving firms that might have been caused by the trading partner's import tariff. When a country ignores the terms-of-trade consequences of its export policies, it is induced to increase its export subsidies to exactly these neutralizing levels, and as a consequence the associated politically optimal policy choices are efficient.

Notice the importance of export policies for this result. If governments were assumed only to have import tariffs (τ_h for the domestic government, τ_f^* for the foreign government), then it is still the case that efficiency would be defined as above, owing to the redundancy of the instruments τ_h and τ_f and the instruments τ_f^* and τ_h^* in terms of their impacts on P, P^*, p_h^*, p_f, n_h and n_f. But as can be seen from the conditions for the political optimum above, the politically optimal setting of τ_h and τ_f^* alone could not achieve efficiency: and indeed, given that there are no terms-of-trade consequences associated with the setting of import tariffs in this model, the politically optimal setting of τ_h and τ_f^* correspond to Nash choices. Hence, if export policies are ruled out in this model, the Nash import tariff choices are inefficient, despite the fact that import tariffs have no terms-of-trade consequences in the model: as a result, there is then a non-terms-of-trade problem for a trade agreement to solve. But viewed in this way, it is also now clear what the non-terms-of-trade problem is: a trade agreement can here help substitute for missing trade policy instruments (export policies) which, if available, would then convert the role of a trade agreement back to the standard terms-of-trade driven Prisoners' Dilemma.

Therefore, as before, the efficiency of the political optimum – and hence the ability to interpret the problem that a trade agreement can solve as a terms-of-trade problem – hinges importantly on the assumption that governments have sufficient trade-tax instruments at their disposal. If they did not, then other non-terms-of-trade problems might also be addressed by a trade agreement (in this setting, just as more generally).

We summarize the results of this section with

Proposition 4 *In the integrated-markets monopolistic competition model of firm delocation, the only rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume.*

In a recent paper, Ossa (2008) uses a monopolistic competition model of firm delocation and attempts to provide new answers relative to the terms-of-trade theory to two central questions in the economics of trade agreements: first, what is the purpose of a trade agreement?; and second, what is the role played by reciprocity and non-discrimination? Regarding the first question, Ossa observes that the firm-delocation externality can provide a separate reason for a trade agreement that is independent of the terms-of-trade externality. Regarding the second question, Ossa then offers a novel interpretation of reciprocity and non-discrimination as simple rules that can neutralize the firm-delocation externality. The result stated in Proposition 4 above seems at odds with Ossa's first observation, and so it is important to explore the differences across the two papers.

There seem to be two substantive differences between the model employed by Ossa (2008) and the one we develop in this subsection. A first difference is that Ossa follows Venables (1987) and adopts a specification of utility that allows income effects on the demand for differentiated products, while we follow Helpman and Krugman (1989, Ch. 7.3) and adopt the (quasi linear) specification of utility in (36) that ensures that there will be no such income effects. So along this dimension, Ossa's model is more general than the model we work with in this subsection. The second difference is related to the first: due to income effects, Ossa's model is difficult to work with when trade taxes imply revenue, and so Ossa assumes for simplicity that trade taxes do not have revenue consequences; and importantly, this assumption requires Ossa to abstract from export policies in his analysis, and focus only on the use of import tariffs. By contrast, the revenue consequences of trade taxes are simple to handle in our quasi-linear setting, because they are soaked up by consumption of the numeraire good, and so we can and do allow for both import tariffs and export taxes; and as we have emphasized above, allowing for a full set of trade policies is crucial for our result.

5 Conclusion

[To be written]

Appendix

5.1 Trade Policies and Profit-Shifting: Linear Model

We consider here the model of Section 3.1, in which the domestic country has a single firm, the foreign country has a single firm, both countries have demand for the product, and the markets are integrated, with exports flowing from the domestic country to the foreign country. Our purpose here is to analyze a linear-demand version of this model, so as to derive closed-form solutions for tariff policies and develop further understanding.

We assume that the demand functions take the following forms: $D(P) = \alpha - \beta P$ and $D^*(P^*) = \alpha^* - \beta P^*$. For this demand system, the market-clearing prices defined by (15) are given as follows:

$$\begin{aligned} P(Q, t+t^*) &= \frac{\alpha + \alpha^* - \beta(t+t^*) - Q}{2\beta} \\ P^*(Q, t+t^*) &= \frac{\alpha + \alpha^* + \beta(t+t^*) - Q}{2\beta}. \end{aligned}$$

The domestic and foreign firm reaction functions are denoted as $q^R(q^*; t+t^*)$ and $q^{*R}(q; t+t^*)$ and take the following forms:

$$\begin{aligned} q^R(q^*; t+t^*) &= \frac{\alpha + \alpha^* - \beta(t+t^*) - 2\beta c - q^*}{2} \\ q^{*R}(q; t+t^*) &= \frac{\alpha + \alpha^* + \beta(t+t^*) - 2\beta c^* - q}{2}. \end{aligned}$$

The associated Cournot-Nash quantities for the domestic and foreign firms are

$$\begin{aligned} q^N(t+t^*) &= \frac{\alpha + \alpha^* - 3\beta(t+t^*) - 2\beta(2c - c^*)}{3} \\ q^{*N}(t+t^*) &= \frac{\alpha + \alpha^* + 3\beta(t+t^*) - 2\beta(2c^* - c)}{3}. \end{aligned}$$

The total Cournot-Nash output, $Q^N(t+t^*) \equiv q^N(t+t^*) + q^{*N}(t+t^*)$, is thus

$$Q^N(t+t^*) = \frac{\alpha + \alpha^* - 2\beta(c + c^*)}{3}.$$

We note that the profit-shifting effect of a change in the total tariff in this model is zero sum, in the sense that the total Cournot-Nash output is insensitive to the total tariff. This property is convenient but special and arises since the domestic and foreign demand functions have the same slope.

We may now express the local and world prices that arise in the Cournot-Nash equilibrium. We find that

$$\begin{aligned} P^N(t+t^*) &= \frac{\alpha + \alpha^* - 3\beta(t+t^*) + 2\beta(c + c^*)}{6\beta} \\ P^{*N}(t+t^*) &= \frac{\alpha + \alpha^* + 3\beta(t+t^*) + 2\beta(c + c^*)}{6\beta} \\ P^{wN}(t, t^*) &= \frac{\alpha + \alpha^* + 3\beta(t-t^*) + 2\beta(c + c^*)}{6\beta}. \end{aligned}$$

These prices satisfy the properties described in the text.

We next consider the Nash tariff policies. Using (18), we find that the domestic and foreign tariff reaction functions, $t^R(t^*)$ and $t^{*R}(t)$, respectively, are given as

$$\begin{aligned} t^R(t^*) &= \frac{-5\alpha + \alpha^* + 2\beta(c + c^*) - 3\beta t^*}{21\beta} \\ t^{*R}(t) &= \frac{-\alpha + 5\alpha^* - 2\beta(c + c^*) - 3\beta t}{21\beta}. \end{aligned}$$

The resulting Nash tariff policies are thus

$$\begin{aligned} t^N &= \frac{\alpha^* - 17\alpha + 8\beta(c + c^*)}{72\beta} \\ t^{*N} &= \frac{17\alpha^* - \alpha - 8\beta(c + c^*)}{72\beta}. \end{aligned}$$

The resulting trade volume under Nash policies can be calculated to be

$$\frac{\alpha^* - \alpha}{8} - \beta(c - c^*).$$

We assume $\alpha^* > \alpha \geq \beta c^* \geq \beta c$. This ensures that the Nash trade volume is positive.

We now observe that the Nash import tariff is positive: $t^{*N} > 0$. This is intuitive, since the foreign country enjoys both a terms-of-trade and a profit-shifting gain when its raises its import tariff from zero, whereas the markup cost is then second order in size. The sign of the Nash export policy, however, is ambiguous. If α^* is very large relative to α, then an export tariff is optimal; however, if $\alpha^* - \alpha$ is small and $\alpha - \beta c^* > 0$, then an export subsidy is optimal. This ambiguity reflects the fact that a higher value for t delivers a terms-of-trade gain for the home country whereas a lower value for t offers a profit-shifting benefit for the home country.

We next derive the politically optimal tariffs. Using (21), we find that the respective domestic and foreign politically optimal reaction functions, $t^{PO}(t^*)$ and $t^{*PO}(t)$, are given as

$$\begin{aligned} t^{PO}(t^*) &= \frac{3\beta t^* - (\alpha + \alpha^*) + 2\beta(2c - c^*)}{6\beta} \\ t^{*PO}(t) &= \frac{3\beta t + (\alpha + \alpha^*) + 2\beta(c - 2c^*)}{6\beta}. \end{aligned}$$

Solving, we obtain the politically optimal tariff policies:

$$\begin{aligned} t^{PO} &= \frac{-(\alpha + \alpha^*) + 10\beta c - 8\beta c^*}{9\beta} \\ t^{*PO} &= \frac{(\alpha + \alpha^*) + 8\beta c - 10\beta c^*}{9\beta}. \end{aligned}$$

We observe that the politically optimal export policy is an export subsidy. Further, the politically optimal import tariff is positive if c and c^* are approximately equal.

We may also calculate the efficient tariff policies. Using (20), we find that joint welfare is maximized when $t + t^* = 2[c - c^*]$. Thus, when $c < c^*$, it is efficient to subsidize trade with a negative total tariff, as a means of expanding (reducing) domestic (foreign) production and thereby achieving greater productive efficiency. By contrast, free trade is efficient when the firms have the same costs. We may use the expressions for politically optimal policies just derived to find that $t^{PO} + t^{*PO} = 2[c - c^*]$. Thus, as expected, the politically optimal tariff policies are efficient. The Nash tariff, however, are not efficient. In particular, we find that

$$t^N + t^{*N} = \frac{\alpha^* - \alpha}{4\beta} > 2(c - c^*) = t^{PO} + t^{*PO}.$$

Thus, in the absence of a trade agreement, governments pursue terms-of-trade gains and the resulting total tariff is positive and higher than efficient. Accordingly, the Nash trade volume is inefficiently low.

The Nash and politically optimal tariffs may be further compared. We find that the Nash import tariff is higher than the politically optimal import tariff, and that the Nash export policy is also more restrictive than the politically optimal export policy:

$$t^{*N} - t^{*PO} = t^N - t^{PO} = \frac{\alpha^* - \alpha - 8\beta(c - c^*)}{8\beta} > 0.$$

We may also compute the difference between domestic and foreign tariffs, for both Nash and politically optimal trade policies. For our linear model, we find that the difference is the same across the two policy scenarios:

$$t^N - t^{*N} = t^{PO} - t^{*PO} = (\frac{-2}{9\beta})(\alpha + \alpha^* - \beta(c + c^*) < 0.$$

This difference is important, since it can be used to compare the world prices across the two policy scenarios. In fact, it is now immediate that $P^{wN}(t^N, t^{*N}) = P^{wN}(t^{PO}, t^{*PO})$.

If a trade agreement is the vehicle in which governments move from the Nash tariffs to the politically optimal tariffs, then we are now in position to describe the details of this path. In the Nash equilibrium, the import tariff is positive and the export policy may be an export tariff or an export subsidy. In any case, the volume of trade is inefficiently low. The governments can proceed to the politically optimal policies if the foreign country reduces its import tariff at the same time as the foreign government reduces its export tariff or increases its export subsidy, with the reductions in t and t^* being done in a "reciprocal" fashion that preserves the terms of trade between the two countries. This is suggestive of an efficiency-enhancing role for the principle of reciprocity in this model with market power, somewhat along the lines of the role identified in perfectly competitive markets (Bagwell and Staiger, 1999).

We conclude our discussion of the linear model with two further points. First, it is interesting to consider the nature of the inefficiency that arises under Nash trade policies. Certainly, if $c < c^*$, then it is easy to understand that Nash trade policies might generate less trade for the domestic firm than would be efficient. Suppose, though, that $c = c^*$. In this case, as we have seen, the efficient total tariff entails free trade whereas the Nash total tariff is positive. Recall now that the total production, $Q^N(t + t^*)$, in the Cournot-Nash interaction between firms is, in this model, independent of the total tariff. Thus, the inefficiency of Nash tariffs is not associated with a reduction in the overall level of production. Rather, the inefficiency of Nash tariffs is associated with the misallocation of output across domestic and foreign consumers. When, for example, the foreign government selects a positive tariff in order to induce a favorable change in the terms of trade and achieve profit-shifting benefits, the foreign price P^{*N} is raised above P^N. This wedge means that the output that is lost to foreign consumers was valued more by these consumers than it is by the domestic consumers who now receive the output. This inefficiency of Nash policies remains even when $c = c^*$ and even though total production is insensitive to the total tariff. The key point is that the volume of trade across countries is sensitive to the total tariff.

Second, the requirement of efficiency determines a level for the total tariff but does not otherwise specify levels for individual tariffs. By contrast, the politically optimal tariffs achieve efficiency with particular levels for the import and export tariffs. The linear model provides a simple setting in which to understand the source of the requirement that politically optimal tariffs be set at particular levels. Consider the foreign government's decision as to whether or not to raise its import tariff a bit higher. A tariff hike would lower P^{wN} and thus generate a terms-of-trade gain, increase the wedge in local prices and thus generate a profit-shifting gain, and cause a reduction in trade volume that harms foreign consumers and reduces tariff revenue. When calculating its politically optimal tariff, the foreign government ignores the terms-of-trade effect. A political optimum thus requires that the profit-shifting benefit, which is of size $(P^{wN} - c^*)$ for each unit of increase in q^{*N}, must be balanced against an equal cost. The cost of reduced volume is of size $(P^{*N} - P^{wN})$ for each unit of reduction in $D^*(P^{*N})$. A cost is thus present if $P^{*N} > P^{wN}$, and so the foreign government must select an import tariff in the political optimum. In a similar way, when the domestic government calculates its politically optimal export policy, it recognizes and ignores the fact that an reduction in t generates a loss in the terms of trade. It focuses instead on the profit-shifting benefit that a reduction in t provides, and balances this benefit against the cost of a higher domestic markup. The profit-shifting benefit of an increase in exports is of size $(P^{wN} - c)$ for each unit of additional exports, while the cost of a reduction in domestic sales is of size $(P^N - P^{wN})$ for each unit of reduction in $D(P^N)$. A cost is thus present if $P^N > P^{wN}$, and so the domestic government must select an export subsidy in the political optimum.

5.2 Strategic Export Policies in Third-Country Models

We consider here the role of export subsidies when exporters in one country compete with exporters from other countries. We undertake this analysis in the context of a "third-country model." In such a model, exporters are located in each of two countries, and all consumption occurs in a third country. With all consumers located in one market, we can put to the side any discussion of segmented markets. The third-country model is useful as a simple setting within which to consider the role of strategic export policies when international competition occurs between exporters from different countries. As Brander and Spencer (1985) have shown, an export subsidy may alter the strategic relationship between exporting firms in international markets, and due to the resulting profit-shifting effect the optimal unilateral export policy may be an export subsidy even for a government that maximizes national welfare. We focus here on the rationale for a trade agreement concerning export subsidies from the perspective of the associated strategic-trade framework. We argue once more that the rationale for a trade agreement stems from the terms-of-trade externality.

We consider the following model. Country A has a single exporter, firm A, and likewise country B has a single exporter, firm B. All consumers reside in country C. Firms A and B compete for sales to consumers in country C, and we assume that this competition takes the form of Cournot competition. The government of country A (i.e., government A) has available a specific export tariff, t^A, where a negative value indicates an export subsidy; and similarly government B has available a specific export tariff, t^B. To add generality and also enable us to better keep track of the respective local and world prices, we allow as well that government C has available an import policy, where t_A^C and t_B^C represent the possibly discriminatory specific import tariffs that country C applies to imports from countries A and B, respectively. We assume that each government maximizes national welfare.

We denote local prices in the three countries as P_A, P_B and P_C, where the former two prices are the respective export prices and the latter price is the price at which consumption occurs. We represent the demand function in country C as $D(P_C)$, and we assume that this function is downward sloping. Along any channel of trade, any difference between export and consumption prices is attributable to the trade taxes imposed along that channel. Thus, $P_C - P_A = t_A + t_C^A$ and $P_C - P_B = t_B + t_C^B$. Letting q_A and q_B denote the respective output choices of firms A and B, we may express the market-clearing condition as $D(P_C) = q_A + q_B$. We may thus represent the market-clearing price in country C as a downward-sloping function, $P_C(q_A + q_B)$.

For given trade policies, firms A and B choose their respective profit-maximizing outputs. Let c_A and c_B denote the respective costs of production for firms A and B. When firm A conjectures that firm B's output choice is q_B, then firm A's best response is the output level q_A that maximizes

$$[P_C(q_A + q_B) - c_A - t_A - t_C^A]q_A.$$

The resulting best-response or reaction function is represented as $q_A^R(q_B; t_A + t_C^A)$. Likewise, when firm B conjectures that firm A's output choice is q_A, then firm B's best response is the output level q_B that maximizes

$$[P_C(q_A + q_B) - c_B - t_B - t_C^B]q_B.$$

Firm B's reaction function is denoted $q_B^R(q_A; t_B + t_C^B)$.[16] As in previous sections, the first-order conditions for profit-maximization ensure that the resulting price exceeds the marginal cost of production plus the total tariff that a firm faces.

Under general conditions, a firm's best response is reduced when it faces a higher total tariff; thus, if we depict a firm's reaction function on a graph with axes for q_A and q_B, then a firm's reaction function shifts in when the total tariff that it faces increases. For a large set of demand functions, including linear demand functions, a firm's reaction function is also decreasing in the output that it conjectures for the rival firm. In other words, if reaction functions are depicted as just described, then they are negatively sloped. Quantities are then said to be "strategic substitutes," and we focus on this case in what follows. Intuitively, when a firm expects that the other firm has selected a larger output, then the former firm anticipates a reduced price and thus associates a lower marginal revenue with its own sales.

The Cournot-Nash equilibrium is a pair of quantities, $q_A^N(t_A + t_C^A, t_B + t_C^B)$ and $q_B^N(t_A + t_C^A, t_B + t_C^B)$, at which each firm correctly conjectures the output of its rival and selects its best response. Graphically, the Cournot-Nash quantities correspond to an intersection of the reaction functions. Each firm's Cournot-Nash quantity is decreasing in the total tariff that it confronts and increasing in the total tariff that its rival confronts. For example, if the total tariff $t_A + t_C^A$ that firm A confronts were to rise, then firm A would face a higher marginal cost of delivering its product to consumers in country C, and firm A's reaction function would shift in. Given that reaction functions are negatively sloped, the new Cournot-Nash equilibrium would entail lower output by firm A and greater output by firm B. Intuitively, firm B understands that the higher total tariff confronted by firm A results in diminished output from firm A, and firm B responds to the more favorable market conditions by increasing its own output. Similarly, if firm A faces a lower total tariff, then the new equilibrium entails higher output from firm A and lower output from firm B. In particular, if government A were to move from free trade to an export subsidy ($t_A < 0$), then firm A's output would increase while firm B's output falls. In effect, as we discuss in more detail below, an export subsidy then "shifts profit" from country B to country A.

The total Cournot-Nash output is denoted as $Q^N(t_A + t_C^A, t_B + t_C^B) \equiv q_A^N(t_A + t_C^A, t_B + t_C^B) + q_B^N(t_A + t_C^A, t_B + t_C^B)$. In the model under consideration here, basic "regularity" conditions are satisfied and total output falls when the total tariff along any channel rises. Thus, Q^N is decreasing in each of its two arguments. Intuitively, when the total tariff that firm A confronts rises, the "direct" effect of a reduction in firm A's output is larger than the "indirect" effect of an induced expansion in firm B's output. Consequently, if we let the Cournot-Nash price be denoted as $P_C^N(t_A + t_C^A, t_B + t_C^B) = P_C(Q^N(t_A + t_C^A, t_B + t_C^B))$, then we may conclude that P_C^N is increasing in each total tariff (i.e., in each of its two arguments). Given our focus on

[16] We assume that the firms' respective second-order conditions are satisfied.

the case of strategic substitutes, we also find that P_C^N rises by less than a dollar, when the total tariff on a given trade channel is increased by a dollar.[17]

We now express the local prices in countries A and B as functions of the respective total tariffs. At the Cournot-Nash equilibrium, the local prices in countries A and B can be expressed as functions of the two total tariffs in the following respective manners:

$$\begin{aligned} P_A^N(t_A+t_C^A, t_B+t_C^B) &= P_C^N(t_A+t_C^A, t_B+t_C^B) - (t_A+t_C^A), \text{ and} \\ P_B^N(t_A+t_C^A, t_B+t_C^B) &= P_C^N(t_A+t_C^A, t_B+t_C^B) - (t_B+t_C^B). \end{aligned}$$

The local price in country A decreases as the total tariff that confronts firm A rises, since the associated rise in the price in country C is not dollar-for-dollar. Similarly, an increase in the total tariff that confronts firm B results in a decrease in the local price in country B. It is interesting to observe as well that an increase in the total tariff that confronts firm A raises the local price in country C and thereby raises the local price in country B as well. An exactly analogous effect extends to the local price in country A when the total tariff that confronts firm B is raised.

We next define and characterize the world prices. Since country C may set discriminatory import tariffs, we must allow for different world prices across different trade channels. Accordingly, at the Cournot-Nash equilibrium, we define the world price between countries A and C as

$$P_A^{wN}(t_A, t_C^A) = P_C^N(t_A+t_C^A, t_B+t_C^B) - t_C^A = P_A^N(t_A+t_C^A, t_B+t_C^B) + t_A.$$

Likewise, we may define the world price between countries B and C as

$$P_B^{wN}(t_B, t_C^B) = P_C^N(t_A+t_C^A, t_B+t_C^B) - t_C^B = P_B^N(t_A+t_C^A, t_B+t_C^B) + t_B.$$

Notice that any difference between the world prices is completely driven by country C's tariff discrimination: $P_A^{wN}(t_A, t_C^A) - P_B^{wN}(t_B, t_C^B) = t_C^B - t_C^A$. We may think of P_A^{wN} as country A's terms of trade, and similarly we may regard P_B^{wN} as country B's terms of trade. Country C experiences an improvement in its bilateral terms of trade with country A when P_A^{wN} falls, and it likewise experiences an improvement in its bilateral terms of trade with country B when P_B^{wN} falls. We define a measure of country C's multilateral terms of trade below.

As discussed above, an increase in the total tariff along a channel of trade is only partially passed through as an increase in the price of the good in country C; thus, when government C raises its import tariff along a given channel, the world price along this channel falls. In other words, $P_A^{wN}(t_A, t_C^A)$ is decreasing in t_C^A, and similarly $P_B^{wN}(t_B, t_C^B)$ is decreasing in t_C^B. This means that country C enjoys a bilateral terms-of-trade gain along any channel on which it raises the import tariff, while the trading partner along this channel experiences a terms-of-trade loss. On the other hand, if country A raises its export tariff t_A, then P_C^N and thus $P_A^{wN}(t_A, t_C^A)$ increase. Likewise, an increase in t_B results in an increase in $P_B^{wN}(t_B, t_C^B)$. Thus, each exporting country can improve its own terms of trade by raising its export tariff. A higher export tariff, however, results in a bilateral terms-of-trade loss for country C. Finally, it is interesting to observe that a higher export tariff by one exporting country raises P_C^N and thus improves the terms of trade for the other exporting country as well.

[17] Calculations reveal that $\partial Q^N/\partial(t_A+t_C^A) = P_C'(Q^N)/\mid D\mid < 0$, where the denominator is the determinant of the Jacobian matrix associated with the firms' first-order conditions, which is positive in the case of strategic substitutes. It follows that $\partial P_C^N/\partial(t_A+t_C^A) = [P_C'(Q^N)]^2/\mid D\mid > 0$; further, calculations confirm that $\partial P_C^N/\partial(t_A+t_C^A) < 1$ in the case of strategic substitutes.

Our next step is to show that the Cournot-Nash quantities may also be expressed as functions of local prices. To this end, we begin with the observation that the total tariff along any channel equals the difference between the local prices in the importing and exporting countries. Thus, $t_A + t_C^A = P_C^N - P_A^N$ and $t_B + t_C^B = P_C^N - P_B^N$. We may thus represent the Cournot-Nash quantities for firms A and B, respectively, as $q_A^N(P_C^N - P_A^N, P_C^N - P_B^N)$ and $q_B^N(P_C^N - P_A^N, P_C^N - P_B^N)$. Similarly, the total quantity can be written as $Q^N(P_C^N - P_A^N, P_C^N - P_B^N)$. Thus, equilibrium quantities are ultimately determined by the respective total tariffs along each channel, but any total tariff itself is equal to the local-price wedge along the associated channel. We can therefore think of government A, for example, choosing its export tariff t_A with the view that its choice will alter local prices in countries A, B and C and thereby alter the quantities produced by firms A and B. For instance, an export subsidy from country A can be thought of as the consequence of a change in t_A from zero (free trade) to a negative value. This change leads to a decrease in P_C^N and thereby P_B^N and an increase in P_A^N. The resulting decrease in $P_C^N - P_A^N$ corresponds exactly to the decrease in t_A, and results in a higher level of output from firm A. For firm B, however, the reduction in $P_C^N - P_A^N$ causes a decrease in its Cournot-Nash output, since as discussed q_B^N is increasing in its first argument. An important implication of this discussion, therefore, is that the profit-shifting effect associated with a unilateral export subsidy can be understood as operating through movements in local prices. In this sense, the incentive to profit-shift operates independently of any motivation to manipulate the terms of trade.

We next consider government welfare functions. For country A, national welfare may be represented as

$$[P_C^N - (c_A + t_A + t_C^A)]q_A^N + t_A q_A^N = [P_C^N - (c_A + t_C^A)]q_A^N.$$

Thus, national welfare for country A is the sum of the (post-tariff) profit earned by firm A and the tariff revenue generated by the export tariff t_A. When selecting its optimal export policy, government A recognizes that its policy has three effects. First, an export tariff generates a welfare-neutral transfer from the profit of firm A to country A's treasury in the form of tariff revenue. This welfare-neutral effect accounts for the manner in which welfare is simplified in the equation above. Second, for any given output by firm B, an export tariff or subsidy induces a change in firm A's output. Starting at free trade ($t_A = t_A^C = 0$), for example, an export subsidy ($t_A < 0$) induces firm A to act as if its costs of production are lower than the true costs of production for country A; that is, when firm A receives an export subsidy, it regards its costs of production as being $c_A + t_A < c_A$. Thus, from country A's perspective, an export subsidy has a welfare-reducing effect in that it distorts firm A's incentives and induces it to produce an output level that is greater than that which would maximize country A's true profit. Third, the export policy chosen by government A induces a change in firm B's output. In particular, q_B^N falls when t_A is reduced. This third effect corresponds to the "profit-shifting" effect of an export subsidy.

Brander and Spencer's (1985) key insight is that, when other countries adopt free trade, the optimal policy for government A is to impose an export subsidy. Intuitively, the subsidy itself is welfare neutral, the upward distortion in firm A's output has no first-order welfare effect for country A if the export subsidy is small, and the resulting decrease in firm B's output raises the price in country C and generates a first-order welfare gain for country A. The optimal export subsidy is not infinite, however. As the export subsidy gets larger, firm A's output becomes increasingly distorted from country A's perspective: for a fixed level of output from firm B, country A's national welfare would enjoy a first-order gain if firm A were to reduce its output. The optimal export subsidy thus balances the first-order gain of a further reduction in firm B's output against the first-order cost of a further increase in firm A's output.

As Brander and Spencer (1985) discuss, when both exporting countries select export policies before firms select quantities, the equilibrium of the two-stage game entails the use of export subsidies by both countries.

The end result is that both reaction functions are shifted out, with both firms producing higher quantities and driving the true profits for countries A and B downward. The real winner from the subsidy war is country C, whose consumers enjoy a reduced price. In fact, global welfare is higher when governments A and B select export subsidies noncooperatively than in an alternative scenario of free trade. As Brander (1995, p. 1448) notes, the reason is that the market is already distorted, due to the presence of oligopoly, and export subsidies expand production and elimination some of this distortion. In comparison to the non-cooperative export subsidy outcome, export policies would be more restrictive if governments A and B were to cooperate and set export policies in a manner that maximized their joint welfare, and export policies would be more expansive if they were set in an efficient manner that maximized the aggregate welfare of all three countries. An agreement to restrict export subsidies can be interpreted as a victory for exporting countries that comes at the expense of importing country - and global - welfare.[18]

As we have developed the Brander-Spencer model above, it is apparent that externalities travel across countries through world prices. It is important, though, to understand whether other externalities may be at play in this model of strategic export policies. We therefore now continue with the development of our formalization of the Brander-Spencer model. Our goal is to represent government welfare functions in terms of local and world prices, so that we can isolate the terms-of-trade externality and determine if efficiency would be achieved if terms-of-trade motivations were removed from government trade policy decisions.

Toward this goal, we observe that government A's welfare function may be represented as

$$W_A(P_A^N, P_B^N, P_C^N, P_A^{wN}) = [P_A^{wN} - c_A] q_A^N (P_C^N - P_A^N, P_C^N - P_B^N),$$

where we utilize the observation above that tariff revenue cancels and recall that $P_A^{wN} = P_A^N - t_C^A$. Thus, country A's national welfare corresponds to a measure of its true profit. Likewise, country B's welfare is given as

$$W_B(P_A^N, P_B^N, P_C^N, P_B^{wN}) = [P_B^{wN} - c_B] q_B^N (P_C^N - P_A^N, P_C^N - P_B^N).$$

Finally, welfare in country C is given as

$$\begin{aligned} & W_C(P_A^N, P_B^N, P_C^N, P_A^{wN}, P_B^{wN}) \\ = \; & CS(P_C^N) + [P_C^N - P_A^{wN}] q_A^N (P_C^N - P_A^N, P_C^N - P_B^N) + [P_C^N - P_B^{wN}] q_B^N (P_C^N - P_A^N, P_C^N - P_B^N). \end{aligned}$$

Thus, country C welfare is the sum of consumer surplus and the tariff revenue received from each bilateral trading relationship. As these expressions confirm, we can thus represent all welfare functions as functions of local and world prices.

With the welfare functions written in this fashion, we can identify the price paths through which externalities are transmitted across countries. Suppose, for example, that government A contemplates a move from free trade to an export subsidy (i.e., a move from $t_A = 0$ to $t_A < 0$). In the resulting Cournot-Nash equilibrium, the export subsidy would lower $P_C^N - P_A^N$ and thereby increase firm A's production. For a fixed and positive true markup, $P_A^{wN} - c_A$, an expansion in firm A's output would be beneficial to country A. But an export subsidy also serves to lower P_A^{wN} and thus the true markup. Government A must thus weigh markup and volume trade-offs when setting its optimal export policy. The export subsidy increases firm A's output in part because of a strategic effect: the export subsidy lowers $P_C^N - P_A^N$ and thereby decreases firm B's Cournot-Nash output. Country B loses from this output reduction, for a fixed and positive true markup,

[18] See Bagwell and Staiger (2001b) for a similar argument in a third-country model when markets are perfectly competitive.

$P_B^{wN} - c_B$. An export subsidy from government A also lowers country B's true markup, since it lowers P_C^N and thus P_B^{wN}. Finally, for country C, the induced changes in local prices affect consumer surplus and tariff revenue. Clearly, the reduction in P_A^{wN} which country A regards as a cost represents a benefit to country C.

We next characterize the joint welfare of the three governments. Using the welfare expressions above, we immediately see that joint welfare, defined as $W_A + W_B + W_C$, is independent of the world prices, P_A^{wN} and P_A^{wN}. Thus, in the Brander-Spencer model, trade policies that are motivated by world-price considerations lead to inefficiencies, since joint welfare is independent or world prices. To go further, we define joint welfare formally as

$$\begin{aligned} & J(P_A^N, P_B^N, P_C^N) \\ = \; & W_A(P_A^N, P_B^N, P_C^N, P_A^{wN}) + W_B(P_A^N, P_B^N, P_C^N, P_B^{wN}) + W_C(P_A^N, P_B^N, P_C^N, P_A^{wN}, P_B^{wN}), \end{aligned}$$

where we utilize our observation that joint welfare is independent of world prices and represent J as a function of local prices. In fact, we find that J takes a simple form:

$$\begin{aligned} & J(P_A^N, P_B^N, P_C^N) \\ = \; & [P_C^N - c_A]q_A^N(P_C^N - P_A^N, P_C^N - P_B^N) + [P_C^N - c_B]q_B^N(P_C^N - P_A^N, P_C^N - P_B^N) + CS(P_C^N). \end{aligned}$$

Joint welfare is thus joint profit and consumer surplus, when the markup is evaluated as if all producers pay no taxes and receive the final good price in country C.

We characterize next the efficient trade policies. These are the policies that maximize joint welfare. We thus begin by deriving expressions for the derivatives of joint welfare with respect to the various trade policies. An immediate observation is that joint welfare depends only on the total tariff along each trade channel. This follows since all local prices depend on total tariffs, while joint welfare is independent of the world prices. We are thus led to evaluate the derivative of J with respect to the total tariff along each channel of trade:

$$\begin{aligned} \frac{dJ(P_A^N, P_B^N, P_C^N)}{d(t_A + t_C^A)} = \; & [\frac{\partial W_A}{\partial P_A^N} + \frac{\partial W_B}{\partial P_A^N} + \frac{\partial W_C}{\partial P_A^N}]\frac{\partial P_A^N}{\partial(t_A + t_C^A)} \\ & +[\frac{\partial W_A}{\partial P_B^N} + \frac{\partial W_B}{\partial P_B^N} + \frac{\partial W_C}{\partial P_B^N}]\frac{\partial P_B^N}{\partial(t_A + t_C^A)} \\ & +[\frac{\partial W_A}{\partial P_C^N} + \frac{\partial W_B}{\partial P_C^N} + \frac{\partial W_C}{\partial P_C^N}]\frac{\partial P_C^N}{\partial(t_A + t_C^A)} \end{aligned}$$

and

$$\begin{aligned} \frac{dJ(P_A^N, P_B^N, P_C^N)}{d(t_B + t_C^B)} = \; & [\frac{\partial W_A}{\partial P_A^N} + \frac{\partial W_B}{\partial P_A^N} + \frac{\partial W_C}{\partial P_A^N}]\frac{\partial P_A^N}{\partial(t_B + t_C^B)} \\ & +[\frac{\partial W_A}{\partial P_B^N} + \frac{\partial W_B}{\partial P_B^N} + \frac{\partial W_C}{\partial P_B^N}]\frac{\partial P_B^N}{\partial(t_B + t_C^B)} \\ & +[\frac{\partial W_A}{\partial P_C^N} + \frac{\partial W_B}{\partial P_C^N} + \frac{\partial W_C}{\partial P_C^N}]\frac{\partial P_C^N}{\partial(t_B + t_C^B)}. \end{aligned}$$

Along any channel of trade, a change in trade policy affects joint welfare through its affect on local prices and thereby the output quantities of firms A and B.

Using the structure of the model presented above and after some manipulation, we find that

$$\frac{dJ(P_A^N, P_B^N, P_C^N)}{d(t_A + t_C^A)} = [P_C^N - c_A]\frac{\partial q_A^N}{\partial(t_A + t_C^A)} + [P_C^N - c_B]\frac{\partial q_B^N}{\partial(t_A + t_C^A)},$$

and

$$\frac{dJ(P_A^N, P_B^N, P_C^N)}{d(t_B + t_C^B)} = [P_C^N - c_A]\frac{\partial q_A^N}{\partial(t_B + t_C^B)} + [P_C^N - c_B]\frac{\partial q_B^N}{\partial(t_B + t_C^B)},$$

where, for example, $\frac{\partial q_A^N}{\partial(t_A+t_C^A)}$ represents the partial derivative of q_A^N with respect to the first argument of that function. It is convenient to recall from above that $\frac{\partial q_A^N}{\partial(t_A+t_C^A)} < 0 < \frac{\partial q_B^N}{\partial(t_A+t_C^A)}$, $\frac{\partial q_B^N}{\partial(t_B+t_C^B)} < 0 < \frac{\partial q_A^N}{\partial(t_B+t_C^B)}$, $\frac{\partial Q_A^N}{\partial(t_A+t_C^A)} = \frac{\partial q_A^N}{\partial(t_A+t_C^A)} + \frac{\partial q_B^N}{\partial(t_A+t_C^A)} < 0$ and $\frac{\partial Q_B^N}{\partial(t_B+t_C^B)} = \frac{\partial q_A^N}{\partial(t_B+t_C^B)} + \frac{\partial q_B^N}{\partial(t_B+t_C^B)} < 0$ all hold provided that the associated Cournot-Nash quantities are positive.

Suppose first that $c_A = c_B$. In this case, it is possible to achieve the maximization of joint welfare with trade policies that deliver an interior solution at which $q_A^N > 0$ and $q_B^N > 0$. The first-order conditions for joint welfare maximization must then hold:

$$\frac{dJ(P_A^N, P_B^N, P_C^N)}{d(t_A + t_C^A)} = 0 = \frac{dJ(P_A^N, P_B^N, P_C^N)}{d(t_B + t_C^B)}.$$

We observe that the first-order conditions are satisfied when trade policies are set so as to achieve

$$P_C^N = c_A = c_B.$$

When $c_A = c_B$, the local price in country C can be driven down to the cost of production with both firms producing positive quantities if and only if the total tariff along each trade channel entails a subsidy: $t_A + t_C^A = t_B + t_C^B \equiv t^E$ where $t^E < 0$ is determined so that $P_C^N(t^E, t^E) = c_A = c_B$.[19] Thus, when firms are symmetric, a continuum of efficient trade policies exists, but all efficient policies that elicit positive production from both firms are such that the total tariff along each trade channel is set at the critical level $t^E < 0$ such that $P_C^N(t^E, t^E) = c_A = c_B$. The firms are thus subsidized to such an extent that the price paid by final consumers equals the price that would have obtained in a free-trade setting with perfect (or Bertrand) competition. As one example of an efficient policy vector, country C might adopt an import policy of free trade while countries B and C both adopt export subsidies at the level $t_A = t_B \equiv t^E$.

Suppose second that $c_A > c_B$. In this case, we may confirm that firm A does not produce when tariff policies are set efficiently. To see this, suppose that $q_A^N > 0$ and $q_B^N \geq 0$. From here, we may increase t_A and lower t_B in a way that lowers q_A^N, raises q_B^N and preserves the total quantity $q_A^N + q_B^N$ and thus the price P_C^N.[20] Referring to the simple form for J that is derived above, we conclude that such a modification raises joint welfare. Thus, an efficient tariff policy must induce $q_A^N = 0$. With all production coming from firm B, efficiency requires further that

$$P_C^N = c_B.$$

[19] Consistent with our discussion of first-order conditions for quantity choices above, we assume that demand and costs are such that $P_C^N(0,0) > c_A = c_B$.

[20] It is possible to construct a tariff policy change of the described form if direct effects dominate indirect effects so that

$$\frac{\partial q_A^N}{\partial(t_A + t_C^A)}\frac{\partial q_B^N}{\partial(t_B + t_C^B)} > \frac{\partial q_A^N}{\partial(t_B + t_C^B)}\frac{\partial q_B^N}{\partial(t_A + t_C^A)}.$$

As previously discussed, direct effects dominate indirect effects in the model under consideration here.

This outcome can be achieved if the total tariff on the trade channel between countries A and B is sufficiently negative that firm B's monopoly output $q_B^R(0; t_B + t_C^B)$ is raised to the level of output Q^{EB} at which $P_C(Q^{EB}) = c_B$. The efficient total tariff on firm B is thus the level $t^{EB} < 0$ such that $q_B^R(0; t^{EB}) = Q^{EB}$. With the market price driven down to $c_B < c_A$, output from firm A is set to zero if, for example, the total tariff between countries A and C is zero. The total tariff between countries B and C may take any of a continuum of forms, provided only that the total tariff satisfies $t_B + t_C^B = t^{EB}$. For example, country C might adopt an import policy of free trade while country B sets an export subsidy such that $t_B = t^{EB}$.

Now that we have characterized efficient total tariffs both when firms are symmetric and when one firm is more efficient, we turn next to consider the politically optimal tariff policies. We start with government A. When government A selects its politically optimal export policy, it places no value on welfare changes that are attributable to a change in world prices. We are thus led to consider the following derivative:

$$\begin{aligned} & \frac{\partial W_A}{\partial P_A^N}\frac{\partial P_A^N}{\partial(t_A+t_C^A)} + \frac{\partial W_A}{\partial P_B^N}\frac{\partial P_B^N}{\partial(t_A+t_C^A)} + \frac{\partial W_A}{\partial P_C^N}\frac{\partial P_C^N}{\partial(t_A+t_C^A)} \\ = \quad & [P_A^{wN} - c_A]\frac{\partial q_A^N}{\partial(t_A+t_C^A)}, \end{aligned}$$

where the equality follows after simplifications that utilize the structure of the model presented above. If the political optimum entails $q_A^N > 0$, then the first-order condition for government A's politically optimal choice must be satisfied, which is to say that the above expression must equal zero. We thus conclude that, in a political optimum,

$$P_A^{wN} = c_A \text{ if } q_A^N > 0.$$

We note that, when choosing its politically optimal tariff policy, government A is mindful of the effect of its policy on firm A's resulting Cournot-Nash output quantity. Thus, profit-shifting objectives are subsumed within the concept of a political optimum.

An exactly related calculation applies for government B. In particular, calculations confirm that

$$\begin{aligned} & \frac{\partial W_B}{\partial P_A^N}\frac{\partial P_A^N}{\partial(t_B+t_C^B)} + \frac{\partial W_B}{\partial P_B^N}\frac{\partial P_B^N}{\partial(t_B+t_C^B)} + \frac{\partial W_A}{\partial P_C^N}\frac{\partial P_C^N}{\partial(t_B+t_C^B)} \\ = \quad & [P_B^{wN} - c_B]\frac{\partial q_B^N}{\partial(t_B+t_C^B)}. \end{aligned}$$

Arguing as above, we may thus conclude that, in a political optimum,

$$P_B^{wN} = c_B \text{ if } q_B^N > 0.$$

In sum, if an exporting country supplies a positive quantity of output, then politically optimal trade policies are set so that the world price for the export equals the actual marginal cost of production in the exporting country.

We come now to government C. For this government, a change in trade policy is attractive as a means of pure rent shifting if it alters P_A^{wN} and/or P_B^{wN} while keeping P_C^N and thus the overall level of imports constant. In addition, for a given overall level of imports, if government C uses its trade policy to alter local prices so as to change the respective export shares of firms A and B, then pure rent is gained when the share is increased on the channel on which government C has the highest import tariff. Of course, this latter source of rent shifting does not arise if government C adopts an MFN tariff policy and sets the same tariff on both channels. Given that we allow for discriminatory tariffs, we are thus led to consider a definition of the *multilateral* terms of trade for country C which would include these various forms of rent shifting. With such a definition in place, we could then define government C's politically optimal trade policy as the pair of import tariffs that maximizes country C's welfare when the incentive for government C to shift rents by altering country C's multilateral terms of trade is removed.

Following Bagwell and Staiger (1999, 2001a, 2005), we define country C's multilateral terms of trade as

$$T^N(P_A^N, P_B^N, P_C^N, P_A^{wN}, P_B^{wN}) = \frac{q_A^N(P_C^N - P_A^N, P_C^N - P_B^N)P_A^{wN} + q_B^N(P_C^N - P_A^N, P_C^N - P_B^N)P_B^{wN}}{Q^N(P_C^N - P_A^N, P_C^N - P_B^N)}.$$

Observe that T^N is a trade-weighted average of bilateral world prices. Using this definition, we can say that country C experiences a multilateral terms-of-trade gain whenever T^N falls. This definition absorbs the various notions of pure rent shifting just mentioned. If the world price falls along either channel while local prices are held constant, so that country C enjoys a bilateral terms-of-trade improvement, then we see from the definition of T^N that country C also enjoys a multilateral terms-of-trade improvement. Next, suppose that government C imposes a higher import tariff on imports from country A, so that $t_C^A > t_C^B$ and thus $P_A^{wN} < P_B^{wN}$. If government C were to use its trade policies so as to alter local prices in countries A and B in a way that maintained the overall import quantity Q^N while raising q_A^N and lowering q_B^N, then country C would experience a pure rent transfer in the form of higher tariff revenue. Given our definition of T^N, we see that such a maneuver results in a lower value for T^N and thus an improvement in country C's multilateral terms of trade.

With this definition at hand, we may express country C's welfare as

$$\begin{aligned} & W_C(P_A^N, P_B^N, P_C^N, T^N(P_A^N, P_B^N, P_C^N, P_A^{wN}, P_B^{wN})) \\ = \quad & CS(P_C^N) + P_C^N q_A^N(P_C^N - P_A^N, P_C^N - P_B^N) + P_C^N q_B^N(P_C^N - P_A^N, P_C^N - P_B^N) \\ & -Q^N(P_C^N - P_A^N, P_C^N - P_B^N)T^N(P_A^N, P_B^N, P_C^N, P_A^{wN}, P_B^{wN}), \end{aligned}$$

where we abuse notation slightly and now present W_C as a function of four arguments. If government C were to ignore the pure rent-shifting effects of its trade policies, it would act "as if" $\frac{\partial W_C}{\partial T^N} \equiv 0$ when setting its policies. The resulting trade policies would then represent government C's politically optimal tariffs. Before proceeding, we emphasize that $T^N = P_A^{wN} = P_B^{wN}$ when government C's import tariffs satisfy MFN. Thus, in the case of MFN tariffs, government C simply ignores welfare changes induced by changes in the (common) world price when setting its politically optimal tariffs. When government C uses MFN import tariffs, therefore, its politically optimal tariffs are defined in a manner that is exactly analogous to the definitions of politically optimal tariffs used above for governments A and B.

To derive government C's politically optimal tariffs, we consider the following derivatives:

$$\begin{aligned} & \frac{\partial W_C}{\partial P_A^N}\frac{\partial P_A^N}{\partial(t_A + t_C^A)} + \frac{\partial W_C}{\partial P_B^N}\frac{\partial P_B^N}{\partial(t_A + t_C^A)} + \frac{\partial W_C}{\partial P_C^N}\frac{\partial P_C^N}{\partial(t_A + t_C^A)} \\ = \quad & [P_C^N - T^N]\frac{\partial Q^N}{\partial(t_A + t_C^A)} \end{aligned}$$

and

$$\frac{\partial W_C}{\partial P_A^N}\frac{\partial P_A^N}{\partial(t_B+t_C^B)}+\frac{\partial W_C}{\partial P_B^N}\frac{\partial P_B^N}{\partial(t_B+t_C^B)}+\frac{\partial W_C}{\partial P_C^N}\frac{\partial P_C^N}{\partial(t_B+t_C^B)}$$
$$= [P_C^N - T^N]\frac{\partial Q^N}{\partial(t_B+t_C^B)},$$

where the equalities follow after some manipulation. Government C's politically optimal tariffs are thus realized when they are set so that $P_C^N = T^N$. We next observe that $P_C^N = T^N$ if and only if

$$[P_C^N - P_A^{wN}]q_A^N + [P_C^N - P_B^{wN}]q_B^N = 0.$$

We thus note that government C's political optimality requirement is achieved when it practices free trade on both goods (so that $P_C^N = P_A^{wN} = P_A^{wN}$) or when it imports along one channel only and adopts a policy of free trade on that channel.

We are now prepared to characterize the vector of politically optimal tariff policies. We start with the case where $c_A = c_B$. In this case, it is possible to achieve a political optimum in which firms A and B both produce positive quantities. The political optimality conditions for governments A and B then are expressed as

$$P_A^{wN} = c_A = c_B = P_B^{wN}.$$

Using this condition, the political optimality condition for government C is thus satisfied if

$$P_C^N = c_A = c_B.$$

We now consider the trade policies that generate the desired prices. We observe that $P_C^N = P_A^{wN} = P_B^{wN}$ holds if and only if government C adopts a policy of free trade: $t_C^A = t_C^B = 0$. When $c_A = c_B$, the local price in country C can be driven down to the cost of production with both firms producing positive quantities if and only if the total tariff along each trade channel entails a subsidy: $t_A + t_C^A = t_B + t_C^B \equiv t^E$ where $t^E < 0$ is determined so that $P_C^N(t^E, t^E) = c_A = c_B$. Given $t_C^A = t_C^B = 0$, we conclude that a political optimum exists in which government C adopts a policy of free trade whereas governments A and B each adopt an export subsidy such that $t_A = t_B \equiv t^E < 0$.

We now observe that the constructed politically optimal trade policies are efficient. Indeed, we use exactly the constructed politically optimal trade policies as an example of an efficient vector of trade policies above. For the case of symmetric exporting countries, we thus conclude that, if governments could be induced not to value the pure international rent-shifting associated with the terms-of-trade movements induced by their tariff choices, then they would set efficient tariffs and there would be nothing left for a trade agreement to do. In short, the model of strategic export policies provides a rationale for a trade agreement; however, the rationale is no different from that provided in the traditional models with competitive firms. Further, as discussed above, an efficiency-enhancing trade agreement would call for larger export subsidies than governments would provide were they to interact non-cooperatively.

We consider now the case in which $c_B < c_A$. We first ask whether it is possible to construct a political optimum that is efficient. In this case, as we discuss above, an efficient tariff policy must induce $q_A^N = 0$. Efficiency requires as well that $P_C^N = c_B$. Thus, firm B must be given incentive to produce $q_B^R(0; t_B + t_C^B) = Q^{EB}$ units, where $P_C(Q^{EB}) = c_B$. The efficient total tariff on firm B is thus the level $t^{EB} < 0$ such that $q_B^R(0; t^{EB}) = Q^{EB}$. Now, a political optimum with $q_B^N > 0$ is possible only if $P_B^{wN} = c_B$. Given that efficiency requires $P_C^N = c_B$, a political optimum is efficient only if the importing country adopts a policy of free trade toward the exporting country with the most efficient supplier: $t_C^B = 0$. It follows that government B must adopt the export subsidy $t_B = t^{EB} < 0$. Let us suppose further that government C adopts a policy of free trade toward exports from country A as well: $t_C^A = 0$. The resulting prices satisfy $P_A^{wN} = P_B^{wN} = c_B = P_C^N = T^N$. It is now evident that governments B and C satisfy the first-order conditions for a political optimum; further, government A cannot gain at fixed world prices by inducing production from firm A, since $P_B^{wN} = c_B < c_A$. Once again, the constructed political optimum is efficient.

We now briefly consider an alternative third-country model, in which firms sell differentiated products and set prices. (Eaton-Grossman (1986) analysis to be written.)

References

Bagwell, K. and R. W. Staiger (1999), "An Economic Theory of GATT," *American Economic Review*, 89, 215-48.

Bagwell, K. and R. W. Staiger (2001a), "Reciprocity, Non-discrimination and Preferential Agreements in the Multilateral Trading System," *European Journal of Political Economy*, 17, 281-325.

Bagwell, K. and R. W. Staiger (2001b), "Strategic Trade, Competitive Industries and Agricultural Trade Disputes," *Economics and Politics*, 13, 113-28.

Bagwell, K. and R. W. Staiger (2002), **The Economics of the World Trading System**, The MIT Press, Cambridge, MA.

Bagwell, K. and R. W. Staiger (2005), "Multilateral Trade Negotiations, Bilateral Opportunism and the Rules of GATT," *Journal of International Economics*, 67, 268-94.

Baldwin, R. (1987), "Politically realistic objectives and trade policy," *Economics Letters* 24, 287-90.

Brander, J. (1981), "Intra-Industry Trade in Identical Commodities," *Journal of International Economics*, 11, 1-14.

Brander, J. (1995), "Strategic Trade Policy," in G. Grossman and K. Rogoff (eds.), **Handbook of International Economics**, vol. III, 1395-1455.

Brander, J. and P. R. Krugman (1983), "A 'Reciprocal-Dumping' Model of International Trade," *Journal of International Economics*, 15, 313-21.

Brander, J. A. and B. J. Spencer (1984), "Tariff Protection and Imperfect Competition," in H. Kierzkowski (ed.), **Monopolistic Competition and International Trade**, Clarendon Press: Oxford.

Brander, J. A. and B. J. Spencer (1985), "Export Subsidies and International Market Share Rivalry," *Journal of International Economics*, 18, 83-100.

Dixit, A. (1984), "International Trade Policy for Oligopolistic Industries," *Economic Journal*, 94 supplement, 1-16.

Dixit, A. and J. Stigltiz (1977), "Monopolistic Competition and Optimum Product Diversity," *American Economic Review*, 67, 297-308.

Eaton, J. and G.M. Grossman (1986), "Optimal trade and industrial policy under oligopoly," *Quarterly Journal of Economics* 101, 383-406.

Grossman, G. M. and E. Helpman (1994), "Protection for sale," *American Economic Review*, 84, 833-50.

Grossman, G. M. and E. Helpman (1995), "Trade Wars and Trade Talks," *Journal of Political Economy*, 103, 675-708.

Helpman, E. and P. R. Krugman (1989), **Trade Policy and Market Structure**, The MIT Press, Cambridge, MA..

Johnson, H. G. (1954), "Optimum Tariffs and Retaliation," *Review of Economic Studies*, 21, 142-53.

Krugman, P. R. (1980), "Scale Economies, Product Differentiation, and the Pattern of Trade," *American Economic Review*, 70, 950-99.

Ossa, R. (2008), "A 'New-Trade' Theory of GATT/WTO Negotiations," mimeo.

Spencer, B. J. and J. A. Brander (1983), "International R&D Rivalry and Industrial Strategy," Review of Economic Studies, 50, 707-22.

Venables, A. (1985), "Trade and Trade Policy with Imperfect Competition: The Case of Identical Products and Free Entry," *Journal of International Economics*, 19, 1-20.

Venables, A. (1987), "Trade and Trade Policy with Differentiated Products: A Chamberlinian-Ricardian Model,"*Economic Journal* 97, 700-717.