Profit Shifting and Trade Agreements in Imperfectly Competitive Markets

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Abstract

When markets are imperfectly competitive, trade policies can alter the terms of trade, shift profits from one country to another, and moderate or exacerbate existing distortions that are associated with the presence of monopoly power. In light of the various ways in which trade policies may influence welfare, it might be expected that new rationales for trade agreements would arise once imperfectly competitive markets are allowed. In this paper, we consider several trade models that feature imperfectly competitive markets and argue that the basic rationale for a trade agreement is, in fact, the same rationale that arises in perfectly competitive markets. In all of the models that we consider, and whether or not governments have political-economic objectives, the only rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume. Having identified the problem that a trade agreement might solve, we next evaluate the form that an efficiency-enhancing trade agreement might take. Here, too, our results parallel the results established previously for models with perfectly competitive markets. In particular, we show that the principles of reciprocity and non-discrimination (MFN) are efficiency enhancing, as they serve to "undo" the terms-of-trade driven restrictions in trade volume that occur when governments pursue unilateral trade policies.

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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 the analysis to markets with imperfect competition, thereby introducing 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. The terms-of-trade externality is still present 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. For a sequence of models with imperfectly competitive markets, we examine the rationale for a trade agreement, and we also consider the form that an efficiency-enhancing trade agreement might take.

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 nationally 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.

These and other motives for trade policy intervention are represented in an expansive literature that examines optimal unilateral trade policy under imperfect competition. One of the main conclusions of this literature is that optimal unilateral trade policy is highly sensitive to market structure.[1] Based on the findings of this literature, it might be expected that the rationale for a trade agreement would likewise vary markedly with market structure. Consistent with this expectation, we show that new international externalities indeed 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. These local-price externalities are associated with the oligopolistic profit-shifting and distortion-influencing affects of trade policies. For our purposes, however, the key question is whether governments internalize these international externalities in an appropriate fashion from a world-wide perspective when they make their unilateral policy choices. For a sequence of models that feature imperfectly competitive market structures, we address this question and establish a surprising answer: the basic rationale for a trade agreement is, in fact, the same rationale that arises in perfectly competitive markets. In particular, in all of the models that we consider, and whether or not governments have political-economic objectives, the *only* rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume. Furthermore, and again as in the benchmark model with perfect competition, the principles of reciprocity and MFN are efficiency enhancing, as they serve to "undo" the terms-of-trade driven restrictions in trade volume that occur when governments pursue unilateral trade policies.

To establish these points, we consider the distinct motives for trade policy intervention that arise when there is a monopoly supplier in one country[2] (Section 2), when there is oligopolistic interaction between an exporting and an import-competing firm[3] (Section 3), and when there is oligopolistic interaction between two firms exporting from two different countries to a third-country market[4] (Section 4). In each setting, our approach is to examine the non-cooperative and efficient policy choices in detail and evaluate the precise reasons for any divergence between them. To this end, 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. For each setting, we show that politically optimal tariffs are efficient, and we thereby establish that the only rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume. With this rationale for a trade agreement in hand, we then proceed to establish that the principles of reciprocity and (in the third-country setting) MFN are efficiency enhancing in each setting as well.

[1] For excellent summaries of the early literature on optimal trade policy under imperfect competition, see Brander (1995) and Helpman and Krugman (1989).

[2] Brander and Spencer (1981, 1984a) consider the role of import tariffs as a means of extracting profits from non-competitive foreign suppliers.

[3] 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 Spencer and Brander (1983) and Brander and Spencer (1985) have shown. These papers assume that international markets are integrated; Brander and Spencer (1984b) and Dixit (1984) explore related models with segmented markets.

[4] International oligopoly competition now occurs between exporters from different countries. As Brander and Spencer (1985) show, due to the profit-shifting effect of an export subsidy, the optimal unilateral export policy for a government in such a setting may be an export subsidy.

If the presence of imperfectly competitive firms introduces new international externalities that are transmitted through non-terms-of-trade channels, as we confirm below, then how is it that the problem for a trade agreement to solve in this more complicated environment still boils down to providing an avenue of escape from a terms-of-trade driven Prisoners' Dilemma? Broadly speaking, the reason is that trade agreements do not expand the set of feasible policy instruments available to governments, and so any efficiency gains generated by a trade agreement must derive from changes in the level of intervention achieved with the existing policy instruments; and as we demonstrate below, even in this more complicated environment it is the international rent-shifting/cost-shifting associated with the terms-of-trade externality – and this externality alone – that accounts for the inefficient level of intervention under unilateral policy choices.

The analysis in this paper 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 models of Sections 3 and 4 – 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. This alternative centers on 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 (Venables, 1985, 1987, Helpman and Krugman, 1989, Ossa 2008). In a companion paper (Bagwell and Staiger, 2009), we consider this alternative by exploring models in which firms are not price takers but where entry is endogenous, and we again ask whether a novel role for trade agreements can be identified. For the models of firm delocation, our main finding is again that the terms-of-trade externality continues to provide the only rationale for a trade agreement.

2 Trade Policies and Market Power

We begin with a simple 2-country partial-equilibrium model in which the good under consideration is produced by a monopolist in the domestic country and consumed in both the domestic and foreign countries. The domestic country thus exports this good to the foreign country. We assume that the domestic and foreign markets are integrated, so that the domestic monopolist cannot price discriminate across the two markets. Any difference in prices across the two markets then derives from trade policies. The alternative case of segmented markets is considered in the Appendix.

2.1 Basic Assumptions

We assume that a monopolist resides in the domestic country, selling good y to domestic consumers and also exporting 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 and positive. The government of the domestic country has an export policy, t, where $t > 0$ indicates an export tariff (expressed in specific terms); and the government of the foreign country has an import policy, t^*, where $t^* > 0$ corresponds to an import tariff (expressed in specific terms). 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: letting $\tau \equiv t + t^*$, it then follows that $P^* = P + \tau$. 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 $P^* = P + \tau$) to maximize profit in the domestic and foreign markets:

$$\Pi(P, \tau) = [P - c_o]D(P) + [P - c_o]D^*(P + \tau),$$

where c_o is the constant marginal cost of production for the monopolist. We assume that the second-order condition for profit maximization holds. The associated first-order condition balances the effect of a price increase across the integrated markets and may be written as follows:[5]

$$\Pi_P(P, \tau) = [P - c_o]D'(P) + D(P) + [P - c_o]D^{*\prime}(P + \tau) + D^*(P + \tau) = 0. \tag{1}$$

As (1) indicates, the profit-maximizing or monopoly price depends on τ, the total tariff on trade flows from the domestic to the foreign country, and so we represent the monopoly price function as $P(\tau)$. Given downward-sloping demand functions, (1) also implies that the monopoly price function entails a positive markup over unit production costs: $P(\tau) > c_o$. Since $P^w = P + t = P^* - t^*$, we may use $P^*(\tau) = P(\tau) + \tau$ to denote the corresponding monopoly price function for foreign sales and $P^w(t, t^*)$ to represent the corresponding world price function.

For a large family of demand functions, including linear demand functions, $P(\tau)$ declines as the total tariff τ rises.[6] 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. More generally, the final price paid by foreign consumers, $P^*(\tau)$, rises with τ.[7] In what follows we therefore assume P^* rises and P falls with the total tariff τ. 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 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.

[5] In keeping with our focus on non-prohibitive tariffs, we maintain the assumption here and throughout that it is optimal for the monopolist to sell strictly positive volume in each country for all relevant tariff levels.

[6] In particular, $P(\tau)$ is decreasing in τ if $(P - c_o)D^{*\prime\prime}(P^*) + D^{*\prime}(P^*) < 0$ at the monopoly selection. For this condition, it is thus sufficient if $D^{*\prime\prime}(P^*) \leq 0$, but this inequality is clearly not necessary.

[7] We find that $P^*(\tau)$ is increasing in τ if $(P - c_o)D''(P) + 2D'(P) < 0$. This is the traditional second-order condition that would apply if the monopolist sold only in the domestic market. This condition holds, for example, if $D''(P) \leq 0$, although this inequality is clearly not necessary.

2.2 Welfare Functions

We next consider government welfare functions. To begin, we assume that each government maximizes the welfare of its country. Domestic country welfare is then

$$[P - c_o]D(P) + CS(P) + [P^* - (c_o + \tau)]D^*(P^*) + tD^*(P^*),$$

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 simplify and represent domestic country welfare as

$$W(P, P^*, P^w) = [P - c_o]D(P) + CS(P) + [P^w - c_o]D^*(P^*). \tag{2}$$

Domestic country welfare is ultimately a function of the underlying tariffs; however, for our purposes, it is more useful to write welfare 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.[8]

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 raises the possibility 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. 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 Nash and efficient policy choices in detail and evaluate the precise reasons for any divergence between them.

To this end, we complete our characterization of government welfare functions by considering

[8] For further discussion of this case, see Bagwell and Staiger (1999, 2001).

the foreign country. Foreign country welfare takes the following simple form:

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

where $CS^*(P^*)$ denotes foreign consumer surplus and $[P^* - P^w]D^*(P^*)$ is foreign tariff revenue. As with domestic welfare, we express foreign welfare as a function of prices in order to isolate the specific channels through which trade policies affect welfare.

2.3 Nash and Efficient Tariffs

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. We assume that the respective second-order conditions are satisfied and focus on the associated first-order conditions for welfare maximization. Using the expressions for domestic and foreign welfare developed above, and noting that $\frac{d\tau}{dt} = 1 = \frac{d\tau}{dt^*}$, 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:

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

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_o), 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.[9]

[9] In particular, we find that $t^N \geq 0$ if and only if $[-D(P)\frac{dP}{dt}] \geq [(P - c_o)D'(P) + D(P)]$ when $t = 0$ and $t^* = t^{*N}$. 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 $t^N < 0$.

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 assume).[10]

It is instructive at this point to consider more generally the interpretation of the Nash policy choices. Let us first examine the tariff choice of the foreign country. As we observe above, foreign welfare may be expressed in the form $W^*(P^*, P^w)$. Consider now Figure 1a. With the foreign import tariff t^* on the vertical axis and the home export tax t on the horizontal axis, an initial tariff pair is represented by the point $A \equiv (t^*, t)$. This pair is associated with a foreign iso-local-price line (i.e., an iso-tariff-sum line), denoted as $P^*(A) \rightarrow P^*(A)$, and an iso-world-price line, depicted as $P^w(A) \rightarrow P^w(A)$. In light of the property established above that the foreign price can be written as $P^*(\tau)$, the iso-local-price line has slope -1. The iso-world-price line has a positive slope, because the world price can be held fixed only if an increase in the foreign export tax is balanced against an increase in the domestic import tariff. For a fixed t, when t^* is increased to t^{*1}, a new point $C \equiv (t^{*1}, t)$ is induced. This point lies on new iso-price lines, represented as $P^*(C) \rightarrow P^*(C)$ and $P^w(C) \rightarrow P^w(C)$, and the foreign local (world) price is now higher (lower) than it was originally at A.

As the bottom equation of (4) suggests, the overall movement from A to C in Figure 1a can be disentangled into separate movements in the world and foreign local prices, respectively. The movement from A to B reflects the induced fall in the world price, holding fixed the foreign local price, and the associated welfare implications for the foreign country are reflected in the bottom equation of (4) by the term $W^*_{P^w}$. Similarly, the movement from B to C isolates the foreign local price change, with the corresponding foreign welfare change reflected in the bottom equation of (4) by the term $W^*_{P^*}$. Exactly as in a competitive setting, the world price movement from A to B can be interpreted as a form of international rent-shifting/cost-shifting: if the foreign government wishes to implement a foreign local price corresponding to the iso-local-price line $P^*(C) \rightarrow P^*(C)$, then a unilateral increase in the foreign import tariff passes some of the costs of this outcome to the domestic country, whose exports are sold at a lower world price. Further, in our model with export-sector market power, the domestic country also has a direct interest in the foreign local price that the foreign government wishes to implement. The foreign government, of course, ignores this interest when choosing its Nash import tariff.

We next turn to an examination of the tariff choice of the domestic country. As we observe above, domestic welfare may be expressed in the form $W(P, P^*, P^w)$. The presence of both domestic and

[10] Formally, $\frac{dW^*}{dt^*} = (P^* - P^w)D^{*\prime}(P^*)\frac{dP^*}{d\tau} - D^*(P^*)\frac{\partial P^w}{\partial t^*}$. At $t^* = 0$, $P^* = P^w$ and so $\frac{dW^*}{dt^*} > 0$, since we assume that $P(\tau)$ and thus $P^w(t, t^*) = P(\tau) + t$ is decreasing in t^*.

foreign local prices in the domestic welfare function implies that the interpretation of the Nash tariff choice that we develop just above for the foreign country cannot be applied directly to the domestic country tariff choice. Nevertheless, an analogous interpretation *does* apply once the appropriate observations are made. To see why, consider Figure 1b. With the domestic export tax t now on the vertical axis and the foreign import tariff t^* now on the horizontal axis, an initial tariff pair is represented by the point $A \equiv (t, t^*)$ in Figure 1b. The key observation is that *both* P and P^* are tied down once the sum of t and t^* (and hence τ) is tied down. Therefore, the tariff pair at A is associated with a domestic-and-foreign iso-local-price line (i.e., an iso-tariff-sum line), denoted as $P(A), P^*(A) \to P(A), P^*(A)$, and an iso-world-price line, depicted as $P^w(A) \to P^w(A)$. As before, the iso-local-price line has slope -1, while the iso-world-price line has a positive slope. For a fixed t^*, when t is increased to t^1, a new point $C \equiv (t^1, t^*)$ is induced. This point lies on new iso-price lines, represented as $P(C), P^*(C) \to P(C), P^*(C)$ and $P^w(C) \to P^w(C)$, and the domestic local price is now lower than it was originally at A, while the foreign local price and the world price are now each higher than they were originally at A.

As the top equation of (4) suggests, the overall movement from A to C in Figure 1b can be disentangled into separate movements in the world price, and in the domestic and foreign local prices, respectively. The movement from A to B reflects the induced increase in the world price, holding fixed the domestic and foreign local prices, and the welfare implications of this change for the domestic country are associated in the top equation of (4) with the term W_{P^w}. Similarly, the movement from B to C isolates the domestic and foreign local price changes, with the corresponding domestic welfare change captured in the top equation of (4) with the terms W_P and W_{P^*}. Despite the added complication of the extra term W_{P^*} in the top equation of (4), it may now be seen that the domestic Nash tariff choice admits an analogous interpretation to the foreign Nash choice. Specifically, and exactly as in a competitive setting, the world price movement from A to B can be interpreted as a form of international cost-shifting: if the domestic government wishes to implement a domestic-and-foreign local price pair corresponding to the iso-local-price line $P(C), P^*(C) \to P(C), P^*(C)$, then a unilateral increase in its export tax passes some of the costs of this outcome to the foreign country, whose imports are purchased at a higher world price. A novel feature of our model with export-sector market power is that the foreign country also has a direct interest in one of the local prices (the foreign local price) that the domestic country wishes to implement. The domestic government ignores this interest when setting its Nash export tariff.

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

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

As inspection of (5) confirms, joint welfare is maximized at the perfectly competitive prices: $P = P^* = c_o$.[11] Governments, however, are unable to deliver these prices using only their export and import tariffs. Under free trade policies, the monopolist sets $P = P^* > c_o$, and deadweight loss results. Using a positive total tariff τ, governments could steer supply toward the domestic market and push the domestic local price down to c_o. But a positive τ introduces a wedge between P and P^*, making it impossible that P^* could also be set equal to c_o. An efficient tariff pair would balance efficiency objectives across markets with the final outcome satisfying $c_o < P$ and $c_o < P^*$.[12]

We next characterize the efficient tariffs at a 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, and that the local prices P and P^* depend only on the tariff sum τ, it follows that efficiency only ties down the sum of the two tariffs. The first-order condition that defines efficient choices of t and t^* is thus given by:

$$W_P \frac{dP}{d\tau} + W_{P^*} \frac{dP^*}{d\tau} + W^*_{P^*} \frac{dP^*}{d\tau} = 0. \quad (6)$$

Efficiency requires only that t and t^* be chosen so that the total tariff τ satisfies (6).

We may now formally confirm that the Nash tariff choices are indeed inefficient. This can be seen by adding the two Nash conditions in (4) together to obtain

$$W_P \frac{dP}{d\tau} + W_{P^*} \frac{dP^*}{d\tau} + W^*_{P^*} \frac{dP^*}{d\tau} + D^*(P^*)[\frac{\partial P^w}{\partial t} - \frac{\partial P^w}{\partial t^*}] = 0, \quad (7)$$

where in writing (7) we have used the fact that (2) implies $W_{P^w} = D^*(P^*)$ and (3) implies $W^*_{P^w} = -D^*(P^*)$. The term $D^*(P^*)[\frac{\partial P^w}{\partial t} - \frac{\partial P^w}{\partial t^*}]$ is strictly positive, and so (7) implies that $W_P \frac{dP}{d\tau} + W_{P^*} \frac{dP^*}{d\tau} + W^*_{P^*} \frac{dP^*}{d\tau}$ must be negative when evaluated at Nash tariff choices. But then, under the assumption that the second-order condition for joint-welfare maximization holds, (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.

2.4 Politically Optimal Tariffs

To determine the *reason* for the inefficiency of the Nash tariff choices, we now follow Bagwell and Staiger (1999, 2001) and define *politically optimal* tariffs as those tariffs that would hypothetically

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

[12] Suppose, for example, that $\tau > 0$ delivers $P = c_o$. The term $[P - c_o]D(P) + CS(P)$ 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 $[P^* - c_o]D^*(P^*) + CS^*(P^*)$. Likewise, if $\tau < 0$, then it would not be efficient to drive P^* to or below c_o.

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 two conditions

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

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.

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, 2001) and the imperfectly competitive setting that we analyze here. In the perfectly competitive setting, domestic welfare can be written as $W(P, P^w)$, and the politically optimal tariff for the domestic government then satisfies $W_P \frac{dP}{d\tau} = 0$. Thus, in the case of perfect competition, 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" $\frac{\partial P^w}{\partial t} \equiv 0$, because either way we have $W_{P^w} \frac{\partial P^w}{\partial t} \equiv 0$.[13] Notice that, under the second interpretation, politically optimal tariffs are the tariffs that governments would choose unilaterally if they were "small" in world markets. In the presence of imperfectly competitive firms, however, this second interpretation is not valid. To see why, recall that the domestic welfare function now includes P^* and observe as well that the relationship $P^w = P^* - t^*$ implies $\frac{\partial P^w}{\partial t} = \frac{dP^*}{d\tau}$. Consequently, if the domestic government were to act "as if" $\frac{\partial P^w}{\partial t} \equiv 0$, it would then by necessity also act "as if" $\frac{dP^*}{d\tau} = 0$, and so its unilaterally chosen tariff would satisfy $W_P \frac{dP}{d\tau} = 0$, 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 offer a formal evaluation of the efficiency properties of politically optimal tariffs as defined by (8). This is easily done: the two conditions in (8), when summed together, imply the condition in (6). We thus now have the following result: politically optimal tariffs are efficient. Put differently, 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.

To understand this result at a more specific level, we refer to Figures 2a-c. In Figures 2a and 2b,

[13] 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.

we illustrate the manner in which the domestic government determines its politically optimal export tariff. Figure 2a isolates the effects in the foreign market of a higher export tariff. The bold lines identify market values at initial export and import tariffs, t^* and t, respectively, where we assume for now that both tariffs are positive. The dotted lines identify the values that are determined after an increase in the export tariff. As Figure 2a illustrates, the domestic country initially enjoys tariff revenue (denoted as TR) in the amount $(P^w - P)D^*(P^*)$ and profit on exported units (denoted as PS_x) in the amount $(P - c_o)D^*(P^*)$, so that the overall benefit that the domestic government enjoys from foreign sales is $(P^w - c_o)D^*(P^*)$. The foreign country likewise enjoys tariff revenue (denoted as TR^*) in the amount $(P^* - P^w)D^*(P^*)$ and consumer surplus (denoted as CS^*) as represented by the triangular area above P^* and below the demand curve. As the domestic government increases its export tariff, local and world prices change, and we illustrate these changes with arrows. In particular, the foreign local price P^* rises, leading to a reduction in foreign demand and thus trade volume. Consequently, the domestic country suffers a loss in tariff revenue and profit, with each unit of lost sales being valued at rate $(P^w - c_o)$. In this way, a higher foreign local price generates a welfare loss (denoted by L_1 and L_2) for the domestic government in the foreign market.

Figure 2a thus identifies a cost to the domestic government of a higher export tariff. This cost is attributable to the reduced trade volume that arises as a consequence of the induced higher foreign local price. The domestic government weighs this cost when determining its politically optimal export policy. Figure 2a also illustrates two effects that the domestic government does *not* weigh when setting its politically optimal export policy. First, a higher export tariff generates a terms-of-trade gain (denoted as $G(TOT)$) for the domestic government, which as Figure 2a illustrates amounts to a direct transfer from the foreign treasury (i.e., from TR^*) to the domestic treasury (i.e., to TR). A government ignores pure international rent shifting of this nature when setting its politically optimal tariff policy. Second, when the domestic government sets its politically optimal export policy, it also ignores the fact that the induced reduction in trade volume itself lowers foreign tariff revenue when the foreign import tariff is positive. This loss (denoted as Z) to the foreign government identifies a negative international externality that is associated with local-price movements and suggests that the politically optimal domestic export tariff may be inefficiently high if the foreign import tariff is positive.

In Figure 2b, we isolate the effect of a higher export tariff in the domestic market. As illustrated, a higher export tariff induces a lower domestic local price P. Since the domestic market is initially distorted due to the presence of monopoly power, the domestic government gains in the domestic market when the export tariff is increased and greater domestic sales are generated. This gain corresponds to the new consumer surplus (denoted as G_1) and the new profit (denoted as G_2) that are enjoyed on units that are domestically consumed only after the higher export tariff is imposed. When setting its politically optimal export tariff, the domestic government thus evaluates an increase in its export tariff by balancing the losses in the foreign market (i.e., $L_1 + L_2$) against the gains in the domestic market (i.e., $G_1 + G_2$). 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 therefore sensitive to the relative slopes of the domestic and foreign demand functions.

We turn now to Figure 2c and consider the politically optimal import tariff for the foreign government. Here, it is convenient to assume that the foreign import tariff is initially zero and that the foreign government is contemplating an increase in the import tariff. For simplicity, in Figure 2c, we assume that the domestic export tariff is positive. If the foreign government raises its import tariff to a positive level, then the foreign local price P^* rises and trade volume is again reduced. As well, the world price falls, and the foreign country thus enjoys a terms-of-trade gain (denoted as $G^*(TOT)$) that amounts to a pure rent transfer from the domestic treasury to the foreign treasury. When setting its politically optimal import policy, however, the foreign government ignores this terms-of-trade effect and instead focuses on the fact that a higher import tariff induces a higher foreign local price and thus a loss in foreign consumer surplus (denoted as L^*). As Figure 2c suggests, then, the politically optimal import policy for the foreign government is a policy of free trade. In fact, this observation can be easily formalized at a general level. At the political optimum, we see from (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: $t^*_{PO} = 0$.[14]

At this point, we may return to consider the domestic government. When setting its politically optimal export policy, the domestic government internalizes all of the gains (i.e., $G_1 + G_2$) of a reduction in deadweight loss in the domestic market; however, it internalizes all of the losses (i.e., $L_1 + L_2 + Z$) of an increase in deadweight loss in the foreign market if and only if the foreign import tariff is zero (i.e., if and only if $Z = 0$). But we have just argued that the politically optimal import tariff for the foreign government *is* zero; therefore, the domestic government internalizes all of the gains and losses in joint welfare when setting its politically optimal export policy. In short, when the foreign government adopts a policy of free trade, the domestic government's export policy no longer generates an international externality through the induced change in the foreign local price. For this reason, politically optimal tariffs are efficient.

A general perspective on this result is possible with reference to Figures 1a and 1b. Consider, for instance, the trade-offs faced by the domestic government as depicted in Figure 1b. If the domestic government seeks to achieve a pair of domestic and foreign local prices corresponding to the iso-local-price line $P(C), P^*(C) \rightarrow P(C), P^*(C)$, then the attainment of this pair of local prices involves no world-price externality when the domestic government's higher export tax is balanced against a higher foreign import tariff, so that the world price is not altered. This corresponds in Figure 1b to the movement from A to D. When the domestic government is not motivated by the terms-of-trade implications of its tariff policy, it prefers choosing a higher export tax and inducing point C instead of selecting a lower export tax and inducing point A if and only if it also prefers

[14] 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.

point D to point A. If both governments choose tariffs in this fashion (so that in Figure 1a the foreign government prefers choosing a higher import tariff and inducing point C instead of selecting a lower import tariff and inducing point A if and only if it also prefers point D to point A), then a resulting consistent set of tariffs is politically optimal. In this case, the tariffs that governments select are not motivated by the cost-shifting effects of movements in the terms of trade.

While the domestic government's willingness to move from point A to point D in Figure 1b induces no externality on the foreign country through the terms of trade, it will involve a change in the foreign local price. If the foreign government also selects a tariff that is politically optimal, however, then a small change in the foreign local price will not alter the foreign welfare to the first order.[15] Similarly, the foreign government's willingness to move from point A to point D in Figure 1a induces no externality on the domestic country through the terms of trade, but it will involve a change in both the domestic and the foreign local price. If the domestic government also selects a tariff that is politically optimal, however, then this small change in the domestic and the foreign local price will not alter the domestic welfare to the first order. In sum, when governments adopt politically optimal tariffs, they are not motivated to impose terms-of-trade externalities on one another, and the international externalities associated with local-price movements are eliminated. We thus now have a general perspective as to why politically optimal tariffs are efficient.

Building from this perspective, let us now suppose that the domestic government chooses its export tax mindful of the terms-of-trade externality associated with movements in the world price (i.e., the movement from D to C in Figure 1b). It then recognizes that some of the costs of achieving the lower domestic and higher foreign local prices are shifted on to the foreign country through the resulting increase in the world price. As a result, the domestic government can be expected to choose a higher export tax (i.e., restrict trade volume more) than is jointly efficient. An analogous observation applies to the foreign government. This explains why Nash trade policies are always inefficient, with trade volumes that are necessarily too low. The broad conclusion that emerges is therefore that an inefficiency arises when governments set trade policies unilaterally if and only if they are motivated by terms-of-trade considerations, exactly as in the case of competitive markets analyzed in Bagwell and Staiger (1999, 2001).

2.5 The Rationale for a Trade Agreement

We can now explicitly consider the rationale for a trade agreement in the model with export-sector monopoly power. To this end, we extend the model slightly beyond the single-good setting 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. The partial-equilibrium model can then be closed to achieve general equilibrium in the usual way with the addition of a traded numeraire good z that enters linearly into the welfare of each country and

[15] Recall that $W^*_{P^*} = 0$ when the foreign government sets its politically optimal tariff. As we discuss above, the foreign country's politically optimal tariff is thus free trade, which ensures that the area Z in Figure 2a is eliminated.

which is always consumed in positive amounts by the representative agent of each country.

Within this extended 3-good setting, if governments set their unilateral policies so as to maximize the welfare of their respective countries, 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 return to the single-good setting and now allow that the domestic government may value profit more heavily than consumer surplus and tariff revenue. Formally, we suppose that the domestic government maximizes the political-economic welfare function

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

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

$$W(P, P^*, P^w; \gamma) = \gamma[P - c_o]D(P) + CS(P) + \gamma[P - c_o]D^*(P^*) + [P^w - P]D^*(P^*). \qquad (9)$$

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 there.

A key observation from (9) 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:

$$J(P, P^*; \gamma) = W(P, P^*, P^w; \gamma) + W^*(P, P^*). \qquad (10)$$

We may define efficient tariffs relative to $J(P, P^*; \gamma)$ as those satisfying the conditions in (6), and

Nash and politically optimal tariffs relative to $W(P, P^*, P^w; \gamma)$ and $W^*(P, P^*)$ as those respectively satisfying (4) and (8). Exactly as before, we may then show that Nash tariffs are inefficient, while 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.[16]

Notice the important role played by both import and export policies for this conclusion. 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.[17] Therefore, 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). 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.[18]

We summarize the results of this section as follows:

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.*

2.6 Reciprocity

An important implication of Proposition 1 is that, for the model with export-sector market power, just as in the competitive benchmark model, a trade agreement that is founded on the principle of

[16] Bagwell and Staiger (2002, Ch. 9) present a related result in a general equilibrium 2-country trade model where imperfectly competitive production takes place in the import-competing sector of one of the countries.

[17] 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 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.

[18] To be clear, what is required for the efficiency of the political optimum is that each country has a complete set of import and export tax instruments, *not* that each country has a complete set of (trade and domestic) tax instruments with which to achieve the first best.

reciprocity can guide governments from their inefficient unilateral policies to the efficiency frontier. To establish this implication, we follow Bagwell and Staiger (1999, 2001) and define tariff changes that conform to *reciprocity* as those that bring about equal changes in the volume of each country's imports and exports when valued at existing world prices.

Working within the 3-good general equilibrium interpretation of the model described above, taking account of trade in the numeraire good, denoting by t_y and t_y^* the domestic and foreign trade taxes on domestic exports of good y (with associated tariff sum τ_y) and by t_x and t_x^* the domestic and foreign trade taxes on foreign exports of good x (with associated tariff sum τ_x), and letting a superscript "0" denote original trade tax levels and a superscript "1" denote new trade tax levels, it is direct to establish that tariff changes conforming to reciprocity must satisfy[19]

$$[P_y^w(t_y^0, t_y^{*0}) - P_y^w(t_y^1, t_y^{*1})] \cdot D_y^*(P_y^*(\tau_y^1)) = [P_x^w(t_x^0, t_x^{*0}) - P_x^w(t_x^1, t_x^{*1})] \cdot D_x(P_x(\tau_x^1)), \qquad (11)$$

where we now distinguish between goods x and y by adding subscripts to prices and demand functions as well. According to (11), tariff changes that conform to reciprocity imply either that (i) all world prices are left unchanged as a result of the tariff changes, or (ii) world prices are altered in a net-revenue neutral fashion, so that there exists an alternative set of tariff changes which would preserve all local prices at their new levels but restore all world prices to their original levels, and which would therefore leave each country indifferent between the original tariff changes and this alternative.[20] Either way, it is clear that there can be no pure international rent shifting across countries as a result of tariff changes that conform to reciprocity. And it is also clear that we can, henceforth and without loss of generality, equate tariff changes that conform to reciprocity in this setting with tariff changes that leave world prices unaltered.

We are now prepared to interpret and evaluate the principle of reciprocity. To this end, we again focus on the domestic export good and thus return to our original (single-good-setting) notation. As just established, tariff changes that conform to reciprocity leave the world price of this good unaltered and thus affect domestic and foreign welfare through the induced changes in local prices.

We make two observations.[21] First, starting at the Nash equilibrium, the domestic and foreign

[19] The steps to derive (11) employ the balanced trade condition that must hold at the original and the new world prices, and are identical to those described in note 19 of Bagwell and Staiger (2001).

[20] Point (ii) can be confirmed as follows. Consider the home country. Observe first that there exists an alternative set of new trade taxes, denoted by the superscript "$1'$," for which $\tau_y^{1'} = \tau_y^1$ and $\tau_x^{1'} = \tau_x^1$ and so $P_y^*(\tau_y^{1'}) = P_y^*(\tau_y^1)$ and $P_x(\tau_x^{1'}) = P_x(\tau_x^1)$ but where $P_y^w(t_y^{1'}, t_y^{*1'}) = P_y^w(t_y^0, t_y^{*0})$ and $P_x^w(t_x^{1'}, t_x^{*1'}) = P_x^w(t_x^0, t_x^{*0})$, and that under these alternative new trade taxes the reciprocity condition (11) is met. It remains to confirm that the net trade tax revenue collected by the home country is the same under either set of new trade taxes. To conserve notation, we now suppress tariff arguments and let a superscript "0" on a price denote that price as a function of original trade tax levels, and let a superscript "1" on a price denote that price as a function of new trade tax levels, and let a superscript "$1'$" on a price denote that price as a function of alternative new trade tax levels. Now observe that domestic net revenue under the new tariffs is given by $[P_x^1 - P_x^{w1}]D_x(P_x^1) - [P_y^1 - P_y^{w1}]D_y^*(P_y^{*1})$, while under the alternative set of new tariffs it is given by $[P_x^1 - P_x^{w0}]D_x(P_x^1) - [P_y^1 - P_y^{w0}]D_y^*(P_y^{*1})$, and hence domestic net revenue under the two sets of new trade taxes will be the same if and only if $[P_y^{w0} - P_y^{w1}]D_y^*(P_y^{*1}) = [P_x^{w0} - P_x^{w1}]D_x(P_x^1)$. But this condition is guaranteed by the reciprocity condition (11). An analogous argument holds for the foreign country.

[21] These two observations mirror the two ways in which the principle of reciprocity finds representation in the GATT/WTO. See Bagwell and Staiger (1999, 2001, 2002) for more on the role of reciprocity in the GATT/WTO.

countries must both gain from a small reduction in trade taxes that satisfies reciprocity. Beginning from Nash policies, a small reduction in domestic trade taxes that is reciprocated by a reduction in foreign trade taxes leaves the world price unaltered and thus impacts domestic welfare according to $-[1-\frac{\partial P^w/\partial t}{\partial P^w/\partial t^*}][W_P\frac{dP}{d\tau}+W_{P^*}\frac{dP^*}{d\tau}]$, where the first term in brackets is positive under our assumptions.[22] Referring now to the top condition in (4) and using $W_{P^w}\frac{\partial P^w}{\partial t}=D^*(P^*)\frac{\partial P^w}{\partial t}>0$, we see that $-[W_P\frac{dP}{d\tau}+W_{P^*}\frac{dP^*}{d\tau}]>0$ at the Nash policies. We thus conclude that the domestic country must gain from this reciprocal trade liberalization. Similarly, if we begin at Nash policies and consider a small reduction in foreign trade taxes that is reciprocated by a reduction in domestic trade taxes, then the impact on foreign welfare is given by $-[1-\frac{\partial P^w/\partial t^*}{\partial P^w/\partial t}][W^*_{P^*}\frac{dP^*}{d\tau}]$, where the first bracketed term is again positive under our assumptions. We may now refer to the bottom condition in (4) and use $W^*_{P^w}\frac{\partial P^w}{\partial t^*}=-D^*(P^*)\frac{\partial P^w}{\partial t^*}>0$ in order to conclude that $-[W^*_{P^*}\frac{dP^*}{d\tau}]>0$ at the Nash policies. Thus, the foreign country must also gain.

Second, if countries negotiate to the political optimum, then neither country has an interest in unilaterally raising its trade tax if it is understood that such an act would be met with a reciprocal action from its trading partner. To confirm this observation, let us begin at the politically optimal policies. A small increase in domestic trade taxes that is reciprocated by an increase in foreign trade taxes impacts domestic welfare according to $[1-\frac{\partial P^w/\partial t}{\partial P^w/\partial t^*}][W_P\frac{dP}{d\tau}+W_{P^*}\frac{dP^*}{d\tau}]$. At the political optimum, however, the top condition in (8) ensures that $W_P\frac{dP}{d\tau}+W_{P^*}\frac{dP^*}{d\tau}=0$. Thus, the domestic country cannot gain from a small tariff increase that is met by a reciprocal response from the foreign country. Likewise, beginning from politically optimal policies, a small increase in foreign trade taxes that is reciprocated by an increase in domestic trade taxes impacts foreign welfare according to $[1-\frac{\partial P^w/\partial t^*}{\partial P^w/\partial t}][W^*_{P^*}\frac{dP^*}{d\tau}]$. But the bottom condition in (8) implies that $W^*_{P^*}\frac{dP^*}{d\tau}=0$ at the political optimum. Hence, the foreign country cannot gain from a small tariff increase that is met by a reciprocal response from the domestic country.

Each of these observations holds as well when political-economy forces are present. Hence, the terms-of-trade Prisoners' Dilemma problem that characterizes the Nash inefficiency in the model with export-sector market power – like the competitive benchmark model – provides a foundation for understanding why a trade agreement that is founded on the principle of reciprocity can guide governments from their inefficient unilateral policies to the efficiency frontier. We summarize with:

Corollary 1 *In the model with export-sector monopoly power, and for governments with or without political-economic preferences, the principle of reciprocity serves to "undo" the terms-of-trade driven restrictions in trade volume that occur when governments pursue unilateral trade policies.*

3 Trade Policies and Profit-Shifting

In the previous section, we considered import and export policies when market power exists on one side of any trade. In this section, we consider two-sided market power. In particular, we

[22] To derive this expression, we recall that P and P^* are functions of τ (and hence t and t^*), and we observe that a reciprocal reduction in t and t^* preserves the world price if and only if $dt^*/dt=-[\partial P^w/\partial t]/[\partial P^w/\partial t^*]$.

analyze a model 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 feature the case in which the domestic and foreign markets are integrated. Firms then cannot price discriminate across the two markets and any difference in prices across the two markets thus derives from trade policies. The case of segmented markets is again considered in the Appendix.

3.1 Basic Assumptions

We extend the model of the previous section by now introducing a foreign firm that competes for sales with the domestic firm according to Cournot competition. We continue to feature the case in which markets are integrated, so that trade occurs in only one direction, and we assume that the foreign firm faces import competition from the domestic firm for sales in the foreign market. With the domestic firm exporting to the foreign country, it follows that the relationship between P and P^* implied by market integration is again given by $P^* = P + \tau$, where recall that τ represents the total tariff $t + t^*$ which we again assume to be non-prohibitive; and we again define the world price as $P^w = P + t = P^* - t^*$. As before, we continue to represent domestic and foreign demands with the downward-sloping and positive functions $D(P)$ and $D^*(P^*)$ respectively.

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 $P^* = P + \tau$ through the (integrated) market-clearing condition

$$q + q^* = D(P) + D^*(P + \tau). \tag{12}$$

Using this market-clearing condition, we may define $P(q+q^*, \tau)$ or equivalently $P(Q, \tau)$ 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 $P^*(Q, \tau) \equiv P(Q, \tau)+\tau$. Given our assumption of downward-sloping demand functions, we can easily show that $P(Q, \tau)$ is decreasing in both Q and the total tariff τ. Intuitively, when the total tariff is raised, the foreign price is directly elevated and aggregate demand (i.e., the right-hand side of (12)) is thus reduced. Market-clearing can be restored only when 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:

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

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:

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

where we use $P(\cdot)$ to denote $P(q + q^*, \tau)$ 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 τ.[23] Since $P(\cdot)$ is decreasing in Q, it thus follows that the markup for the domestic firm is positive: $P(\cdot) > c_o$.

Similarly, for given tariffs 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:

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

The first-order condition that defines the foreign firm's optimal output choice is:

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

where we use $P^*(\cdot)$ to denote $P^*(q + q^*, \tau)$ to reduce notation. The foreign-firm reaction function is derived from this equation and indicates the profit-maximizing quantity choice for the foreign firm for given values of q and τ.[24] Since $P^*(\cdot)$ is decreasing in Q, it thus follows that the markup for the foreign firm is also positive: $P^*(\cdot) > c_o^*$.

At the Nash equilibrium of the Cournot game, the domestic and foreign firms are on their respective reaction curves. Let $q^N(\tau)$ denote the Cournot-Nash output choice of the domestic firm and $q^{*N}(\tau)$ denote the Cournot-Nash output choice of the foreign firm. We can then represent the total output in the Cournot equilibrium as $Q^N(\tau) \equiv q^N(\tau) + q^{*N}(\tau)$. From here, we may define the Cournot-Nash prices as functions of the tariffs. Specifically, let $P^N(\tau) \equiv P(Q^N(\tau), \tau)$, $P^{*N}(\tau) \equiv P^N(\tau) + \tau$, and $P^{wN}(t, t^*) \equiv P^N(\tau) + t = P^{*N}(\tau) - t^*$ 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 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.[25] 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 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

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

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

[25] All of the properties described in this section hold, for example, if the domestic and foreign demand functions are linear and model parameters are such that an exporting firm sells in both markets.

reaction functions, we anticipate that an increase in the total tariff may cause $q^N(\tau)$ to decrease and $q^{*N}(\tau)$ 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, $P^{*N}(\tau)$, and decrease the Cournot-Nash domestic price, $P^N(\tau)$. In the discussion that follows, we assume that P^{*N} rises and P^N falls with the total tariff. Finally, note that our assumptions ensure that the world price, $P^{wN}(t, t^*)$, 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.[26]

3.2 Welfare Functions

To understand the welfare functions, we begin by considering an experiment in which t is increased and t^* is decreased to an equal degree so that the total tariff τ 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 examine 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 $\tau = P^{*N} - P^N$, where to ease the notational burden we now suppress the dependence of the Cournot-Nash prices on the total tariff. We next may write $q^{*N}(\tau) = q^{*N}(P^{*N} - P^N)$ 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

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

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

$$W(P^N, P^{*N}, P^{wN}) = [P^N - c_o]D(P^N) + CS(P^N) + [P^{wN} - c_o][D^*(P^{*N}) - q^{*N}(P^{*N} - P^N)]. \quad (13)$$

[26] 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 third term in (13) can now be understood as "true" exporting profit for the domestic country. 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:

$$W^*(P^{*N}, P^N, P^{wN}) = CS^*(P^{*N}) + [P^{*N} - c_o^*]q^{*N}(P^{*N} - P^N) + [P^{*N} - P^{wN}][D^*(P^{*N}) - q^{*N}(P^{*N} - P^N)]. \tag{14}$$

Foreign country welfare is thus the sum of foreign consumer surplus, foreign profit and tariff revenue enjoyed on imported units. Notice from (14) 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 explain above.

3.3 Nash and Efficient Tariffs

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:

$$\begin{aligned} W_{P^N}\frac{dP^N}{d\tau} + W_{P^{*N}}\frac{dP^{*N}}{d\tau} + W_{P^{wN}}\frac{\partial P^{wN}}{\partial t} &= 0, \text{ and} \\ W^*_{P^N}\frac{dP^N}{d\tau} + W^*_{P^{*N}}\frac{dP^{*N}}{d\tau} + W^*_{P^{wN}}\frac{\partial P^{wN}}{\partial t^*} &= 0, \end{aligned} \tag{15}$$

where once again we use the fact that $\frac{d\tau}{dt} = 1 = \frac{d\tau}{dt^*}$. Thus, 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 and hence τ, 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^* and hence τ, 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 be any other sources of inefficiency? To address this question, we express joint welfare as

$$\begin{aligned} J(P^N, P^{*N}) &\equiv W(P^N, P^{*N}, P^{wN}) + W^*(P^{*N}, P^N, P^{wN}) \\ &= [P^N - c_o]D(P^N) + CS(P^N) + [P^{*N} - c_o][D^*(P^{*N}) - q^{*N}(P^{*N} - P^N)] \\ &\quad + CS^*(P^{*N}) + [P^{*N} - c_o^*]q^{*N}(P^{*N} - P^N). \end{aligned} \tag{16}$$

As (16) indicates, joint welfare can thus be understood as capturing domestic country producer and consumer surplus on units sold domestically, domestic (pre-tax) 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. Recalling that the world price cancels from the joint welfare expression, and that the local prices P^N and P^{*N} depend only on the tariff sum τ, it follows as before that efficiency only ties down the sum of the two tariffs. The corresponding first-order condition that defines efficient choices of t and t^* is thus given by:

$$W_{P^N}\frac{dP^N}{d\tau}+W_{P^{*N}}\frac{dP^{*N}}{d\tau}+W^*_{P^{*N}}\frac{dP^{*N}}{d\tau}+W^*_{P^N}\frac{dP^N}{d\tau}=0. \tag{17}$$

As before, efficiency requires only that t and t^* be chosen so that the total tariff τ satisfies (17).

We next confirm that the Nash tariff choices are inefficient. To this end, we add the two Nash conditions in (15) to obtain

$$\begin{aligned} & W_{P^N}\frac{dP^N}{d\tau}+W_{P^{*N}}\frac{dP^{*N}}{d\tau}+W^*_{P^{*N}}\frac{dP^{*N}}{d\tau}+W^*_{P^N}\frac{dP^N}{d\tau} \\ = \; & [D^*(P^{*N})-q^{*N}(P^{*N}-P^N)][\frac{\partial P^{wN}}{\partial t^*}-\frac{\partial P^{wN}}{\partial t}]<0, \end{aligned} \tag{18}$$

where we use (13) and (14) to impose that $W_{P^{wN}}=D^*(P^{*N})-q^{*N}(P^{*N}-P^N)=-W^*_{P^{wN}}$. The inequality in (18) then follows from our assumption that P^{wN} rises with t and falls with t^*. Assuming that the second-order condition for joint-welfare maximization holds, we may now compare (17) and (18) to conclude that the sum of Nash tariffs is higher than is efficient. Consequently, in the Nash equilibrium, the volume of trade $(D^*(P^{*N})-q^{*N}(P^{*N}-P^N))$ is lower than is efficient.

3.4 Politically Optimal Tariffs and the Rationale for a Trade Agreement

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

$$\begin{aligned} W_{P^N}\frac{dP^N}{d\tau}+W_{P^{*N}}\frac{dP^{*N}}{d\tau} &= 0, \text{ and} \\ W^*_{P^{*N}}\frac{dP^{*N}}{d\tau}+W^*_{P^N}\frac{dP^N}{d\tau} &= 0. \end{aligned} \tag{19}$$

As (19) 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 reduce 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 balances the beneficial effect on profit of greater production by the foreign firm against 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 (17) and the definition of politically optimal tariffs in (19) 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, 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. Thus, as a general matter, there exist local-price international externalities that are associated with profit shifting. We note further that 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.

Let us now recall that each government has a trade policy instrument with which to affect local prices and achieve a balance between benefits and costs. In particular, 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. In addition to an analysis of segmented markets which we provide in the Appendix, 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.

We summarize the results of this section as follows:

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.*

3.5 Reciprocity

Like Proposition 1 for the model with export-sector market power, Proposition 2 carries with it an important implication: in the duopoly profit-shifting model, just as in the competitive benchmark model, a trade agreement that is founded on the principle of reciprocity can guide governments from their inefficient unilateral policies to the efficiency frontier. This implication can be established with identical steps to those taken in the context of the model with export-sector market power that we analyze in the previous section.

Specifically, we may consider a 3-good general-equilibrium interpretation of the duopoly profit-shifting model, where good y is exported from the domestic country to the foreign country as above, good x is a mirror-image good that is exported in the opposite direction, and the third good is a traded numeraire good. Using identical arguments to those described in the previous section, we may establish that tariff changes that conform to reciprocity as defined in (11) can be equated with tariff changes that leave world prices unaltered. But this means that starting at the Nash equilibrium, the domestic and foreign countries must both gain from a small reduction in trade taxes that satisfies reciprocity.[27] Moreover, if countries negotiate to the political optimum, then neither country has an interest in unilaterally raising its trade tax if it is understood that such an act would be met with a reciprocal action from its trading partner.[28] Each of these observations holds as well when political-economy forces are present.

Hence, the terms-of-trade Prisoners' Dilemma problem that characterizes the Nash inefficiency in the duopoly profit-shifting model – like the competitive benchmark model – provides a foundation for understanding why a trade agreement that is founded on the principle of reciprocity can guide governments from their inefficient unilateral policies to the efficiency frontier. We summarize this discussion as follows:

Corollary 2 *In the duopoly profit-shifting model, and for governments with or without political-economic preferences, the principle of reciprocity serves to "undo" the terms-of-trade driven restrictions in trade volume that occur when governments pursue unilateral trade policies.*

[27] To see why, recall that tariff changes that conform to reciprocity leave world prices unaltered. This means that, beginning from Nash policies, a small reduction in domestic trade taxes that is reciprocated by a reduction in foreign trade taxes impacts domestic welfare according to $-[1-\frac{\partial P^{wN}/\partial t}{\partial P^{wN}/\partial t^*}][W_{P^N}\frac{dP^N}{d\tau}+W_{P^{*N}}\frac{dP^{*N}}{d\tau}]$, where the first term in brackets is positive under our assumptions. Referring now to the top condition in (15) and using $W_{P^{wN}}\frac{\partial P^{wN}}{\partial t}=[D^*(P^{*N})-q^{*N}(P^{*N}-P^N)]\frac{\partial P^{wN}}{\partial t}>0$, we see that $-[W_{P^N}\frac{dP^N}{d\tau}+W_{P^{*N}}\frac{dP^{*N}}{d\tau}]>0$ at the Nash policies. We thus conclude that the domestic country must gain from a small amount of trade liberalization that conforms to reciprocity. Similarly, if we begin at Nash policies and consider a small reduction in foreign trade taxes that is reciprocated by a reduction in domestic trade taxes, then the impact on foreign welfare is given by $-[1-\frac{\partial P^{wN}/\partial t^*}{\partial P^{wN}/\partial t}][W^*_{P^N}\frac{dP^N}{d\tau}+W^*_{P^{*N}}\frac{dP^{*N}}{d\tau}]$, where the first term in brackets is positive under our assumptions. We may now refer to the bottom condition in (15) and use $W^*_{P^{wN}}\frac{\partial P^{wN}}{\partial t^*}=-[D^*(P^{*N})-q^{*N}(P^{*N}-P^N)]\frac{\partial P^{wN}}{\partial t^*}>0$ in order to conclude that $-[W^*_{P^N}\frac{dP^N}{d\tau}+W^*_{P^{*N}}\frac{dP^{*N}}{d\tau}]>0$ at the Nash policies. Thus, the foreign country must also gain from a small amount of trade liberalization that conforms to reciprocity.

[28] To confirm this observation, let us begin at the politically optimal policies. A small increase in domestic trade taxes that is reciprocated by an increase in foreign trade taxes impacts domestic welfare according to $[1-\frac{\partial P^{wN}/\partial t}{\partial P^{wN}/\partial t^*}][W_{P^N}\frac{dP^N}{d\tau}+W_{P^{*N}}\frac{dP^{*N}}{d\tau}]$. At the political optimum, however, the top condition in (19) ensures that $W_{P^N}\frac{dP^N}{d\tau}+W_{P^{*N}}\frac{dP^{*N}}{d\tau}=0$. Thus, the domestic country cannot gain from a small tariff increase that is met by a reciprocal response from the foreign country. Likewise, beginning from politically optimal policies, a small increase in foreign trade taxes that is reciprocated by an increase in domestic trade taxes impacts foreign welfare according to $[1-\frac{\partial P^{wN}/\partial t^*}{\partial P^{wN}/\partial t}][W^*_{P^{*N}}\frac{dP^{*N}}{d\tau}+W^*_{P^N}\frac{dP^N}{d\tau}]$. But the bottom condition in (19) implies that $W^*_{P^{*N}}\frac{dP^{*N}}{d\tau}+W^*_{P^N}\frac{dP^N}{d\tau}=0$ at the political optimum. Hence, the foreign country cannot gain from a small tariff increase that is met by a reciprocal response from the domestic country.

4 Strategic Export Policies in Third-Country Models

We now consider the role of a trade agreement in a "third-country model," in which 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 exporters from different countries compete.

4.1 Basic Assumptions

We suppose that 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. We allow as well that government C has available an import policy, where t_C^A and t_C^B represent the possibly discriminatory specific import tariffs that country C applies to imports from countries A and B, respectively.

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 as above we assume that this function is downward sloping and positive. Along any channel of trade, any difference between export and consumption prices is attributable to the trade taxes imposed along that channel. Defining $\tau^A \equiv t_A + t_C^A$ and $\tau^B \equiv t_B + t_C^B$, we thus have $P_C - P_A = \tau^A$ and $P_C - P_B = \tau^B$. 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_o denote the common marginal cost of production for firms A and B. When firm A conjectures that firm B's output choice is q_B, firm A's best response is the output level q_A that maximizes

$$[P_C(q_A + q_B) - c_o - \tau^A]q_A.$$

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

$$[P_C(q_A + q_B) - c_o - \tau^B]q_B.$$

Firm B's reaction function is denoted $q_B^R(q_A; \tau^B)$.[29] As in previous sections, the first-order conditions for profit-maximization ensure that the resulting price exceeds the marginal cost of production

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

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. Quantities are then said to be "strategic substitutes," and we focus on this case in what follows.

The Cournot-Nash equilibrium is a pair of quantities, $q_A^N(\tau^A, \tau^B)$ and $q_B^N(\tau^A, \tau^B)$, at which the reaction functions intersect. We assume the existence of a unique and stable Cournot-Nash equilibrium.[30] Each firm's Cournot-Nash quantity is then decreasing in the total tariff that it confronts and increasing in the total tariff that its rival confronts. For example, if the total tariff τ^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. Similarly, if firm A were to face a lower total tariff, then the new equilibrium would entail 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 would fall. 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 $Q^N(\tau^A, \tau^B) \equiv q_A^N(\tau^A, \tau^B) + q_B^N(\tau^A, \tau^B)$. Under our stability assumption, total output falls when the total tariff along any channel rises. Thus, Q^N is decreasing in τ^A and τ^B. Intuitively, when the total tariff τ^A 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 $P_C^N(\tau^A, \tau^B) = P_C(Q^N(\tau^A, \tau^B))$, then we may conclude that P_C^N is increasing in τ^A and τ^B. Given our focus on 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: $\partial P_C^N / \partial \tau^A < 1$ and $\partial P_C^N / \partial \tau^B < 1$.

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 τ^A and τ^B in the following respective manners:

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

The local price in country A decreases as τ^A rises, since the associated rise in the price in country C is not one-for-one. Similarly, an increase in τ^B results in a decrease in the local price in country B. Finally, an increase in τ^A raises the local price in country C and thereby also raises the local price in country B; an analogous effect extends to the local price in country A when τ^B is raised.

[30] On a graph with q_A on the y axis and q_B on the x axis, stability means that firm B's reaction function is steeper than is firm A's reaction function.

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

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

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

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

Notice that any difference between the world prices is completely driven by country C's tariff discrimination: $P_A^{wN}(t_A, t_C^A, t_B, t_C^B) - P_B^{wN}(t_A, t_C^A, t_B, t_C^B) = t_C^B - t_C^A$. 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, $P_A^{wN}(t_A, t_C^A, t_B, t_C^B)$ is decreasing in t_C^A, and similarly $P_B^{wN}(t_A, t_C^A, t_B, t_C^B)$ 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 $P_A^{wN}(t_A, t_C^A, t_B, t_C^B)$ increase. Likewise, an increase in t_B results in an increase in $P_B^{wN}(t_A, t_C^A, t_B, t_C^B)$. 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.

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, $\tau^A = P_C^N - P_A^N$ and $\tau^B = P_C^N - P_B^N$. 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 τ and hence the local-price difference between countries A and C, and thereby alter the quantities produced by firms A and B. For instance, if government A moves from free trade to an export subsidy, then 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 τ) 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 shift profits operates independently of any motivation to manipulate the terms of trade.

4.2 Welfare Functions

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

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

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. The associated tariff revenue, however, amounts to a transfer from the profit of firm A to country A's treasury. Such a transfer is welfare neutral. This accounts for the manner in which the welfare expression is simplified in the equation above. National welfare for country B may be represented in a similar manner.

For our purposes, it is most useful to represent government welfares as functions of local and world prices. We observe that government A's welfare function may be represented as

$$W_A(P_A^N, P_B^N, P_C^N, P_A^{wN}) = [P_A^{wN} - c_o]q_A^N(P_C^N - P_A^N, P_C^N - P_B^N), \tag{20}$$

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

$$W_B(P_A^N, P_B^N, P_C^N, P_B^{wN}) = [P_B^{wN} - c_o]q_B^N(P_C^N - P_A^N, P_C^N - P_B^N). \tag{21}$$

Finally, welfare in country C is given as

$$\begin{aligned} & W_C(P_A^N, P_B^N, P_C^N, P_A^{wN}, P_B^{wN}) \qquad (22) \\ = \;& CS(P_C^N) + [P_C^N - P_A^{wN}]q_A^N(P_C^N - P_A^N, P_C^N - P_B^N) + [P_C^N - P_B^{wN}]q_B^N(P_C^N - P_A^N, P_C^N - P_B^N). \end{aligned}$$

Thus, country C welfare is the sum of consumer surplus and the tariff revenue received from each bilateral trading relationship.

With the welfare functions represented in this way, we can identify the precise paths through which externalities are transmitted across countries. Suppose, for example, that government A contemplates a move from free trade to an export subsidy. 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, $P_A^{wN} - c_o$, 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, $P_B^{wN} - c_o$. 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.

4.3 Nash and Efficient Tariffs

When a trade agreement is not in place, governments select their policies unilaterally, and a Nash equilibrium thus obtains. The Nash tariff policies may be represented as t_A^N, t_B^N, t_C^{AN} and t_C^{BN}. Given the symmetric structure of the model and under appropriate concavity conditions, the unique Nash equilibrium is symmetric. We thus assume here that a symmetric Nash equilibrium exists and focus on that equilibrium in what follows. In a symmetric Nash equilibrium, governments A and B adopt the same export policies, $t_A^N = t_B^N$, and government C's optimal import policy is symmetric as well, $t_C^{AN} = t_C^{BN}$. Thus, one implication of our symmetric model is that government C's import policy respects the principle of non-discrimination in the Nash equilibrium. Consequently, world prices in the Nash equilibrium do not differ across trade channels: $P_A^{wN} = P_B^{wN}$.

Using the symmetric structure of the model and noting that $\frac{d\tau^A}{dt_A} = 1 = \frac{d\tau^A}{dt_A^C}$, the Nash equilibrium tariffs, $t_A^N = t_B^N$ and $t_C^{AN} = t_C^{BN}$, are defined by the following two equations:

$$\begin{aligned} \sum_{j=A,B,C}[\frac{\partial W_A}{\partial P_j^N}\frac{\partial P_j^N}{\partial \tau^A}] + \frac{\partial W_A}{\partial P_A^{wN}}\frac{\partial P_A^{wN}}{\partial t_A} &= 0 \\ \sum_{j=A,B,C}[\frac{\partial W_C}{\partial P_j^N}\frac{\partial P_j^N}{\partial \tau^A}] + \frac{\partial W_C}{\partial P_A^{wN}}\frac{\partial P_A^{wN}}{\partial t_C^A} + \frac{\partial W_C}{\partial P_B^{wN}}\frac{\partial P_B^{wN}}{\partial t_C^A} &= 0. \end{aligned} \tag{23}$$

The first equation in (23) gives the first-order condition for government A's selection of its import tariff, t_A. As the equation confirms, and as discussed above, government A is mindful of the effect of its import tariff on local prices and its terms of trade, P_A^{wN}. The second equation in (23) provides the first-order condition for government C's selection of the import tariff, t_C^A, that it applies to exports from country A. Government C is mindful of the effect of its import tariff on local prices and its bilateral terms of trade, P_A^{wN} and P_B^{wN}.

Utilizing the structure of the model, we find that the conditions in (23) can be rewritten as

$$\begin{aligned} [P_A^{wN} - c_o]\frac{\partial q_A^N}{\partial \tau^A} + q_A^N\frac{\partial P_A^{wN}}{\partial t_A} &= 0 \\ [P_C^N - P_A^{wN}]\frac{\partial q_A^N}{\partial \tau^A} + [P_C^N - P_B^{wN}]\frac{\partial q_B^N}{\partial \tau^A} - q_A^N\frac{\partial P_A^{wN}}{\partial t_C^A} - q_B^N\frac{\partial P_B^{wN}}{\partial t_C^A} &= 0, \end{aligned} \tag{24}$$

where the corresponding Nash first-order conditions for t_B and t_C^B are exactly symmetric.

We now characterize the Nash trade policies. We begin by considering the first condition in (24). Under the assumptions presented above, we have that $\partial q_A^N/\partial \tau^A < 0 < \partial P_A^{wN}/\partial t_A$. With $q_A^N > 0$ at the Nash trade policies, we thus conclude from this first condition that $P_A^{wN} = P_B^{wN} > c_o$. Consider now the second condition in (24). Since $P_A^{wN} = P_B^{wN}$ and $q_A^N = q_B^N$ at the Nash trade policies, we may rewrite this second condition as

$$[P_C^N - P_A^{wN}]\frac{\partial Q^N}{\partial \tau^A} - q_A^N[\frac{\partial P_A^{wN}}{\partial t_C^A} + \frac{\partial P_B^{wN}}{\partial t_C^A}] = 0, \tag{25}$$

where $\partial Q^N/\partial \tau^A < 0$ under the assumptions presented above. We now strengthen our assumptions slightly and assume that, starting at the Nash equilibrium, $P_A^{wN} + P_B^{wN}$ decreases when t_C^A is raised. Under this assumption, when governments start at the Nash equilibrium, if government C were to raise slightly the tariff that it applies to goods imported from country A, then the direct effect of its bilateral terms-of-trade gain on its trading relationship with country A would dominate the indirect effect of its bilateral terms-of-trade loss on its trading relationship with country B. Intuitively, and as we confirm below when we define country C's multilateral terms of trade for general tariffs, this assumption ensures that country A enjoys an overall terms-of-trade gain when it slightly increases one import tariff above its Nash level. With this assumption in place, we thus conclude from (25) that $P_C^N > P_A^{wN} = P_B^{wN}$ at the Nash trade policies. Combining our findings, we have thus now established that $P_C^N > c_o$ at the Nash trade policies.

We next characterize the joint welfare of the three governments. Using the welfare expressions (20)-(22) presented above, we 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}. Since the Nash trade policies are motivated by world-price considerations, we thus have an immediate perspective regarding the inefficiency of Nash trade policies. To go further, we define joint welfare formally as

$$\begin{aligned} & J(P_A^N, P_B^N, P_C^N) \\ = \;& W_A(P_A^N, P_B^N, P_C^N, P_A^{wN}) + W_B(P_A^N, P_B^N, P_C^N, P_B^{wN}) + W_C(P_A^N, P_B^N, P_C^N, P_A^{wN}, P_B^{wN}), \end{aligned} \tag{26}$$

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:

$$\begin{aligned} & J(P_A^N, P_B^N, P_C^N) \\ = \;& [P_C^N - c_o]q_A^N(P_C^N - P_A^N, P_C^N - P_B^N) + [P_C^N - c_o]q_B^N(P_C^N - P_A^N, P_C^N - P_B^N) + CS(P_C^N). \end{aligned} \tag{27}$$

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. 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. We are thus led to evaluate the derivative of J with respect to the total tariff along each channel of trade. For simplicity, we focus on efficient policies in which both firms produce. Using (27), we find after some manipulation that the corresponding first-order conditions for efficiency are given by

$$\frac{dJ(P_A^N, P_B^N, P_C^N)}{d\tau^A} = [P_C^N - c_o]\frac{\partial q_A^N}{\partial \tau^A} + [P_C^N - c_o]\frac{\partial q_B^N}{\partial \tau^A} = 0 \tag{28}$$

and

$$\frac{dJ(P_A^N, P_B^N, P_C^N)}{d\tau^B} = [P_C^N - c_o]\frac{\partial q_A^N}{\partial \tau^B} + [P_C^N - c_o]\frac{\partial q_B^N}{\partial \tau^B} = 0. \tag{29}$$

Recalling that $\partial Q^N/\partial \tau^A < 0$ and $\partial Q^N/\partial \tau^B < 0$ hold under our assumptions, we may conclude from (28) and (29) that $P_C^N = c_o$ at any set of efficient tariffs.

Efficiency can be achieved when a symmetric total tariff is used along each trade channel. The efficient total tariff then entails a subsidy: $\tau^A = \tau^B \equiv \tau^E$ where $\tau^E < 0$ is determined so that $P_C^N(\tau^E, \tau^E) = c_o$.[31] Thus, a continuum of efficient trade policies exists, even when the total tariff is symmetric across trade channels. In total, the firms are 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 $t_A = t_B \equiv \tau^E$.

We now compare Nash and efficient policies. As we argue above, when trade policies are set at their Nash levels, the local price in country C exceeds the marginal cost of production, c_o. By contrast, when trade policies are set in an efficient manner, the local price in country C equals c_o. Since the demand curve in country C is downward sloping, it follows immediately that the volume of trade in the Nash equilibrium is inefficiently low. In other words, the total tariff is inefficiently high in the absence of a trade agreement.

4.4 Politically Optimal Tariffs and the Rationale for a Trade Agreement

We next identify the reason that the Nash tariffs are too high. To this end, we consider the politically optimal tariff policies. For simplicity, we focus on politically optimal tariffs in which both firms have positive production.

Consider first 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 thus represent the first-order condition for the determination of government A's politically optimal export policy as follows:

$$\sum_{j=A,B,C} [\frac{\partial W_A}{\partial P_j^N}\frac{\partial P_j^N}{\partial \tau^A}] = [P_A^{wN} - c_o]\frac{\partial q_A^N}{\partial \tau^A} = 0, \tag{30}$$

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

where the first equality follows after some manipulation. Using (30), we thus conclude that, in a political optimum, $P_A^{wN} = c_o$. 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 analogous calculation applies for government B. In particular, the first-order condition for government B's politically optimal export policy is given as:

$$\sum_{j=A,B,C}\left[\frac{\partial W_B}{\partial P_j^N}\frac{\partial P_j^N}{\partial \tau^B}\right] = [P_B^{wN} - c_o]\frac{\partial q_B^N}{\partial \tau^B} = 0. \tag{31}$$

Arguing as above, we may thus use (31) to conclude that, in a political optimum, $P_B^{wN} = c_o$.

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, 2001, 2005), we define country C's multilateral terms of trade as

$$T^N(P_A^N, P_B^N, P_C^N, P_A^{wN}, P_B^{wN}) = \frac{q_A^N(P_C^N - P_A^N, P_C^N - P_B^N)P_A^{wN} + q_B^N(P_C^N - P_A^N, P_C^N - P_B^N)P_B^{wN}}{Q^N(P_C^N - P_A^N, P_C^N - P_B^N)}. \tag{32}$$

Thus, 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 T^N falls and country C thus 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.

We now pause to consider the effect of an increase in t_C^A on country C's multilateral terms of trade, T^N. In particular, starting at the (symmetric) Nash equilibrium, we find that

$$\frac{\partial T^N}{\partial t_C^A} = \frac{q_A^N \frac{\partial (P_A^{wN} + P_B^{wN})}{\partial t_C^A}}{Q^N}.$$

Thus, starting at the Nash equilibrium, if $P_A^{wN} + P_A^{wN}$ decreases when t_C^A is slightly increased, then T^N falls. Accordingly, the assumption made above in our analysis of (25) indeed can be interpreted as an assumption that country C improves its multilateral terms of trade when it slightly increases one import tariff above the Nash level.

With a definition for country C's multilateral terms of trade now in hand, we may modify (22) slightly and express country C's welfare as

$$\begin{aligned} & W_C(P_A^N, P_B^N, P_C^N, T^N(P_A^N, P_B^N, P_C^N, P_A^{wN}, P_B^{wN})) \quad (33) \\ = \quad & CS(P_C^N) + P_C^N q_A^N(P_C^N - P_A^N, P_C^N - P_B^N) + P_C^N q_B^N(P_C^N - P_A^N, P_C^N - P_B^N) \\ & -Q^N(P_C^N - P_A^N, P_C^N - P_B^N) T^N(P_A^N, P_B^N, P_C^N, P_A^{wN}, P_B^{wN}), \end{aligned}$$

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, then 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 observe from (32) 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.

We are now prepared to present the first-order conditions that determine country C's politically optimal tariffs. These conditions are

$$\sum_{j=A,B,C} [\frac{\partial W_C}{\partial P_j^N} \frac{\partial P_j^N}{\partial \tau^A}] = [P_C^N - T^N] \frac{\partial Q^N}{\partial \tau^A} = 0 \quad (34)$$

and

$$\sum_{j=A,B,C} [\frac{\partial W_C}{\partial P_j^N} \frac{\partial P_j^N}{\partial \tau^B}] = [P_C^N - T^N] \frac{\partial Q^N}{\partial \tau^B} = 0, \quad (35)$$

where the simplified expressions follow after some manipulation. Referring to (34) and (35), we thus see that government C's politically optimal tariffs are realized when they are set so that $P_C^N = T^N$. Using (32), we next observe that $P_C^N = T^N$ if and only if

$$[P_C^N - P_A^{wN}] q_A^N + [P_C^N - P_B^{wN}] q_B^N = 0. \quad (36)$$

We observe from (36) that government C's political optimality requirement is achieved if it practices free trade on both goods so that $P_C^N = P_A^{wN} = P_B^{wN}$.

We next establish that any politically optimal tariff policy vector in which firms A and B both produce positive quantities must be efficient. Using (30) and (31), the political optimality conditions for governments A and B then are expressed as

$$P_A^{wN} = c_o = P_B^{wN}. \tag{37}$$

Using (36) and (37), the political optimality condition for government C becomes

$$P_C^N = c_o. \tag{38}$$

To complete the argument, we recall from above that (38) is also the condition that defines an efficient trade volume.

Our next task is to construct a politically optimal tariff vector that generates the prices required by (37) and (38). We observe first that $P_C^N = P_A^{wN} = P_B^{wN}$ holds if and only if government C adopts a policy of free trade: $t_C^A = t_C^B = 0$. Next, we observe that the local price in country C can be driven down to the cost of production when a symmetric total tariff is used that entails a subsidy: $\tau^A = \tau^B \equiv \tau^E$ where $\tau^E < 0$ is determined so that $P_C^N(\tau^E, \tau^E) = c_0$. 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 $t_A = t_B \equiv \tau^E < 0$. The constructed politically optimal tariff vector is necessarily efficient, and, indeed, we use exactly this policy vector above as an example of an efficient policy vector.

In sum, 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. We thus again conclude 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. As in the previous sections, our basic conclusion is also robust to an extension of the model in which governments have political-economic objectives. We thus now summarize as follows:

Proposition 3 *In the third-country model of strategic export policies, 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.*

4.5 Reciprocity and Non-discrimination

As with Propositions 2 and 1 before it, an important implication of Proposition 3 is that, for the third-country model of strategic export policies, just as in the competitive benchmark model, a trade agreement that is founded on the principle of reciprocity can guide governments from their inefficient unilateral policies to the efficiency frontier. Moreover, the 3-country feature of the third-country model permits an additional link to be forged with the competitive benchmark model: for both models, in a many-country world the attractive features of the principle of reciprocity obtain only when reciprocity is combined with the principle of non-discrimination (MFN). And so in the third-country model of strategic export policies, the dual principles of reciprocity and non-discrimination can be seen as simple rules that together aid countries in their effort to negotiate an escape from a terms-of-trade-driven Prisoners' Dilemma.

To establish these implications, we again follow Bagwell and Staiger (1999, 2001) and define tariff changes that conform to reciprocity as those that bring about equal changes in the volume of each country's imports and exports when valued at existing world prices. However, we now work within a 4-good general-equilibrium interpretation of the third-country model, in which (i) each of the three countries A, B and C is now the sole consumer of a good – a, b and c respectively – which is supplied by competing exporters from the other two countries, and (ii) a fourth numeraire good is freely traded among the three countries. For any non-numeraire good i, we denote by q^i_j the quantity of good i supplied by country j's firm. The demand for good i in country j is then denoted as D^i_j, where $D^i_j \equiv 0$ for all $j \neq i$.

When each country's import tariff satisfies MFN, the set of trade taxes may be denoted by t^i_j with $j \in \{A, B, C\}$ and $i \in \{a, b, c\}$, and a single world price for each of the non-numeraire goods obtains: $P^{wN}_a(t^a_A, t^a_B, t^a_C)$, $P^{wN}_b(t^b_A, t^b_B, t^b_C)$ and $P^{wN}_c(t^c_A, t^c_B, t^c_C)$. Taking account of trade in the numeraire good, and letting a superscript "0" denote magnitudes evaluated at original trade tax levels and a superscript "1" denote magnitudes evaluated at new trade tax levels, it can be shown (see note 19) that tariff changes conforming to MFN and reciprocity must satisfy

$$\begin{aligned}
[P^{wN0}_a - P^{wN1}_a]D^{a1}_A &= [P^{wN0}_b - P^{wN1}_b]q^{b1}_A + [P^{wN0}_c - P^{wN1}_c]q^{c1}_A, \\
[P^{wN0}_b - P^{wN1}_b]D^{b1}_B &= [P^{wN0}_a - P^{wN1}_a]q^{a1}_B + [P^{wN0}_c - P^{wN1}_c]q^{c1}_B, \quad \text{and} \\
[P^{wN0}_c - P^{wN1}_c]D^{c1}_C &= [P^{wN0}_a - P^{wN1}_a]q^{a1}_C + [P^{wN0}_b - P^{wN1}_b]q^{b1}_C.
\end{aligned} \tag{39}$$

According to (39), tariff changes that conform to reciprocity and MFN imply either that (i) all world prices are left unchanged as a result of the tariff changes, or (ii) world prices are altered in a net-revenue neutral fashion, so that there exists an alternative set of tariff changes which would preserve all local prices at their new levels but restore all world prices to their original levels, and which would therefore leave each country indifferent between the original tariff changes and this alternative.[32] Either way, it is clear that there can be no pure international rent shifting across countries as a result of tariff changes that conform to MFN and reciprocity. And it is also clear that we can again, henceforth and without loss of generality, equate tariff changes that conform to MFN and reciprocity with tariff changes that leave world prices unaltered.

Several observations now follow. First, starting at the (MFN) Nash equilibrium, all countries must gain from a small reduction in the level of their trade taxes that satisfies MFN and reciprocity.[33] Second, if countries negotiate to the political optimum, then no country has an interest

[32] Point (ii) can be confirmed with the same steps as those described in note 20.

[33] To see why, consider the Nash MFN import tariff that country C places on good c, which is defined by the

in unilaterally raising its MFN trade taxes if it is understood that such an act would be met with a reciprocal MFN action from its trading partners.[34] And third, a bilateral negotiation between any two countries which conforms to reciprocity and satisfies MFN insulates the third country from the effects of this negotiation: hence reciprocity and MFN together insure against third-party effects of bilateral trade liberalization.[35] Finally, it can be shown that each of these features requires that reciprocal tariff changes conform to MFN: neither reciprocity nor MFN without the other can deliver these points.[36]

Each of these observations holds as well when political-economy forces are present. Hence, the terms-of-trade Prisoners' Dilemma problem that characterizes the Nash inefficiency in the third-country model of strategic export policies – like the competitive benchmark model – provides a foundation for understanding why a trade agreement that is founded on the principles of reciprocity and non-discrimination (MFN) can guide governments from their inefficient unilateral policies to

first-order condition $\frac{\partial W_C}{\partial P_A^N}\frac{dP_A^N}{dt_C} + \frac{\partial W_C}{\partial P_B^N}\frac{dP_B^N}{dt_C} + \frac{\partial W_C}{\partial P_C^N}\frac{dP_C^N}{dt_C} + \frac{\partial W_C}{\partial P^{wN}}\frac{\partial P^{wN}}{\partial t_C} = 0$, where for notational ease we represent country C's MFN import tariff on good c as t_C and we suppress the good-c subscript on all prices. Recalling that tariff changes that conform to reciprocity and MFN leave world prices unaltered, this means that, beginning from Nash policies, a small reduction in C's MFN import tariff that is reciprocated by a reduction in the export trade tax of, say, A, impacts C's welfare according to $-[1 - \frac{\partial P^{wN}/\partial t_C}{\partial P^{wN}/\partial t_A}][\frac{\partial W_C}{\partial P_A^N}\frac{dP_A^N}{dt_C} + \frac{\partial W_C}{\partial P_B^N}\frac{dP_B^N}{dt_C} + \frac{\partial W_C}{\partial P_C^N}\frac{dP_C^N}{dt_C}]$, where the first term in brackets is positive under our assumptions. Referring now to the Nash condition above and using $\frac{\partial W_C}{\partial P^{wN}}\frac{\partial P^{wN}}{\partial t_C} = -D_C\frac{\partial P^{wN}}{\partial t_C} > 0$, we see that $-[\frac{\partial W_C}{\partial P_A^N}\frac{dP_A^N}{dt_C} + \frac{\partial W_C}{\partial P_B^N}\frac{dP_B^N}{dt_C} + \frac{\partial W_C}{\partial P_C^N}\frac{dP_C^N}{dt_C}] > 0$ at the Nash policies. We thus conclude that country C must gain from a small amount of import trade liberalization that conforms to reciprocity and MFN. Similar arguments hold for each other trade policy and each other country.

[34] To confirm this observation, let us focus on the MFN import tariff that country C places on good c and employ the same notational simplifications as in the previous footnote . In general, and recalling that tariff changes that conform to reciprocity and MFN leave world prices unaltered, a small increase in C's MFN import tariff that is reciprocated by an increase in the export trade tax of, say, A, impacts C's welfare according to $[1 - \frac{\partial P^{wN}/\partial t_C}{\partial P^{wN}/\partial t_A}][\frac{\partial W_C}{\partial P_A^N}\frac{dP_A^N}{dt_C} + \frac{\partial W_C}{\partial P_B^N}\frac{dP_B^N}{dt_C} + \frac{\partial W_C}{\partial P_C^N}\frac{dP_C^N}{dt_C}]$. At the political optimum, however, we must have $\frac{\partial W_C}{\partial P_A^N}\frac{dP_A^N}{dt_C} + \frac{\partial W_C}{\partial P_B^N}\frac{dP_B^N}{dt_C} + \frac{\partial W_C}{\partial P_C^N}\frac{dP_C^N}{dt_C} = 0$. We thus conclude that, beginning from the political optimum, country C cannot gain from a small MFN tariff increase that is met by a reciprocal response from countries A and/or B. Similar arguments hold for each other trade policy and each other country.

[35] To see this, consider the impact on Country A's welfare when Country B and C engage in a reciprocal tariff negotiation concerning good c that satisfies MFN. Country A's welfare associated with good c is given by $W_A(P_A^N, P_B^N, P_C^N, P^{wN}) = [P^{wN} - c_o]q_A^N(P_C^N - P_A^N, P_C^N - P_B^N)$, where for notational ease we again suppress the good-c notation. Recalling that tariff changes that conform to reciprocity and MFN leave world prices unaltered, a bilateral negotiation between B and C that conforms to reciprocity and MFN will therefore leave A's welfare unaffected provided that $q_A^N(P_C^N - P_A^N, P_C^N - P_B^N)$ is unaltered by this negotiation. Recalling now that q_A^N is decreasing in its first argument and increasing in its second argument, it is clear that a bilateral negotiation between B and C that conforms to MFN and leads to a drop in P_C^N combined with an appropriate increase in P_B^N could expand trade in good c between B and C while keeping q_A^N unchanged. But in fact, it is straightforward to show that the changes in t_C and t_B that are required to keep q_A^N unchanged are precisely those that hold the world price P^{wN} fixed and thereby satisfy reciprocity. Finally, we note that the ability of reciprocity and MFN to jointly insure against third-party effects of trade liberalization is not complete: as in the competitive benchmark setting, there can arise circumstances in which two countries can use a bilateral negotiation which conforms to reciprocity and MFN to nevertheless alter local prices in a way that benefits them at the expense of the third country. However, the circumstances under which this is possible are quite limited (see Bagwell and Staiger, 2002, Appendix to Ch. 5), and in any event apply equally to the competitive benchmark setting and the setting we evaluate here, and so we do not emphasize them in our discussion above.

[36] That these features break down when tariff changes need only conform to either MFN or reciprocity separately has been established in a competitive setting in Bagwell and Staiger (1999, 2001, 2005). Analogous arguments can be extended to the present setting and establish that the same breakdown occurs here.

the efficiency frontier. We summarize this discussion as follows:

Corollary 3 *In the third-country model of strategic export policies, and for governments with or without political-economic preferences, the principles of reciprocity and non-discrimination (MFN) serve to "undo" the terms-of-trade driven restrictions in trade volume that occur when governments pursue unilateral trade policies.*

5 Conclusion

When markets are imperfectly competitive, trade policies can alter the terms of trade, shift profits from one country to another, and moderate or exacerbate existing distortions that are associated with the presence of monopoly power. In light of the various ways in which trade policies may influence welfare, it might be expected that new rationales for trade agreements would arise once imperfectly competitive markets are allowed. In this paper, we consider a sequence of trade models that feature imperfectly competitive markets and argue that the basic rationale for a trade agreement is, in fact, the same rationale that arises in perfectly competitive markets. In all of the models that we consider, and whether or not governments have political-economic objectives, the *only* rationale for a trade agreement is to remedy the inefficient terms-of-trade driven restrictions in trade volume.

Having identified the problem that a trade agreement might solve, we are able to proceed to the next step and evaluate the form that an efficiency-enhancing trade agreement might take. Here, too, our results parallel the results established previously for models with perfectly competitive markets. In particular, we show that the principles of reciprocity and non-discrimination (MFN) are efficiency-enhancing, as they serve to "undo" the terms-of-trade driven restrictions in trade volume that occur when governments pursue unilateral trade policies.

Our analysis thus suggests that the implications of the terms-of-trade approach to trade agreements are quite general, as they apply not just to perfectly competitive but also to a wide range of imperfectly competitive markets. This suggestion is further supported in our companion paper (Bagwell and Staiger, 2009), which draws analogous conclusions in an imperfectly competitive setting where the number of firms is endogenous and firm-delocation effects are featured. Nevertheless, in all of the settings that we consider the international externalities share an important trait: they all travel through prices, and are hence pecuniary in nature. Whether our results can be extended to environments in which the key international externalities under consideration are non-pecuniary – and hence can shed light on the form that an efficiency-enhancing agreement meant to address such problems might take – is an important question that we leave for future research.[37]

[37] An additional feature which is common to the settings we consider is that international prices and the quantities traded are ultimately determined by market-clearing mechanisms between (possibly non-competitive) suppliers and consumers. Antras and Staiger (2008) show that, when trade reflects specialized products whose international prices are determined through bilateral bargaining between sellers and buyers rather than market clearing mechanisms, the role of a trade agreement must expand beyond providing an avenue of escape from a terms-of-trade driven Prisoners' Dilemma if governments are to achieve the international efficiency frontier.

Appendix to Section 2

Our consideration of export-sector market power in Section 2 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 show that politically optimal tariffs are efficient in segmented markets as well.

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.[38] 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:

$$\Pi(P, P^*, \tau) = [P - c_o]D(P) + [P^* - (c_o + \tau)]D^*(P^*),$$

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:

$$\begin{aligned} \Pi_P(P, P^*, \tau) &= [P - c_o]D'(P) + D(P) = 0, \text{ and} \\ \Pi_{P^*}(P, P^*, \tau) &= [P^* - (c_o + \tau)]D^{*\prime}(P^*) + D^*(P^*) = 0. \end{aligned}$$

We again assume that second-order conditions are satisfied. 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 τ and may thus be represented as $P^*(\tau)$. Under general conditions, $P^*(\tau)$ rises with the total tariff. We also note that $P > c_o$ and $P^*(\tau) > c_o$ are required by the monopoly first-order conditions.

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

$$[P - c_o]D(P) + CS(P) + [P^* - (c_o + \tau)]D^*(P^*) + tD^*(P^*).$$

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

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

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

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

[38] An interesting implication of this feature, first pointed out by Brander and Spencer (1984a), is that the segmented market assumption and its implied possibility of international price discrimination in effect makes all countries "large" enough to alter foreign exporter prices with their trade policy choices. As Brander and Spencer (p. 236) put it, "With price discrimination even a country that is far too small to affect world prices can influence the profit-maximizing output and price chosen by foreign producers for the domestic market."

Recalling that P is independent of t and t^* and that P^* is a function only of the total tariff τ, we may express the first-order condition that defines efficient choices of t and t^* as

$$W_{P^*}\frac{dP^*}{d\tau} + W^*_{P^*}\frac{dP^*}{d\tau} = 0. \tag{40}$$

As before, efficiency requires only that t and t^* be chosen so that the total tariff τ satisfies (40).

Let us now consider the politically optimal tariffs. We again define the politically optimal tariffs 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, 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

$$\begin{aligned} W_{P^*}\frac{dP^*}{d\tau} &= 0, \text{ and} \\ W^*_{P^*}\frac{dP^*}{d\tau} &= 0. \end{aligned} \tag{41}$$

We may now immediately confirm from (41) that politically optimal tariffs satisfy the efficiency conditions in (40). 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 $W_{P^*}\frac{dP^*}{d\tau} = 0$ implies $[P^w - c_o]D^{*\prime}(P^*) = 0$, which could only happen if $P^w = c_o$. Likewise, the second condition for political optimality $W^*_{P^*}\frac{dP^*}{d\tau} = 0$ implies $P^* = P^w$. Together, the two conditions imply that $P^* = P^w = c_o$; 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.[39] Once again, an exactly analogous result applies when governments have political-economic objectives.

Appendix to Section 3

Our consideration of duopoly profit-shifting in Section 3 focused on integrated markets. We now assume that the domestic and foreign markets are segmented rather than integrated. As in Section 3, 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. 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

[39] The finding that the politically optimal export policy is an export subsidy that pushes the world price down to cost is equivalent to the observation that a monopolist would lower its price to cost if it did not value the pure rent transfer to infra-marginal consumers that a price cut would imply.

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:

$$q_h + q_f = D(P). \tag{42}$$

Using the home market-clearing condition (42), we may therefore define $P(q_h + q_f)$ or equivalently $P(Q)$. Notice from (42) 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:

$$q_h^* + q_f^* = D^*(P^*). \tag{43}$$

As before, we may use the foreign market-clearing condition (43) and define $P^*(q_h^* + q_f^*)$ or equivalently $P^*(Q^*)$. Again, notice from (43) 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^*.

Letting $\tau^* \equiv t_h^* + t_f^*$, we may now write the home firm's home-and-foreign-market profit as:

$$\Pi^h(q_h, q_f, q_h^*, q_f^*, \tau^*) = [P(q_h + q_f) - c_o]q_h + [P^*(q_h^* + q_f^*) - (c_o + \tau^*)]q_h^*.$$

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:

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

Using (42) to derive $\frac{dP}{dQ} = \frac{1}{D'(P)}$ and using (43) to derive $\frac{dP^*}{dQ^*} = \frac{1}{D^{*\prime}(P^*)}$, we may rewrite the first-order conditions as

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

These conditions determine the home-firm reaction curves for the home and foreign markets, respectively.[40] Given our assumption that demand functions are downward sloping, we see that the home firm's markups (inclusive of trade tariffs) must be positive: $P(Q) > c_o$ and $P^*(Q^*) > c_o + \tau^*$.

The foreign firm faces analogous conditions. With $\tau \equiv t_h + t_f$, the foreign firm's home-and-foreign-market profit is:

$$\Pi^f(q_h, q_f, q_h^*, q_f^*, \tau) = [P(q_h + q_f) - (c_o^* + \tau)]q_f + [P^*(q_h^* + q_f^*) - c_o^*]q_f^*.$$

As before, in each market, the first-order condition equates the marginal revenue generated from a slight

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

increase in the foreign firm's output in that market with its marginal cost of delivery to that market:

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

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

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

These conditions determine the foreign-firm reaction curves for the home and foreign markets, respectively.[41] As before, we see that the foreign firm's markups (inclusive of trade tariffs) must be positive: $P^*(Q^*) > c_o^*$ and $P(Q) > c_o^* + \tau$.

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: $q_h^N(\tau)$ and $q_f^N(\tau)$, respectively. The total Cournot-Nash output in the home market is represented as $Q^N(\tau) \equiv q_h^N(\tau) + q_f^N(\tau)$, and we may thus denote the corresponding Cournot-Nash price as $P^N(\tau) \equiv P(Q^N(\tau))$. 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: $q_h^{*N}(\tau^*)$ and $q_f^{*N}(\tau^*)$, respectively. For the foreign market, the total Cournot-Nash output is represented as $Q^{*N}(\tau^*) \equiv q_h^{*N}(\tau^*) + q_f^{*N}(\tau^*)$, and we may thus denote the associated Cournot-Nash price as $P^{*N}(\tau^*) \equiv P^*(Q^{*N}(\tau^*))$.

In the home market, a higher total tariff raises the marginal cost of delivery for the foreign firm. We thus expect that $q_f^N(\tau)$ 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 $q_h^N(\tau)$ 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 $Q^N(\tau)$ 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, $P^N(\tau)$. Exactly analogous conditions apply in the foreign market: an increase in the total tariff τ^* raises the marginal cost of the home firm for sales in the foreign market and thereby lowers $q_h^{*N}(\tau^*)$, raises $q_f^{*N}(\tau^*)$, lowers $Q^{*N}(\tau^*)$ and raises $P^{*N}(\tau^*)$. In the discussion that follows we assume that P^N and P^{*N} rise with their corresponding total tariffs, 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

$$[P^N - c_o]q_h^N(\tau) + CS(P^N) + [P^{*N} - (c_o + \tau^*)]q_h^{*N}(\tau^*) + t_h^* q_h^{*N}(\tau^*) + t_h q_f^N(\tau),$$

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 $P^{*wN}(t_h^*, t_f^*) = P^{*N}(\tau^*) - t_f^*$ and the world price for exports to the home market by $P^{wN}(t_h, t_f) = P^N(\tau) - t_h$. We may also define $R^N(\tau^*) = P^{*wN}(t_h^*, t_f^*) - t_h^*$ as the price received by the home firm for foreign sales,

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

and $R^{*N}(\tau) = P^{wN}(t_h, t_f) - t_f$ as the price received by the foreign firm for domestic sales. Notice now that $P^N - R^{*N} = \tau$ and $P^{*N} - R^N = \tau^*$. We may thus regard the Cournot-Nash quantities as functions of local price differences. With this observation in place, we may represent domestic country welfare as

$$\begin{aligned} & W(P^N, R^N, P^{wN}, P^{*N}, R^{*N}, P^{*wN}) \\ = \; & [P^N - c_o]q_h^N(P^N - R^{*N}) + CS(P^N) \\ & +[P^{*wN} - c_o]q_h^{*N}(P^{*N} - R^N) + [P^N - P^{wN}]q_f^N(P^N - R^{*N}), \end{aligned} \tag{44}$$

where in deriving (44) 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

$$[P^{*N} - c_o^*]q_f^{*N}(\tau^*) + CS^*(P^{*N}) + [P^N - (c_o^* + \tau)]q_f^N(\tau) + t_f q_f^N(\tau) + t_f^* q_h^{*N}(\tau^*),$$

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

$$\begin{aligned} & W^*(P^{*N}, R^{*N}, P^{*wN}, P^N, R^N, P^{wN}) \\ = \; & [P^{*N} - c_o^*]q_f^{*N}(P^{*N} - R^N) + CS^*(P^{*N}) \\ & +[P^{wN} - c_o^*]q_f^N(P^N - R^{*N}) + [P^{*N} - P^{*wN}]q_h^{*N}(P^{*N} - R^N). \end{aligned} \tag{45}$$

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 (44) and (45), 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

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

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, and using $\frac{d\tau}{dt_h} = 1 = \frac{d\tau}{dt_f}$ and $\frac{d\tau^*}{dt_h^*} = 1 = \frac{d\tau^*}{dt_f^*}$, we can express the conditions that define efficient choices of t_h, t_h^*, t_f and t_f^* as

$$\begin{aligned} W_{P^N}\frac{dP^N}{d\tau} + W_{R^{*N}}\frac{dR^{*N}}{d\tau} + W^*_{P^N}\frac{dP^N}{d\tau} + W^*_{R^{*N}}\frac{dR^{*N}}{d\tau} &= 0, \text{ and} \\ W_{P^{*N}}\frac{dP^{*N}}{d\tau^*} + W_{R^N}\frac{dR^N}{d\tau^*} + W^*_{P^{*N}}\frac{dP^{*N}}{d\tau^*} + W^*_{R^N}\frac{dR^N}{d\tau^*} &= 0. \end{aligned} \tag{46}$$

Any combination of t_h, t_h^*, t_f and t_f^* that implies tariff sums τ and τ^* satisfying the conditions in (46) are efficient.

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

$$\begin{aligned} W_{P^N}\frac{dP^N}{d\tau} + W_{R^{*N}}\frac{dR^{*N}}{d\tau} &= 0, \\ W_{P^{*N}}\frac{dP^{*N}}{d\tau^*} + W_{R^N}\frac{dR^N}{d\tau^*} &= 0, \\ W^*_{P^N}\frac{dP^N}{d\tau} + W^*_{R^{*N}}\frac{dR^{*N}}{d\tau} &= 0, \text{ and} \\ W^*_{P^{*N}}\frac{dP^{*N}}{d\tau^*} + W^*_{R^N}\frac{dR^N}{d\tau^*} &= 0. \end{aligned} \tag{47}$$

But it is now immediate from a comparison of (47) with (46) 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.

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Figure 1a
Foreign tariff choice and iso-price lines

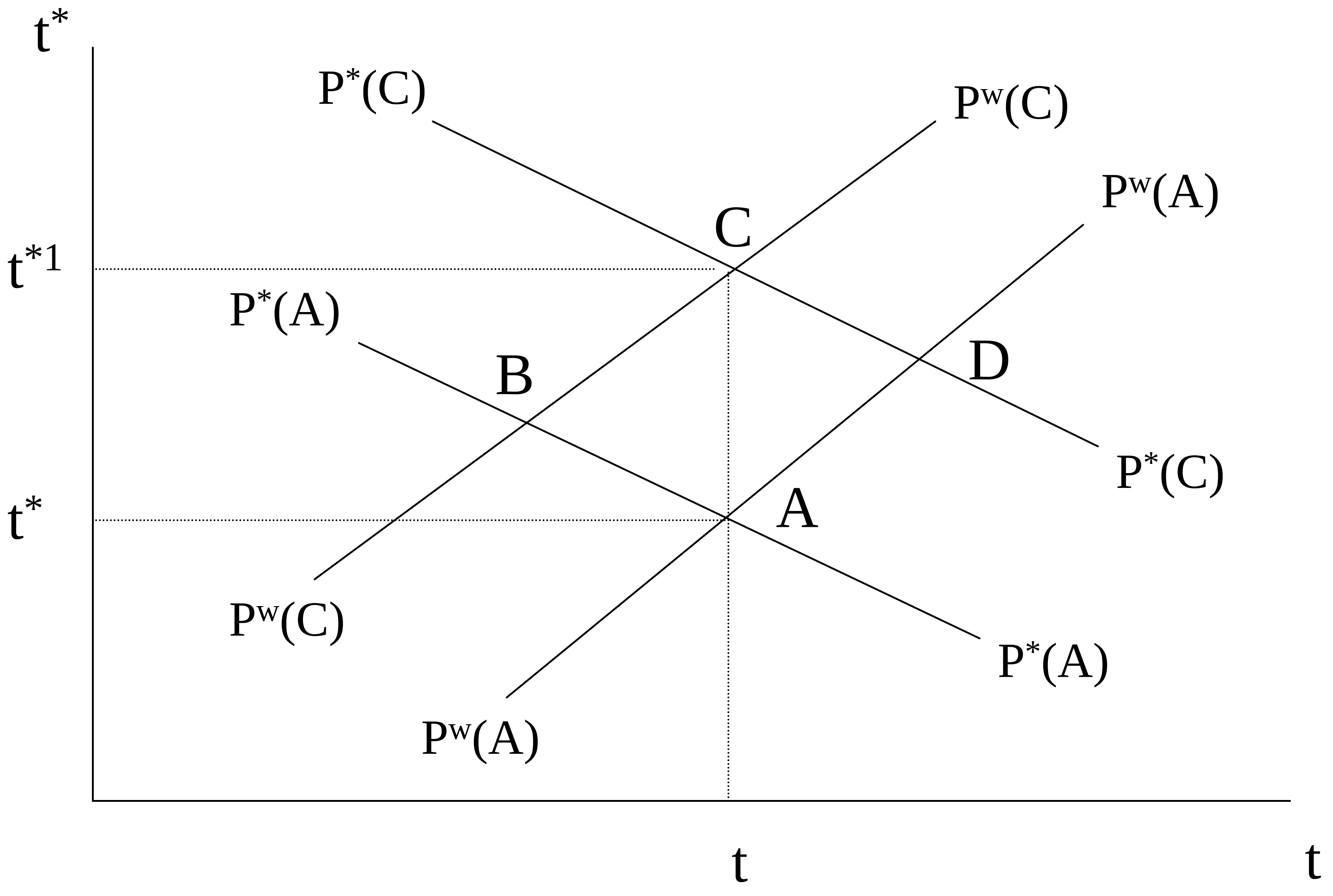

Figure 1b
Domestic tariff choice and iso-price lines

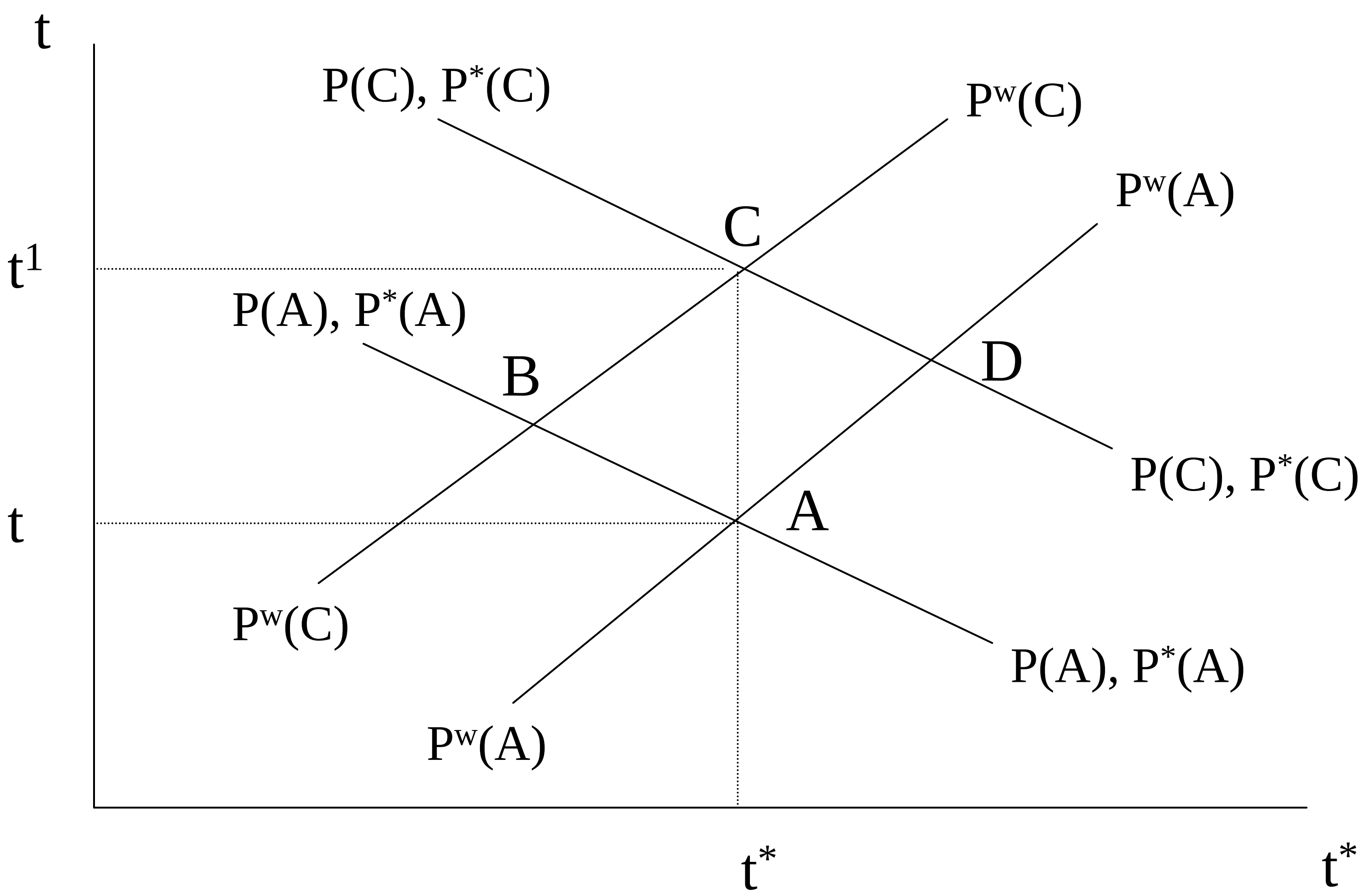

Figure 2a
Effect of export tariff increase in foreign market
$W=[P-c]D(P) + CS(P) + [P^w-c]D^*(P^*)$

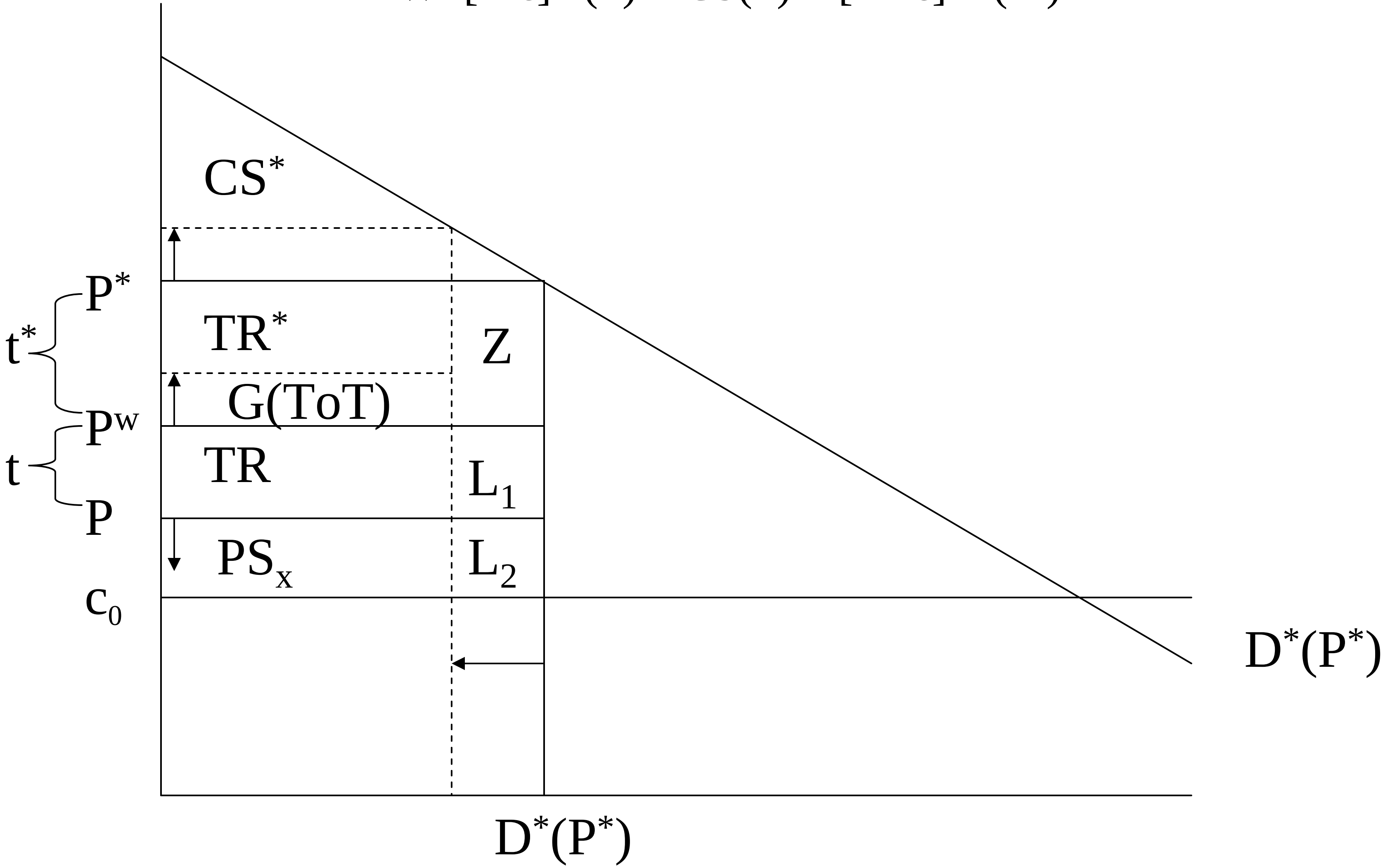

Figure 2b

Effect of export tariff increase in domestic market

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

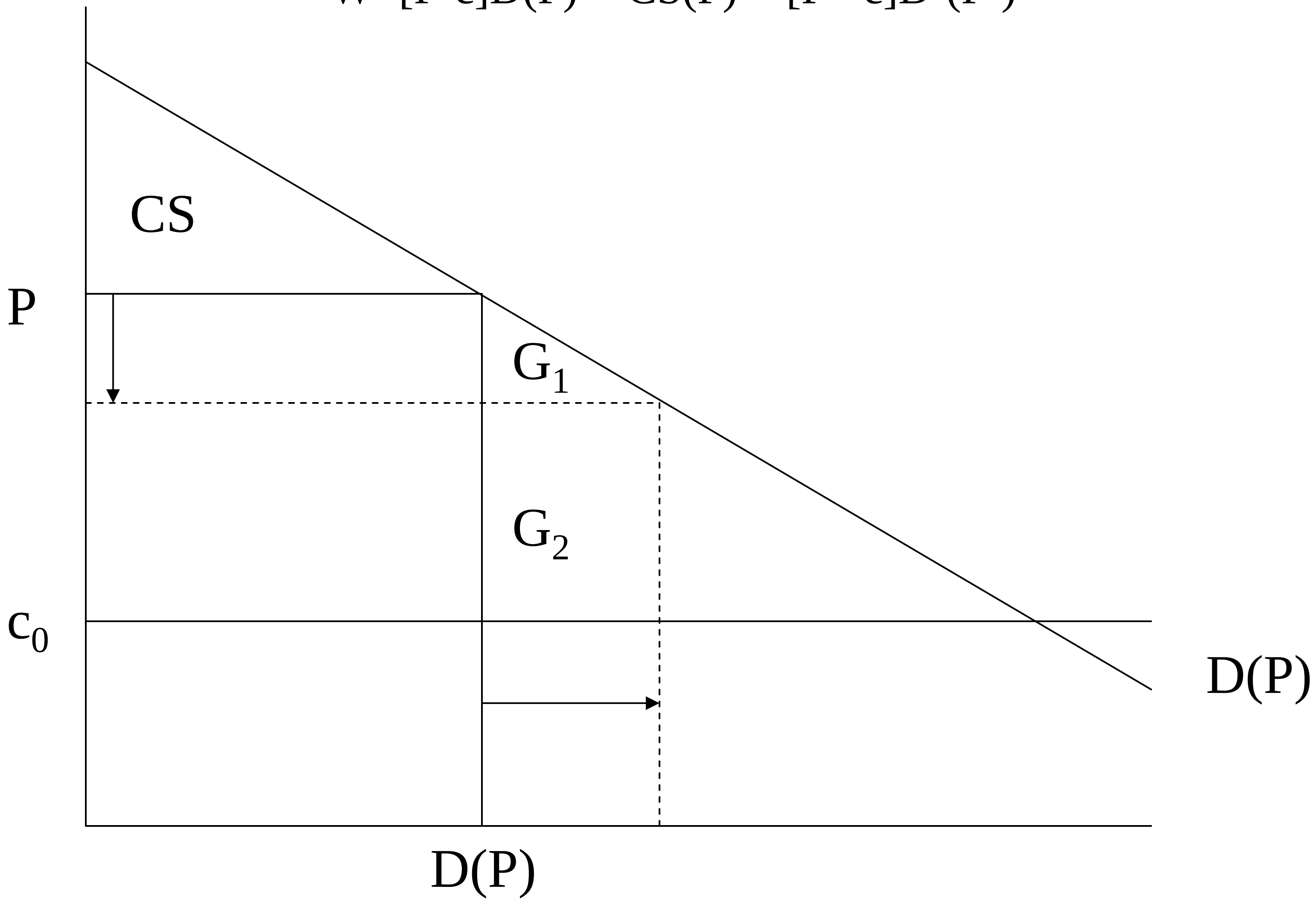

Figure 2c

Effect of import tariff increase from $t^{*} = 0$ in foreign market

$$W^{*} = CS^{*}(P^{*}) + [P^{*} - P^{w}]D^{*}(P^{*})$$