# Delocation and Trade Agreements in Imperfectly Competitive Markets*
## (Preliminary)

Kyle Bagwell
Stanford and NBER

Robert W. Staiger
Stanford and NBER

June 13, 2009

Abstract

We consider the purpose and design of trade agreements in imperfectly competitive environments featuring …rm-delocation e¤ects. In both the segmented-market Cournot and the integrated-market monopolistic competition settings where these e¤ects have been identi…ed, we show that the only rationale for a trade agreement is to remedy the ine¢ ciency attributable to the terms-of-trade externality, the same rationale that arises in perfectly competitive markets. Furthermore, and again as in the perfectly competitive benchmark case, we show that the principle of reciprocity is e¢ ciency enhancing, as it serves to "undo" the terms-of-trade driven ine¢ ciency that occurs when governments pursue unilateral trade policies. Our results therefore indicate that the terms-of-trade theory of trade agreements applies to a broader set of market structures than previously thought.

*We thank Ralph Ossa and seminar participants at Princeton for very useful comments.

for sales in segmented markets under conditions of free entry. Venables (1987) then showed that this e¤ect extends to a setting of free-entry monopolistic competition where markets are integrated and …rms compete to sell di¤erentiated products. In the model of monopolistic competition used by Venables, it is the savings on transport costs implied by the …rm-delocation e¤ect rather than the impacts on competition that can enhance the welfare of the intervening country. As Venables demonstrates, if the home country raises barriers to its imports or subsidizes its exports, then foreign …rms can be "delocated" to the home market. Home consumers then save on trade costs in the form of a lower overall price index, at the expense of foreign consumers whose price index rises.[1]

When this novel motive for trade policy intervention is present, it might be expected that a novel rationale for a trade agreement would likewise be present. In line with this expectation, we show that new international externalities indeed arise when the …rm-delocation e¤ect 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. The key question for our purposes, however, is whether governments internalize these international externalities in an appropriate fashion from a world-wide perspective when they make their unilateral policy choices. In both the Cournot and the monopolistic competition settings where the …rm-delocation e¤ect has been shown to arise, we address this question and establish a surprising answer: the rationale for a trade agreement is to remedy the ine¢ ciency attributable to the terms-of-trade externality, the same rationale that arises in perfectly competitive markets. Furthermore, and again as in the benchmark model with perfect competition, the principle of reciprocity is e¢ ciency enhancing, as it serves to "undo" the terms-of-trade driven ine¢ ciency that occurs when governments pursue unilateral trade policies.

To establish these results, we characterize the non-cooperative and e¢ cient policy choices, and we then evaluate the precise reasons for any divergence between them. To this end, we follow Bagwell and Staiger (1999) and evaluate tari¤s, de…ned as those tari¤s 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 tari¤ choices. We do this …rst for the Cournot model of …rm delocation (Section 2) and then for the monopolistic competition model (Section 3). In each setting, we show that the noncooperative tari¤s are ine¢ cient and that the politically optimal tari¤s are e¢ cient. In particular, starting at the noncooperative tari¤s, both countries could gain by reducing the total trade impediment on any trade ‡ow. We thereby establish that the only rationale for a trade agreement is to remedy the higher-than-e¢ cient tari¤s that arise as a consequence of the value that governments place upon the terms-of-trade movements induced by their unilateral tari¤ choices.

We also show that the Cournot and monopolistic competition models exhibit an interesting

[1] More recently, the …rm-delocation e¤ect of trade policy intervention has been featured in Melitz and Ottaviano (2008) and Ossa (2009). Melitz and Ottaviano extend the analysis of this e¤ect to a heterogeneous-…rm setting. Ossa considers the rationale for trade agreements when …rm-delocation e¤ects are present. We relate our paper to Ossa's

and overlooked feature: in each model, the terms-of-trade effects of import tariffs and export taxes are . The asymmetry is most pronounced in the Cournot delocation model. In that model, a country can in standard fashion improve its terms of trade by levying an import tariff; however, an export tax the terms of trade in the model, contrary to the standard case. By implication, an export subsidy a country's terms of trade in the Cournot delocation model. This features distinguishes the Cournot delocation model from other models of commercial policy. The monopolistic competition delocation model that we utilize is similar to that developed in Helpman and Krugman (1989). As Helpman and Krugman (1989) observe, in this model, a country is unable to alter its terms of trade by using an import tariff. We include export policies in our analysis as well, however, and observe that a country can generate a somewhat extreme (dollar-for-dollar) improvement in its terms of trade by applying an export tariff.

Our paper is most closely related to the recent paper of Ossa (2009). Utilizing a monopolistic competition model of firm delocation, Ossa argues that the firm-delocation effect provides a new rationale for a trade agreement, and a rationale that is especially relevant for (two-way) trade between similar countries. Ossa then goes on to offer a novel interpretation of reciprocity and non-discrimination as simple rules that can neutralize the firm-delocation effect. Our result concerning the rationale of a trade agreement in this setting is at odds with Ossa's first observation, and so it is important to explore the differences across the two papers. There are two substantive differences between the monopolistic competition model employed by Ossa and the one we utilize below. A first of intervention under unilateral policy choices.

The analysis in this paper maintains the assumption that free entry eliminates pro…ts in equilibrium even though …rms are not price-takers. This allows us to focus on the …rm-delocation e¤ect, and on the novel role for trade policy intervention in the presence of this e¤ect. An alternative role for government intervention can arise when the number of producers in each country is …xed and invariant to trade policy. In this case, there may exist pro…table …rms, and the pursuit of those pro…ts – either converted into tari¤ revenue or shifted from one …rm to another – combined with the relaxation of the assumption of price-taking behavior can provide an alternative "pro…t shifting" role for trade policy intervention. In a companion paper (Bagwell and Staiger, 2009), we consider this alternative by exploring models in which …rms are not price takers but where the number of …rms is …xed, and we again ask whether a novel role for trade agreements can be identi…ed. For the models of pro…t-shifting, our main …nding is again that the terms-of-trade externality continues to provide the only rationale for a trade agreement.

# 2 Delocation with Cournot Competition and Segmented Markets

In this section we consider a model whose underlying structure is essentially that contained in Venables (1985).[3] We refer to this model as the model. The industry under consideration is comprised of …rms who produce a homogeneous good and compete in a Cournot fashion for sales in a domestic and foreign market under conditions of free entry. The markets are segmented, and two-way trade in identical products arises as a consequence. There are transport costs between the markets, and each government may also impose a trade tax/subsidy on trade ‡ows in and/or out of its market. This environment exhibits a …rm-delocation e¤ect that has important implications for the impacts of trade policy, as Venables …rst emphasized. Our main purpose here, however, is to identify and interpret the sources of ine¢ ciency that arise when governments set their trade policies unilaterally, and thereby to explore the potential role and design of a trade agreement in this environment.

## 2.1 Model Setup

There are two countries (home and foreign), each endowed with a large amount of labor which is the only factor of production. In the background, a competitively supplied numeraire good is produced with labor alone according to a constant-returns-to-scale production function common across countries (1 unit of labor produces 1 unit of the numeraire). The numeraire good enters linearly into the utility of each country, is always produced and consumed in positive amounts by each country (due to the large supply of labor in each country), and is freely traded across countries, so that its price (and hence the wage of labor) is …xed and equalized (and normalized to one) everywhere in the world. This structure permits a partial equilibrium treatment of the second,

[3] The model we develop here imposes additional symmetry across countries relative to Venables (1985), but this symmetry serves only to simplify the exposition and is not necessary for our main results.

imperfectly competitive, industry that is our main focus. The home country has $n_h$ Cournot …rms in this industry, and the foreign country has $n_f$ Cournot …rms, all producing the same good at a (common) marginal cost c and …xed cost F under conditions of free entry. If the good sells in the home country at price P, then home consumers demand D(P) units; likewise, if the good sells in the foreign country at price $P^*$, then foreign consumers demand $D^*(P^*)$ units. We assume that D(P) and $D^*(P^*)$ are positive and downward sloping.

The markets are segmented, so that the home and foreign market prices P and $P^*$ are determined by separate home and foreign market-clearing conditions, and the problem of output choice for each …rm is separable across the home and foreign markets. As shown by Brander (1981), an implication of the segmented markets setting is that in general trade will occur in both directions.[4] Trade in either direction is costly in this industry, and we let ' denote the cost of transporting one unit of the good between countries (measured in units of the numeraire). We assume that each country has both import and export policies at its disposal, and we express all trade taxes in speci…c terms: for exports from the home country to the foreign country, $t_h^*$ is the export tax imposed by the home country ($t_h^* < 0$ if an export subsidy) and $t_f^*$ is the import tari¤ imposed by the foreign country; and for exports from the foreign country to the home country, $t_f$ is the export tax imposed by the foreign country ($t_f < 0$ if an export subsidy) and $t_h$ is the import tari¤ imposed by the home country. We maintain a focus throughout on non-prohibitive trade taxes.

For convenience we de…ne the total trade impediments facing home and foreign imports, respectively, by

$$\equiv \; ' + t_h + t_f; \text{ and} \qquad (1)$$

$$^* \; \equiv \; ' + t_h^* + t_f^*:$$

In what follows, we assume the existence of positive transport costs so that

'

Home …rm i must also choose output destined for the foreign market $q_h^{i*}$ to maximize its foreign-market pro…t in light of the $(n_h - 1)$ other (symmetric) home …rms' foreign output choices $(n_h - 1)q_h^*$ and the $n_f$ (symmetric) foreign …rms' foreign output choices $n_f q_f^*$. The industry output destined for the foreign market $Q^* \equiv q_h^{i*} + (n_h - 1)q_h^* + n_f q_f^*$ then determines $P^*$ through the foreign market-clearing condition

$$q_h^{i*} + (n_h - 1)q_h^* + n_f q_f^* = D^*(P^*): \qquad (3)$$

Using (2) and (3), we may therefore de…ne the home and foreign market-clearing prices $P(q_h^i + (n_h - 1)q_h + n_f q_f)$ and $P^*(q_h^{i*} + (n_h - 1)q_h^* + n_f q_f^*)$, or equivalently $P(Q)$ and $P^*(Q^*)$. Notice that, owing to the segmented market assumption, $P$ and $P^*$ do not depend on trade taxes directly, but may depend indirectly on trade taxes to the extent that trade taxes alter respectively $Q$ and $Q^*$.

We may now write home …rm i's home-and-foreign-market pro…ts as

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

For each market, home …rm i's …rst-order condition equates the marginal revenue generated from a slight increase in its output in that market with its marginal cost of delivery to that market. Using (2) to derive $\frac{dP}{dQ} = \frac{1}{D'(P)}$ and using (3) to derive $\frac{dP^*}{dQ^*} = \frac{1}{D^{*\prime}(P^*)}$, these …rst-order conditions can be expressed as

$$\begin{aligned} q_h^i + [P(\cdot) - c]D'(P(\cdot)) &= 0; \text{ and} \qquad (4) \\ q_h^{i*} + [P^*(\cdot) - (c + \ {}^*)]D^{*\prime}(P^*(\cdot)) &= 0; \end{aligned}$$

where we use $P(\cdot)$ to denote $P(q_h^i + (n_h - 1)q_h + n_f q_f)$ and $P^*(\cdot)$ to denote $P^*(q_h^{i*} + (n_h - 1)q_h^* + n_f q_f^*)$ to reduce notation. These conditions de…ne home-…rm i's reaction curve for the home and foreign markets, respectively.[5] Under our assumption that demand functions are downward sloping, we may observe from (4) that home …rm i's markups (inclusive of trade costs) must be positive in both markets.

With analogous steps, we may write foreign …rm i's home-and-foreign-market pro…ts as

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

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

[5] We assume that the second-order conditions hold. These conditions are given by 2[ ′( ( ))] [ ( ) ] ″( ( )) and 2[ *′( *( ))] [ *( ) ( + )

market. These first-order conditions can be expressed as

$$
\begin{aligned}
q_f^{i*} + [P^*(\cdot) - c]D^{*\prime}(P^*(\cdot)) &= 0; \text{ and} \\
q_f^{i} + [P(\cdot) - (c + \ )]D^{\prime}(P(\cdot)) &= 0:
\end{aligned}
\tag{5}
$$

These conditions define foreign-firm $i'$s reaction curve for the foreign and home markets, respectively.[6] Again, given our assumption that demand functions are downward sloping, we see from (5) that foreign firm $i$'s markups (inclusive of trade costs) must be positive in both markets.

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

And similarly, we may write the maximized pro...ts of a representative foreign ...rm as

$$
\begin{aligned}
{}^{f}(n_h; n_f; \;{}^{*}; \;) \quad = \quad & [P^{*}(Q^{*N}(n_h; n_f; \;{}^{*})) - c]q_f^{*N}(n_h; n_f; \;{}^{*}) \\
& +[P(Q^{N}(n_h; n_f; \;)) - (c + \;)]q_f^{N}(n_h; n_f; \;) - F:
\end{aligned}
\tag{8}
$$

We assume that ${}^{h}(n_h; n_f; \;{}^{*}; \;)$ and ${}^{f}(n_h; n_f; \;{}^{*}; \;)$ are each decreasing in $n_h$ and $n_f$. This assumption holds for a broad family of demand functions (including linear demands).

Under free entry, $n_h$ and $n_f$ adjust to ensure that the maximized pro...ts of home and foreign ...rms de...ned in (7) and (8) respectively are equal to zero, or

$$
{}^{h}(n_h; n_f; \;{}^{*}; \;) = 0 = \;{}^{f}(n_h; n_f; \;{}^{*}; \;); \tag{9}
$$

which then de...nes $n_h^N(\;{}^{*}; \;)$ and $n_f^N(\;{}^{*}; \;)$. Our focus on non-prohibitive trade taxes ensures that both $n_h^N(\;{}^{*}; \;)$ and $n_f^N(\;{}^{*}; \;)$

…rm as

$$\tilde{q}_h^N( \ ^*; \ ) \equiv q_h^N(n_h^N( \ ^*; \ ); n_f^N( \ ^*; \ ); \ ); \tag{11}$$
$$\tilde{q}_f^N( \ ^*; \ ) \equiv q_f^N(n_h^N( \ ^*; \ ); n_f^N( \ ^*; \ ); \ );$$
$$\tilde{q}_h^{*N}( \ ^*; \ ) \equiv q_h^{*N}(n_h^N( \ ^*; \ ); n_f^N( \ ^*; \ ); \ ^*); \text{ and}$$
$$\tilde{q}_f^{*N}( \ ^*; \ ) \equiv q_f^{*N}(n_h^N( \ ^*; \ ); n_f^N( \ ^*; \ ); \ ^*):$$

According to (10) and (11), all Nash equilibrium prices and quantities can be expressed as functions of the total trade impediments $^*$ and .

## 2.2 The Firm-Delocation E¤ect

At this point, we evaluate the impacts of tari¤s on the Nash local prices $\tilde{P}^N( \ ^*; \ )$ and $\tilde{P}^{*N}( \ ^*; \ )$, and thereby further highlight the importance of the …rm-delocation e¤ect. To this end, we substitute (4) into (7) and (5) into (8) to rewrite (9) as

$$[P(\cdot) - c]^2[-D'(P(\cdot))] + [P^*(\cdot) - (c + \ ^*)]^2[-D^{*\prime}(P^*(\cdot))] - F = 0; \text{ and} \tag{12}$$
$$[P^*(\cdot) - c]^2[-D^{*\prime}(P^*(\cdot))] + [P(\cdot) - (c + \ )]^2[-D'(P(\cdot))] - F = 0;$$

where with a slight abuse of notation we now use $P(\cdot)$ to denote $P(Q^N(n_h; n_f; \ ))$ and $P^*(\cdot)$ to denote $P^*(Q^{*N}(n_h; n_f; \ ^*))$. The top equation in (12) traces out a locus of home and foreign prices ($P$ and $P^*$) that, for any $^*$, is consistent with the home-…rm zero-pro…t condition; similarly, the bottom equation of (12) traces out a locus of home and foreign prices that, for any , is consistent with the foreign-…rm zero-pro…t condition. Di¤erent values of $n_h$ and $n_f$ trace out the locus of $(P; P^*)$ combinations described by each of the two equations in (12), and the equilibrium values $n_h^N( \ ^*; \ )$ and $n_f^N( \ ^*; \ )$ –and hence $\tilde{P}^N( \ ^*; \ )$ and $\tilde{P}^{*N}( \ ^*; \ )$ –are determined where the two loci the point at which they cross corresponds to an initial equilibrium price combination denoted in the figure by $\tilde{P}_0^N$ and $\tilde{P}_0^{*N}$. As can be confirmed from (12), a small increase in triggered by an increase in either $t_h$ or $t_f$ leaves the $^{h} = 0$ locus unaffected, but it shifts out the $^{f} = 0$ locus.[9] In Figure 1, this new locus is depicted by the dashed line and labeled $^{f}_{1} = 0$, and the new equilibrium prices are denoted by $\tilde{P}_1^N$ and $\tilde{P}_1^{*N}$.

Recall that, with $n_h$ and $n_f$ held fixed, $P(Q^N(n_h; n_f; \ ))$ rises when is increased but by less than the rise in , while $P^*(Q^{*N}(n_h; n_f; \ ^*))$ is unaffected. To restore zero-profits for both home and foreign firms, there must be entry of home firms ($n_h$ must rise) and exit of foreign firms ($n_f$ must fall); and as Figure 1 illustrates, the competitive effects of this entry and exit must be sufficient to ensure that $\tilde{P}^N(\ ^*; \ )$ ultimately and $\tilde{P}^{*N}(\ ^*; \ )$ ultimately . In other words, a small increase in results in a pro-competitive (entry) effect which reduces the price in the home market and an anti-competitive (exit) effect which raises the price in the foreign market. A corresponding analysis establishes that a small increase in $^*$, triggered by an increase in either $t_h^*$ or $t_f^*$, will decrease $\tilde{P}^{*N}(\ ^*; \ )$ and increase $\tilde{P}^N(\ ^*; \ )$.

These surprising price impacts of tariff intervention are the hallmark of the firm-delocation effect. As Venables (1985) emphasizes, these impacts arise when trade costs are positive, since a firm then has greater sales in its domestic market than abroad, all else equal, and so adjustments in the domestic price bear the primary burden for restoring zero profits following any trade policy intervention. As Venables (1985) establishes, the firm-delocation effect gives rise to a novel motive for trade policy intervention: an import tariff or export subsidy can benefit a country's ,
by stimulating entry of domestic firms and thereby reducing domestic prices through enhanced competition; this benefit, however, comes at the expense of foreign consumers, who experience higher prices as a result of foreign-firm exit and diminished competition in the foreign market. We next introduce a complete representation of welfare, so that we may explore the implications of the firm-delocation effect for optimal unilateral trade policy choices and the nature of trade agreements.

## 2.3 Representation of Welfare

To proceed, we now develop expressions for the welfare of each country. We begin with the home welfare function. Because the free-entry condition (9) ensures that oligopoly profits are zero, we can write home welfare as the sum of consumer surplus and net trade tax revenue, or

$$CS(\tilde{P}^N) + t_h n_f^N \tilde{q}_f^N + t_h^* n_h^N \tilde{q}_h^{*N};$$

where we note that $n_f^N \tilde{q}_f^N$ corresponds to home-country imports and $n_h^N \tilde{q}_h^{*N}$ corresponds to home-country exports. To refine the expression for home welfare, we next introduce a number of further price definitions.

First, at the Cournot-Nash equilibrium, let us denote the world price for exports to the home

[9] This follows from the second-order conditions.

market by

$$\tilde{P}^{wN}(t_h;\ ^*;\ ) = \tilde{P}^N(\ ^*;\ ) - t_h \tag{13}$$

and the world price for exports to the foreign market by

$$\tilde{P}^{*wN}(t_f^*;\ ^*;\ ) = \tilde{P}^{*N}(\ ^*;\ ) - t_f^*: \tag{14}$$

We also define $\tilde{R}^N(\ ^*;\ ) = \tilde{P}^{*wN}(t_f^*;\ ^*;\ ) - ' - t_h^*$ as the price received by the home firm for foreign sales (the segmentation of markets implies that in general $\tilde{R}^N \neq \tilde{P}^N$), and similarly $\tilde{R}^{*N}(\ ^*;\ ) = \tilde{P}^{wN}(t_h;\ ^*;\ ) - ' - t_f$ as the price received by the foreign firm for home-country sales (the segmentation of markets implies that in general $\tilde{R}^{*N} \neq \tilde{P}^{*N}$). Notice using (1) that $\tilde{P}^N - \tilde{R}^{*N} =$ and $\tilde{P}^{*N} - \tilde{R}^N = \ ^*$. We may thus regard the equilibrium numbers of firms defined in (9) and hence the Cournot-Nash quantities defined in (11) as functions of local price differences.

With these observations in place, we now represent home-country imports $M$ and exports $E$ respectively as

$$\begin{aligned} M(\tilde{P}^{*N} - \tilde{R}^N; \tilde{P}^N - \tilde{R}^{*N}) &= n_f^N(\tilde{P}^{*N} - \tilde{R}^N; \tilde{P}^N - \tilde{R}^{*N})\tilde{q}_f^N(\tilde{P}^{*N} - \tilde{R}^N; \tilde{P}^N - \tilde{R}^{*N}); \text{ and} \\ E(\tilde{P}^{*N} - \tilde{R}^N; \tilde{P}^N - \tilde{R}^{*N}) &= n_h^N(\tilde{P}^{*N} - \tilde{R}^N; \tilde{P}^N - \tilde{R}^{*N})\tilde{q}_h^{*N}(\tilde{P}^{*N} - \tilde{R}^N; \tilde{P}^N - \tilde{R}^{*N}); \end{aligned}$$

allowing home country welfare to be expressed as a direct function of prices:

$$\begin{aligned} W(\tilde{P}^N; \tilde{R}^N; \tilde{P}^{wN}; \tilde{P}^{*N}; \tilde{R}^{*N}; \tilde{P}^{*wN}) &= CS(\tilde{P}^N) \\ &\quad + [\tilde{P}^N - \tilde{P}^{wN}]M(\tilde{P}^{*N} - \tilde{R}^N; \tilde{P}^N - \tilde{R}^{*N}) \\ &\quad + [\tilde{P}^{*wN} - \tilde{R}^N - ']E(\tilde{P}^{*N} - \tilde{R}^N; \tilde{P}^N - \tilde{R}^{*N}): \end{aligned} \tag{15}$$

Next consider the foreign welfare function. Foreign welfare is given by the sum of consumer surplus and net trade tax revenue, or

$$CS^*(\tilde{P}^{*N}) + t_f n_f^N \tilde{q}_f^N + t_f^* n_h^N \tilde{q}_h^{*N}:$$

We may therefore represent foreign country welfare by

$$\begin{aligned} W^*(\tilde{P}^{*N}; \tilde{R}^{*N}; \tilde{P}^{*wN}; \tilde{P}^N; \tilde{R}^N; \tilde{P}^{wN}) &= CS^*(\tilde{P}^{*N}) \\ &\quad + [\tilde{P}^{wN} - \tilde{R}^{*N} - ']M(\tilde{P}^{*N} - \tilde{R}^N; \tilde{P}^N - \tilde{R}^{*N}) \\ &\quad + [\tilde{P}^{*N} - \tilde{P}^{*wN}]E(\tilde{P}^{*N} - \tilde{R}^N; \tilde{P}^N - \tilde{R}^{*N}): \end{aligned} \tag{16}$$

Hence, by (15) and (16), we may express the welfare of each country as a function of home and foreign local prices and the terms of trade (as reflected in the two world prices).

Notice an interesting feature of the Cournot delocation model: the terms-of-trade effects of import tariffs and export taxes are . To see this, consider first the impact of an increase in the home import tariff $t_h$ on the world prices $\tilde{P}^{wN}$ and $\tilde{P}^{*wN}$. Using the definitions of the world prices given in (13) and (14), we have $\frac{d\tilde{P}}{dt} = \frac{\partial \tilde{P}}{\partial t} + \frac{\partial \tilde{P}}{\partial} = \frac{\partial \tilde{P}}{\partial} - 1 < 0$ and $\frac{d\tilde{P}^*}{dt} = \frac{\partial \tilde{P}^*}{\partial} = \frac{\partial \tilde{P}^*}{\partial} > 0$, and hence the home import tariff improves the home terms of trade by lowering the world price of home imports and raising the world price of home exports. An analogous statement holds for the foreign import tariff. The terms-of-trade effect of an import tariff in the Cournot delocation model is thus the standard effect expected from competitive models for a country that is large in world markets, and this provides a second motive (in addition to firm delocation) for import tariffs in the model: international cost-shifting.[10]

Now consider the impact of an increase in the home export tax $t_h^*$ on the world prices $\tilde{P}^{wN}$ and $\tilde{P}^{*wN}$. In this case we have $\frac{d\tilde{P}}{dt^*} = \frac{\partial \tilde{P}}{\partial \; *} = \frac{\partial \tilde{P}}{\partial \; *} > 0$ and $\frac{d\tilde{P}^*}{dt^*} = \frac{\partial \tilde{P}^*}{\partial \; *} = \frac{\partial \tilde{P}^*}{\partial \; *} < 0$, and hence, contrary to the standard effect in competitive models, the home export tax the home terms of trade by raising the world price of home imports and lowering the world price of home exports. Again an analogous statement holds for the foreign export tax. Intuitively, a home export tax worsens the home terms-of-trade because of the domestic exit and foreign entry that the export tax induces: as noted above in section 2.2, the anti-competitive effect of the domestic exit induced by the home export tax is sufficient to ra8Td[()@59()9hom(of)-3951(mf)-1(e242)-389o7secomexp mm

(15) and (16) reveal a further and crucial distinction between the perfectly competitive benchmark and the setting we consider here: in the present setting, each country's welfare depends not only upon its own local prices and the world prices, but also on the local prices that prevail in the markets of its trading partner. This is because it is the difference between local prices at home and abroad that determines Nash equilibrium trade volumes and therefore trade tax revenues.

Hence, as (15) and (16) confirm, there is a new international externality present for each government as compared to the competitive benchmark setting: for the home government, in addition to the terms-of-trade externalities that travel through $\tilde{P}^{wN}$ and $\tilde{P}^{*wN}$, there are also (foreign) local price externalities that run through $R^{*N}$ and $\tilde{P}^{*N}$; and similarly, for the foreign government, in addition to the terms-of-trade externalities that travel through $\tilde{P}^{wN}$ and $\tilde{P}^{*wN}$, there are also (home-country) local price externalities that run through $R^{N}$ and $\tilde{P}^{N}$. This indicates a more complex international policy environment than exists under the competitive benchmark, 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, and if not, why not. To answer this question, we need to examine the non-cooperative and efficient policy choices in detail and evaluate the precise reasons for any divergence between them.

## 2.4 Nash Policies and Inefficiency

We next characterize the Nash policy choices, which we interpret to be those policies that governments would choose in the absence of a trade agreement. Using (15) and the fact that $\frac{d}{dt} = 1 = \frac{d\ ^{*}}{dt^{*}}$ by (1), the first-order conditions that define the optimal unilateral policy choices for the home country are given by[13]

$$W_{\tilde{P}} \frac{\partial \tilde{P}^{N}}{\partial} + W_{\tilde{R}} \frac{\partial \tilde{R}^{N}}{\partial} + W_{\tilde{P}} \frac{d\tilde{P}^{wN}}{dt_h} + W_{\tilde{P}^*} \frac{\partial \tilde{P}^{*N}}{\partial} + W_{\tilde{R}^*} \frac{\partial \tilde{R}^{*N}}{\partial} + W_{\tilde{P}^*} \quad \partial \tilde{P}^{*wN}$$

$t_f^*$, and they are given by

$[W_{P'}$

that satisfy the following four conditions:

$$W_{\tilde{P}} \frac{\partial \tilde{P}^N}{\partial} + W_R \frac{\partial R^N}{\partial} + W_{\tilde{P}^*} \frac{\partial \tilde{P}^{*N}}{\partial} + W_{R^*} \frac{\partial R^{*N}}{\partial} = 0; \tag{25}$$

$$W_{\tilde{P}} \frac{\partial \tilde{P}^N}{\partial \;\; ^*} + W_R \frac{\partial R^N}{\partial \;\; ^*} + W_{\tilde{P}^*} \frac{\partial \tilde{P}^{*N}}{\partial \;\; ^*} + W_{R^*} \frac{\partial R^{*N}}{\partial \;\; ^*} = 0;$$

$$W^* \;\; R \;\; ^{\alpha}$$

together, imply the efficiency condition (21); and the second and third conditions in (25), when summed together, imply the efficiency condition (22). Politically optimal tariffs are thus efficient. Put differently, if governments could be induced not to value the pure international rent-shifting associated with the terms-of-trade movements caused by their unilateral tariff choices, then they would set efficient tariffs. Evidently, the firm-delocation motive for trade-policy intervention provides no independent source of international inefficiency in the Cournot delocation model.

It is interesting to compare the Nash and politically optimal trade policies, so that we may understand the nature of the import and export policy commitments that government must make if they are to move from the Nash to the political optimum in the Cournot delocation model. A complete comparison is difficult to undertake without further structure, however. With the restriction of linear demand, we show in Bagwell and Staiger (2009a) that the politically optimal policy is free trade. As we note above, for the linear-demand case, we also show in Bagwell and Staiger (2009a) that the Nash import policy is an import tariff and the Nash export policy is an export tax. As we observe above, it is also true that, beginning from free trade, each government has a unilateral incentive to subsidize its exports. For the linear-demand case, we thus argue in Bagwell and Staiger (2009a) that the efficient political optimum (free trade) requires that governments be restrained from imposing import tariffs and export subsidies, despite the fact that the unilateral incentive to subsidize exports does not arise in the model until import tariffs are restrained to sufficiently low levels.

A final point worth emphasizing is the important role played by both import and export policies

Proposition 1

## 2.6 Reciprocity

An important implication of Proposition 1 is that, for the Cournot delocation 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. To establish this implication, we follow Bagwell and Staiger (1999, 2001) and define tariff changes that conform to 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 general equilibrium interpretation of the model described at the beginning of section 2.1, taking account of trade in the numeraire good, 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[21]

$$[\tilde{P}^{wN}(t_h^0; \ ^{*0}; \ ^{0}) - \tilde{P}^{wN}(t_h^1; \ ^{*1}; \ ^{1})]M( \ ^{*1}; \ ^{1}) \tag{26}$$
$$= [\tilde{P}^{*wN}(t_f^{*0}; \ ^{*0}; \ ^{0}) - \tilde{P}^{*wN}(t_f^{*1}; \ ^{*1}; \ ^{1})]E( \ ^{*1}; \ ^{1}):$$

According to (26), tariff changes that conform to reciprocity imply either that (i) world prices are left unchanged as a result of the tariff changes, so that $\tilde{P}^{wN}(t_h^0; \ ^{*0}; \ ^{0}) = \tilde{P}^{wN}(t_h^1; \ ^{*1}; \ ^{1})$ and $\tilde{P}^{*wN}(t_f^{*0}; \ ^{*0}; \ ^{0}) = \tilde{P}^{*wN}(t_f^{*1}; \ ^{*1}; \ ^{1})$, or (ii) world prices are altered in a net-trade-tax-revenue neutral fashion. 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. Moreover, notice that under (ii) there exists an alternative set of tariff changes which would preserve $^{*1}$ and $^{1}$ and hence $M( \ ^{*1}; \ ^{1})$ and $E( \ ^{*1}; \ ^{1})$ but satisfy $\tilde{P}^{wN}(t_h^0; \ ^{*0}; \ ^{0}) = \tilde{P}^{wN}(t_h^1; \ ^{*1}; \ ^{1})$ and $\tilde{P}^{*wN}(t_f^{*0}; \ ^{*0}; \ ^{0}) = \tilde{P}^{*wN}(t_f^{*1}; \ ^{*1}; \ ^{1})$, and which would therefore continue to satisfy reciprocity and leave each country indifferent between the original tariff changes and this alternative.[22] As a consequence, we can

---

terms-of-trade theory, adding these concerns does not alter the basic reason for a trade agreement (see Bagwell and Staiger, 1999, for a statement of this result in the competitive benchmark setting, and Bagwell and Staiger, 2009, for an extension of this result to a setting of imperfect competition with fixed numbers of firms). In the free-entry setting that we consider in this paper, however, it is not immediately clear how to introduce political economy considerations, because those considerations typically lead governments to place extra weight on producer surplus as they make their trade policy choices, and in our free-entry setting equilibrium producer surplus is always driven to zero. For this reason, we leave the introduction of political economy concerns in this kind of setting to future work.

[21] T[a)-344

henceforth and without loss of generality equate tari¤ changes that conform to reciprocity in this setting with tari¤ changes that leave each world price unaltered.

We are now prepared to interpret and evaluate the principle of reciprocity within the Cournot delocation model. We do so in two steps.[23]

First, beginning from the Nash equilibrium, we wish to evaluate the impacts on home and foreign welfare of small changes in trade policies that reduce the total trade impediments and $^*$ while satisfying reciprocity. We refer to such trade policy changes as .
Notice that with the four trade taxes $t_h$, $t_h^*$, $t_f$ and $t_f^*$, the magnitude of the changes in and $^*$ can be chosen independently while adjusting $t_h$ and $t_f^*$ to maintain $d\tilde{P}^{wN} = 0 = d\tilde{P}^{*wN}$ and thereby satisfy reciprocity (the changes in and $^*$ imply changes in M and E while the changes in $t_h$ and $t_f^*$ imply changes in the volume of numeraire trade which assures reciprocity). Therefore, the reciprocal trade liberalization we consider amounts to a small reduction in (d $< 0$), and a small reduction in $^*$ (d $^* < 0$) whose relative magnitude is given by $\frac{d\ ^*}{d} > 0$, all induced by changes in the four underlying trade taxes which conform to reciprocity and hence satisfy $d\tilde{P}^{wN} = 0 = d\tilde{P}^{*wN}$.

As there is no implied change in either world price, the impact of a small amount of reciprocal trade liberalization on home-country welfare is given by

$$-\{[W_{\tilde{P}} \frac{\partial \tilde{P}^N}{\partial} + W_R \frac{\partial R^N}{\partial} + W_{\tilde{P}^*} \frac{\partial \tilde{P}^{*N}}{\partial} + W_{R^*} \frac{\partial R^{*N}}{\partial}] + [W_{\tilde{P}} \frac{\partial \tilde{P}^N}{\partial\ ^*} + W_R \frac{\partial R^N}{\partial\ ^*} + W_{\tilde{P}^*} \frac{\partial \tilde{P}^{*N}}{\partial\ ^*} + W_{R^*} \frac{\partial R^{*N}}{\partial\ ^*}] \cdot \frac{d\ ^*}{d}\};$$

while the impact on foreign-country welfare is given by

$$-\{[W^*_{\tilde{P}^*} \frac{\partial \tilde{P}^{*N}}{\partial\ ^*} + W^*_{R^*} \frac{\partial R^{*N}}{\partial\ ^*} + W^*_{\tilde{P}} \frac{\partial \tilde{P}^N}{\partial\ ^*} + W^*_R \frac{\partial R^N}{\partial\ ^*}] \cdot \frac{d\ ^*}{d} + [W^*_{\tilde{P}^*} \frac{\partial \tilde{P}^{*N}}{\partial} + W^*_{R^*} \frac{\partial R^{*N}}{\partial} + W^*_{\tilde{P}} \frac{\partial \tilde{P}^N}{\partial} + W^*_R \frac{\partial R^N}{\partial}]\}:$$

Evaluated at the Nash equilibrium de…ned by (17)-(20), the above two expressions reduce respectively to

$$\{[-M^N \cdot (\frac{\partial \tilde{P}^N}{\partial} - 1) + E^N \partial \tilde{P}$$

We wish to explore whether each country gains from at least a small amount of reciprocal trade liberalization. This amounts to asking whether each expression in (27) is positive. The first term in each expression records how each country feels about the small reduction in the total impediment to its import trade. This term is positive because of the firm-delocation effect: an increase in the total impediment to import trade in one country leads to a lower price in that country's market and a higher price in the market of the other country (e.g., for the home country's import trade, we have $\frac{\partial \tilde{P}}{\partial} < 0 < \frac{\partial \tilde{P}^*}{\partial}$). Correspondingly, since reciprocity neutralizes any world-price movements, (17) and (19) imply that each country would desire a reduced total impediment to its import trade

Our second step is to consider the impact of reciprocity when it is applied in response to the reintroduction of trade barriers. In particular, we now establish that, if countries negotiate to the political optimum, then neither country has an interest in unilaterally raising its import tariff or export subsidy if it is understood that such an act would be met with a reciprocal action from its trading partner.

To confirm this observation, consider the impact on home-country welfare if, beginning from the political optimum defined by (25), the home country were to raise slightly its import tariff (increase $t_h$), and in response to this the foreign country were to respond in a reciprocal fashion with its import and export taxes so as to prevent the world prices from changing. Denoting these reciprocal foreign responses by $\frac{dt}{dt}|$ and $\frac{dt^*}{dt}|$, the impact on home-country welfare is given by

$$\{[W_{\tilde{P}} \frac{\partial \tilde{P}^N}{\partial} + W_{\tilde{R}} \frac{\partial \tilde{R}^N}{\partial} + W_{\tilde{P}^*} \frac{\partial \tilde{P}^{*N}}{\partial} + W_{\tilde{R}^*} \frac{\partial \tilde{R}^{*N}}{\partial}] \cdot (1 + \frac{dt_f}{dt_h}| \quad )$$

$$+ [W_{\tilde{P}} \frac{\partial \tilde{P}^N}{\partial}$$

monopolistically competitive firms use a single factor of production to produce differentiated varieties according to an increasing-returns technology, consumer demand for differentiated products takes a CES form, and there is free entry of firms in both home and foreign countries. As before, a freely-traded homogeneous "outside" good is produced with the same factor of production according to a constant-returns technology. The outside good enters linearly into utility and is always produced and consumed in each country in positive amounts. These assumptions have the effect of tying down marginal costs of differentiated-goods production in both countries and eliminating income effects on the demand for differentiated products as well. We allow for the presence of "iceberg" transport costs on the trade in differentiated products between countries, and indeed it is now the savings on transport costs implied by the firm-delocation effects of trade policy intervention – rather than the impacts on competition as in the Cournot model of the previous section – that can enhance the welfare of the intervening country in this setting. Finally, and importantly, in addition to the import policies considered in Helpman and Krugman (1989), we permit governments to pursue export policies as well.

By construction, this model has some very special features As emphasized by Helpman and Krugman (1989), the model displays no terms-of-trade impacts of import tariffs. On the other hand, as we will show, terms-of-trade impacts of export policies present in the model, and in contrast to the Cournot delocation model they are of the conventional kind although somewhat extreme. Be that as it may, our main purpose is again to identify and interpret the sources of inefficiency that arise when governments set their trade policies unilaterally, and to thereby explore the potential role and design of a trade agreement in this environment.

## 3.1 Model Setup

There are two countries (home and foreign), each endowed with a large amount of labor (L and

$Y$ is 1, while the marginal utility of consuming another unit of good $D$ is $(C_D)^{-1}$, and analogously for the utility function $U^*$

form

$$c^i = C_D \cdot \left( \frac{p^i}{P} \right)^{-} ; \quad (33)$$

where $= \frac{1}{1-} > 1$. Plugging into (33) the expression for $C_D$ in (29) and simplifying yields

$$c^i = (p^i)^{-} \; P^{\;\;-} \equiv c^i(p^i; P): \quad (34)$$

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

$$c^{*i} = (p^{*i})^{-} \; (P^*)^{\;\;-} \equiv c^{*i}(p^{*i}; P^*): \quad (35)$$

Notice that, due to the existence of the outside good Y and the way that it enters into the utility functions in (28), there are no income e¤ects on the demand for di¤erentiated products, as (34) and (35) con…rm. This property provides a key simpli…cation that will become very useful once trade policies are introduced below, because with this property the revenue consequences of trade policy intervention have no bearing on the equilibrium conditions in the di¤erentiated products industry (a feature also shared by the Cournot delocation model of the previous section).

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

If a home-country …rm wishes to sell to foreign consumers, we assume that it must confront the following trade costs: an "iceberg" transport cost $> 0$ according to which a fraction of the good is used up in shipment; an ad valorem export tax imposed by the home government at rate $^*_h$ (an export subsidy if $^*_h < 0$); and an ad valorem import tari¤ imposed by the foreign government at rate $^*_f$. We denote (1 plus) the total ad valorem trade impediment on home exports to the foreign market by $^*$, where[25]

$$^* \equiv 1 + \; + \; ^*_h + \; ^*_f: \quad (36)$$

We assume that markets are integrated and focus throughout on non-prohibitive trade costs, so that the wedge between the home market price for a home produced variety i and the price at which that variety sells in the foreign market is given by $p^{*i}_h = \; ^* p^i_h$, where $p^i_h$ denotes the home-market price of a home-produced good and $p^{*i}_h$ denotes the foreign-market price of a home-produced good.[26]

[25] As re‡ected in (36), all trade impediments are expressed in ad valorem terms relative to the factory-gate price ^ (as characterized below). Hence, we as1(mp)-29d pree

Similarly, if a foreign …rm wishes to sell to home-country consumers, we assume that it must confront the following trade costs: the iceberg transport cost according to which a fraction of the good is used up in shipment; an ad valorem export tax imposed by the foreign government at rate ${}_f$ (an export subsidy if ${}_f < 0$); and an ad valorem import tari¤ imposed by the home government at rate ${}_h$. We denote (1 plus) the total ad valorem trade impediment on foreign exports to the home-country market by , where[27]

$$\equiv 1 + \quad + {}_h + {}_f : \tag{37}$$

cost and thereby maximizing pro…ts implies the price choice

$$p_f^{*i} = \frac{\quad}{\quad - 1} \equiv \hat{p} \tag{40}$$

for a foreign …rm producing any variety i. We may now also record the domestic-market price of a (representative) foreign-produced variety:

$$p_f^i = \quad \hat{p} \equiv p_f(\quad); \tag{41}$$

Hence, using (31) and (32) in combination with (38)-(41), if there are $n_h$ home …rms producing di¤erentiated varieties and $n_f$ foreign …rms, then the home and foreign price indexes are given respectively by

$$\begin{aligned} P &= [n_h \cdot \hat{p}^{\frac{a}{a-1}} + n_f \cdot p_f^{\frac{a}{a-1}}]^{\frac{a-1}{a}} \equiv P(n_h; n_f; p_f); \text{ and} \\ P^* &= [n_f \cdot \hat{p}^{\frac{a}{a-1}} + n_h \cdot p_h^{*\frac{a}{a-1}}]^{\frac{a-1}{a}} \equiv P^*(n_h; n_f; p_h^*); \end{aligned} \tag{42}$$

where for notational simplicity we suppress the dependence of $p_f$ on  and $p_h^*$ on $^*$ in what follows. Finally, free entry implies that $n_h$ and $n_f$ adjust to ensure

$$\begin{aligned} c(\hat{p}; P(n_h; n_f; p_f)) + (1 + \quad)c^*(p_h^*; P^*(n_h; n_f; p_h^*)) &= \frac{F}{(\hat{p} - \quad)} \\ c^*(\hat{p}; P^*(n_h; n_f; p_h^*)) + (1 + \quad)c(p_f; P(n_h; n_f; p_f)) &= \frac{F}{(\hat{p} - \quad)}; \end{aligned} \tag{43}$$

where we now utilize the symmetric structure of the model and remove the superscript i's from positive home import tariff $_h$. With $n_h$ and $n_f$ initially held fixed, (42) implies that $p_h^*$ and $P^*$ are unchanged while $P$ and thus $c(\hat{p}; P(n_h; n_f; p_f))$ rise; furthermore, calculations confirm that the rise in $P$ is less than the rise in $p_f$ and that $c(p_f; P(n_h; n_f; p_f))$ falls. It then follows that, holding fixed $n_h$ and $n_f$, a positive home import tariff $_h$ increases the left-hand-side of the top condition in (43) while decreasing the left-hand-side of the bottom condition in (43), implying positive profits for

## 3.2 Representation of Welfare

The impacts of trade taxes on the price indexes $P$ and $P^*$ that we have just described capture the firm-delocation effects associated with trade policy in this setting, but these effects are not by themselves enough to determine the welfare impacts of trade policy, as (30) indicates. We must also determine how trade taxes effect income in each country ($I$ and $I^*$).

To this end, note that our assumption that labor is the only factor of production and that the wage is fixed at 1, in combination with free entry ensuring that profits are zero, implies that income

lo;5.0661P0.909is notentryhat4.504, 7Tf5.6513.959Td[(4.24TJ/F481p(t)1(h)01(i)1(s)-h)-893(i.777051.)

## 3.3 Nash Policies and Ine¢ ciency

We next 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 begin by characterizing the domestic government's best-response import and export policies. Recalling that $p^{*w}$ depends only on $_h^*$ and that $p^w$ is independent of $_h$ and $_h^*$, and noting from (36), (37), (39) and (41) that $p_h^*$ is independent of $_h$ while $p_f$ is independent of $_h^*$, the …rst-order conditions that jointly de…ne the domestic government's best-response import and export policies are given by:

$$V_p \frac{dp_f}{d_{\ h}} = 0; \text{ and} \tag{45}$$

$$V_{p^*} \frac{dp_h^*}{d_{\ h}^*} + V_{p^*} \frac{dp^{*w}}{d_{\ h}^*} = 0:$$

Before turning to characterize the foreign government's best-response policies, it is helpful to delve further into the …rst-order conditions that de…ne the domestic government's best-response that jointly de…ne the foreign government's best-response import and export policies as

$$V_{p^*}^* \frac{dp_h^*}{d\ {}_f^*} = 0; \text{ and} \quad (47)$$

$$V_p^* \frac{dp_f}{d\ {}_f} + V_p^* \frac{@p^w}{@\ {}_f} = 0:$$

The Nash policy choices, which we denote by ${}_h^N$, ${}_h^{*N}$, ${}_f^{*N}$ and ${}_f^N$, are given by the joint solutions to (45) and (47).

To evaluate the e¢ ciency properties of the Nash tari¤ choices, we …rst need to characterize the trade policy choices that would be internationally e¢ cient in this environment. Consider, then, the e¢ cient policies. These are the choices of ${}_h^*$, ${}_f^*$, ${}_f$ and ${}_h$ that maximize $V + V^*$. We note that

$$I(\cdot) + I^*(\cdot) = L + L^* + [p_h^* - \ \hat{p} - \hat{p}]E(p_f; p_h^*) + [p_f - \ \hat{p} - \hat{p}]M(p_f; p_h^*) \equiv K(p_h^*; p_f);$$

and so the world prices $p^w$ and $p^{*w}$ drop out of the sum of domestic and foreign incomes, permitting this sum to be expressed as $K(p_h^*; p_f)$. But this in turn implies that joint welfare may be expressed as

$$V(\cdot) + V^*(\cdot) = (\ \ )^{-1}[P((p_f; p_h^*))]^{-} \ + (\ \ )^{-1}[P^*((p_f; p_h^*))]^{-} \ + K(p_h^*; p_f) \quad (48)$$

$$\equiv G(p_h^*; p_f):$$

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

Using the expression for joint welfare in (48), recalling that $p_h^*$ depends only on $^*$ while $p_f$ depends only on , and using (36) and (37) to con…rm that $\frac{d\ ^*}{d\ ^*} = 1 = \frac{d\ ^*}{d\ ^*}$ and $\frac{d}{d} = 1 = \frac{d}{d}$, it follows that there are only two independent conditions that de…ne e¢ cient choices of ${}_h^*$, ${}_f^*$, ${}_f$ and ${}_h$, [illegible] be expressed as:]

where $\frac{n}{2} \equiv n_h = n_f$. The expression in (51) is the product of two bracketed terms. The first bracketed term is positive, and the second bracketed term is negative (see footnote 29). Hence, the left-hand-side of the condition in (49) is negative when evaluated at global free trade policies ${}^*_h + {}^*_f = 0 = {}_f + {}_h$, indicating that ${}^*_h + {}^*_f < 0$ would then be required to satisfy this condition. An analogous conclusion can be drawn with regard to efficiency condition (50) and the implication that ${}_f + {}_h < 0$ is required to satisfy this condition. Therefore, efficiency in this setting requires that trade be subsidized.[33]

We may now confirm that the Nash tariff choices are indeed inefficient. This can be seen by adding the bottom Nash condition in (45) to the top Nash condition in (47) and the top Nash condition in (45) to the bottom Nash condition in (47) to obtain

$$[V_{p^*} + V^*_{p^*}]\frac{dp^*_h}{d\ {}^*} = -E\frac{dp^{*w}}{d\ {}^*_h}; \quad \text{and} \tag{52}$$

$$[V_p + V^*_p]\frac{dp_f}{d} = -M\frac{dp^w}{d\ {}_f}; \tag{53}$$

governments do not value any world price movements in the political optimum.

Accordingly, politically optimal tari¤s are de…ned by

$$V_{p^*} \frac{dp_h^*}{d\ *} = 0; \qquad (54)$$
$$V_p \frac{dp_f}{d} = 0; \quad \text{and}$$

$$V_{p^*}^* \frac{dp_h^*}{d\ *} = 0; \qquad (55)$$
$$V_p^* \frac{dp_f}{d} = 0:$$

But it is now immediate that the top conditions of (54) and (55) together imply (49), while the bottom conditions of (54) and (55) together imply (50). Hence, politically optimal tari¤s are e¢ cient: if governments could be induced not to value the pure international rent-shifting associated with the terms-of-trade movements induced by their tari¤ choices, they would set e¢ cient tari¤s and there would be nothing left for a trade agreement to do. Evidently, as in the Cournot delocation model of the previous section, the …rm-delocation motive for trade-policy intervention provides no independent source of international ine¢ ciency in the monopolistic competition model of …rm delocation.

Again it is interesting to compare the conditions for politically optimal trade policies (54) and (55) with the Nash conditions (45) and (47). Notice …rst that the Nash import tari¤s for each country are de…ned by the same conditions as the conditions that de…ne their politically optimal import tari¤s. This follows from the special feature of this model which, as we have noted, ensures that import tari¤s have no terms-of-trade e¤ects. On the other hand, as we have observed, export taxes do have terms-of-trade e¤ects in this setting, and these e¤ects account for the di¤erence between the Nash export policy conditions and the politically optimal export policy conditions. In particular, as a comparison of the bottom condition in (45) with the top condition in (54) con…rms, by not valuing the terms-of-trade consequences of its export policy ($V_{p^*} \frac{dp^*}{d\ *} > 0$), the home government is induced by its politically optimal condition to select a lower value of $^*_h$ than it would were its selection determined by its Nash condition. An analogous statement applies to the export policy of the foreign government.

Intuitively, in the Nash equilibrium governments use import tari¤s in this model for the sole purpose of delocating …rms from the markets of their trading partners to their own market and thereby lowering their own price index; an additional impact arises as the trade volume of the …rms that remain located in their trading partners is reduced; and as we have already noted, there is no terms of trade impact of import tari¤s in the model. But governments also use export policies, and here there is an o¤setting incentive: an export subsidy could similarly help to delocate …rms; but an export tax is warranted for terms-of-trade purposes in this model; and this vernme an be set so as to neutralize delocation that might otherwise occur as a result of the import tariff of a trading partner, and it could also be set so as to neutralize any trade volume reduction for offers a novel interpretation of reciprocity and non-discrimination as simple rules that can neutralize the firm-delocation externality. The result stated in Proposition 2 above is at odds with Ossa's first observation, and so it is important to explore the differences across the two papers.

There are two substantive differences between the model employed by Ossa (2009) and the one we develop in this section. A first difference is that Ossa follows Venables (1987) and adopts a specification of utility that allows income effects on the demand for differentiated products, while we follow Helpman and Krugman (1989) and adopt the (quasi linear) specification of utility in (28) that ensures that there will be no such income effects. So along this dimension, Ossa's model is more general than the model we work with in this section. The second difference is related to the first: due to income effects, Ossa's model is difficult to work with when trade taxes imply revenue, and so Ossa assumes for simplicity that trade taxes do not have revenue consequences. Importantly, this assumption requires Ossa to abstract from export policies in his analysis, and focus only on the use of import tariffs. By contrast, the revenue consequences of trade taxes are simple to handle in our quasi-linear setting, because they are soaked up by consumption of the numeraire good, and so we can and do allow for both import tariffs and export taxes; and as we have emphasized above, allowing for a full set of trade policies is crucial for our result.

## 3.5 Reciprocity

As with the Cournot model of the previous section, an important implication of Proposition 2 is that, for the monopolistically competitive firm delocation 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. To establish this, we again follow Bagwell and Staiger (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.

Again taking account of trade in the numeraire good, 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[36]

$$
\begin{aligned}
&[p^w(\tau_f^0) - p^w(\tau_f^1)]M(p_f^1; p_h^{*1}) \\
&= [p^{*w}(\tau_h^{*0}) - p^{*w}(\tau_h^{*1})]E(p_f^1; p_h^{*1}):
\end{aligned}
\tag{56}
$$

As was the case in the previous section, it is clear that there can be no pure international rent shifting across countries as a result of tariff changes that conform to reciprocity: according to (56), such tariff changes imply either that (i) world prices are left unchanged as a result of the tariff changes, so that $p^w(\tau_f^0) = p^w(\tau_f^1)$ and $p^{*w}(\tau_h^{*0}) = p^{*w}(\tau_h^{*1})$, or (ii) world prices are altered in a net-trade–tax-revenue neutral fashion.

35135T]TJ/F2Ohan612(ar3)-3356(o)1-14(c)-1(o)1-14(i)-17(pu36ull)-l340(ax-rev)28(enl340(a40io17210)-3841(utra)1(ue)-o5T]TJ/F2Oh,o5T]TJ3spri)/F28]TJ/06(a40i-333(t)1(o)-39T4)-1(e)-304(t)1(h)-1(ey)-3

We are now prepared to interpret and evaluate the principle of reciprocity in the monopolistic competition model of firm delocation. As in the previous section, we proceed in two steps.

As a first step, it is straightforward to establish that, starting at the Nash equilibrium, the home and foreign countries must both gain from a small adjustment in trade taxes that reduces total trade barriers ( and $^*$, and hence by (39) and (41), $p_f$ and $p_h^*$) and satisfies reciprocity. Consider first a reduction in and $^*$ that is engineered with a small reduction in the home and foreign import tariffs $_h$ and $^*_f$. As we have observed, the special features of this model imply that import tariffs have no impacts on world prices, and so by (56) reductions in $_h$ and $^*_f$ will conform to reciprocity in this model.[37] But then, evaluated at the Nash conditions given by (45) and (47), the impact on home and foreign welfare of a small (reciprocal) reduction in $_h$ and $^*_f$ is given respectively by

$$-\{V_p \frac{dp_f}{d\ _h} + V_{p^*}\frac{dp_h^*}{d\ ^*_f}\} = -\{V_p \frac{dp_f}{d\ _h} + V_{p^*}\frac{dp_h^*}{d\ ^*_h}\} = -V_{p^*}\frac{dp_h^*}{d\ ^*_h} = E^N\frac{dp^{*w}}{d\ ^*_h} > 0; \text{ and}$$

$$-\{V^*_{p^*}\frac{dp_h^*}{d\ ^*_f} + V_p^*\frac{dp_f}{d\ _h}\} = -\{V^*_{p^*}\frac{dp_h^*}{d\ ^*_f} + V_p^*\frac{dp_f}{d\ _f}\} = -V_p^*\frac{dp_f}{d\ _f} = M^N\frac{dp^w}{d\ _f} > 0:$$

With analogous arguments, it can be shown that both countries gain from a small reduction in and $^*$ that is engineered with reciprocal reductions in the home and foreign export taxes $^*_h$ and $_f$ from their Nash levels. In particular, it follows from (56) that the reduction in $_f$ that is required to satisfy reciprocity in response to a small reduction in $^*_h$, which we denote by $\frac{d}{d\ ^*}|$ , is defined by

$$\frac{d\ _f}{d\ ^*_h}| = \frac{E^0}{M^0}; \tag{57}$$

where $M^0$ and $E^0$ denote the initial levels of home-country imports and exports, respectively.[38] But then, evaluated at the Nash conditions given by (45) and (47) and using (57), the impact on home and foreign welfare of a small reciprocal reduction in $^*_h$ and $_f$ is given respectively by

$$-\{V_p \frac{dp_f}{d\ _f}\frac{d\ _f}{d\ ^*_h}| + V_{p^*}\frac{dp_h^*}{d\ ^*_h} + V_{p^*}\frac{dp^{*w}}{d\ ^*_h} + V_p\frac{dp^w}{d\ _f}\frac{d\ _f}{d\ ^*_h}|\} = E^N\frac{dp^w}{d\ _f} > 0; \text{ and}$$

$$-\{V^*_{p^*}\frac{dp_h^*}{d\ ^*_h} + V_p^*\frac{dp_f}{d\ _f}\frac{d\ _f}{d\ ^*_h}| + V^*_{p^*}\frac{dp^{*w}}{d\ ^*_h} + V_p^*\frac{dp^w}{d\ _f}\frac{d\ _f}{d\ ^*_h}|\} = E^N\frac{dp^{*w}}{d\ ^*_h} > 0:$$

Our second step is to consider the impact of reciprocity when it is applied in response to the reintroduction of trade barriers. Specifically, we now establish that, if countries negotiate to the political optimum, then neither country has an interest in unilaterally raising its import tariff or export tax if it is understood that such an act would be met with a reciprocal action from its trading

[37] Intuitively, this simply reflects the fact that in this model each country is "small" with regard to its import tariff, and for a small country a change in its trade policy must lead to equal changes in the volume of its imports and exports by the condition that trade must remain balanced at the (fixed) world prices.

[38] The expression in (57) may be derived in the same way as (56) by considering small tariff changes and dropping second-order terms, and using —— = ^ = $\frac{*}{*}$.

partner. To confirm this observation, let us begin at the politically optimal policies defined by (54) and (55). Clearly, neither country has any incentive to raise its import tariff above its politically optimal level, because as (45) and (47) confirm the condition that defines the politically optimal level of each country's import tariff is the same as that which defines its Nash level (and as we have observed, no policy response from the trading partner is warranted to maintain reciprocity in this case). Consider next export policies. If the home country were to raise $^{*}_{h}$ beginning from the political optimum, and the foreign government were to reciprocate according to $\frac{d}{d\ ^{*}}|$ , the impact on home-country welfare would be given by

$$V_p \ \frac{dp_f}{d\ _f}\frac{d\ _f}{d\ ^{*}_{h}}| \quad + V_p$$

motive for trade policy intervention and argue that the basic rationale for a trade agreement is, in fact, the same rationale that arises in perfectly competitive markets. In both the Cournot and monopolistically competitive models of firm delocation, the rationale for a trade agreement is to remedy the inefficiency attributable to the terms-of-trade externality. Furthermore, and again as in the benchmark model with perfect competition, we show that the principle of reciprocity is efficiency enhancing, as it serves to "undo" the terms-of-trade driven inefficiency that occurs when governments pursue unilateral trade policies.

Our analysis thus suggests that the broad 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 fixed and profit-shifting effects are featured. With this suggestion we do not mean to imply that extending the analysis of trade agreements to imperfectly competitive markets is unimportant. On the contrary, as Ossa (2009) emphasizes, such work is critical for extending the applicability of the trade agreements literature to better reflect the realities of international trading patterns. In addition, novel insights emerge once we move outside of the setting of perfect competition; for example, as we argue in Bagwell and Staiger (2009a), the novel implications of the Cournot delocation model for export policies provides a new way of understanding export subsidy agreements. Rather, our point is simply that the terms-of-trade approach to trade agreements remains valid in imperfectly competitive settings as the foundation from which to evaluate and interpret the design of trade agreements in light of the underlying problems that they exist to solve.

Finally, 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. Of increasing urgency in the world economy are problems – such as global warming – that feature international externalities that take a non-pecuniary form. An important task for future research is to characterize the form that an efficiency-enhancing agreement might take when the underlying problems stem from non-pecuniary externalities.

## References


Antras, P. and R. W. Staiger (2008), "O¤shoring and the Role of Trade Agreements," NBER Working Paper No. 14285, August.

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

Bagwell, K. and R. W. Staiger (2001), "Reciprocity, Non-discrimination and Preferential Agreements in the Multilateral Trading System," , 17, 281-325.

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

Bagwell, K. and R. W. Staiger (2009), "Pro…t Shifting and Trade Agreements in Imperfectly Competitive Markets," NBER Working Paper Number 14803, March.

Bagwell, K. and R. W. Staiger (2009a), "The Economics of Trade Agreements in the Linear Cournot Delocation Model," unpublished manuscript, Stanford University

Brander, J. A. (1981), "Intra-Industry Trade in Identical Commodities," , 11, 1-14.

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

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

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

Grossman, G. M. and E. Helpman (1995), "Trade Wars and Trade Talks," , 103, 675-708.

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

Johnson, H. G. (1953-54), "Optimum Tari¤s and Retaliation," , 21, 142-53.

Krugman, P. R. (1980), "Scale Economies, Product Di¤erentiation, and the Pattern of Trade," , 70, 950-99.

Melitz, M. J. and G. I. P. Ottaviano (2008), "Market Size, Trade, and Productivity," 75, pp. 295-316.

Ossa, R. (2009), "A 'New-Trade' Theory of GATT/WTO Negotiations," unpublished manuscript, University of Chicago.

Samuelson, P.A. (1954), "The Transfer Problem and Transpor25(m)131(nd)-39aosts P244)-47dnonysis4(ransoctly)-ransE

## Figure 1
## Firm Delocation in the Cournot Model