Strategic Competition and Optimal Parallel Import Policy*

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Abstract

In two-country Hotelling type duopoly model of price competition, we show that parallel import (PI) policy can act as an instrument of strategic trade policy. The home firm’s profit is higher when it cannot price discriminate internationally if and only if the foreign market is sufficiently bigger than the domestic one. The key mechanism in the model is that the home firm’s incentive to keep its domestic price close to the optimal monopoly price affects its behavior during price competition abroad. We also analyze the welfare implications of PI policies and show that our key insights extend to quantity competition.

Keywords: Parallel Imports, Exports, Trade Policy, Oligopoly, Product Differentiation, Market Structure, Welfare.

JEL Classifications: F13, F10, F15.

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1 Introduction

This paper shows that a country’s policy stance towards parallel imports (PIs) can serve as an instrument of strategic trade policy by altering the behavior of its firm during price competition abroad.\(^1\) It is well recognized that restrictions on PIs affect the ability of a monopolist to engage in price discrimination across markets with consequent welfare implications. What is not understood, however, is the effect PI policies have on strategic conduct and rent acquisition by firms engaged in competition in international markets, and how, in turn, these considerations influence the welfare calculus determining optimal PI policies.

In our two-country duopoly model, the products of the two firms are assumed to be differentiated horizontally on a Hotelling product space. To be able to export successfully, the home firm must first incur a fixed investment cost that is irreversible in nature. The timing of decisions is as follows. First, the two governments (home and foreign) choose their PI policies: each government faces a discrete choice – to permit or forbid PIs. Next, the home firm decides whether or not to bear the fixed investment cost necessary to export. Finally, firms choose prices: if the home firm exports, firms compete in prices; otherwise each firm operates as a monopolist in its local market.

An important insight of our analysis is that, when PIs are prohibited by the home country, the domestic firm can reduce its price in the foreign market without a commensurate reduction in its domestic price, and as a result, it becomes a more aggressive price competitor in the foreign market relative to when PIs are permitted. While the freedom to reduce price abroad without lowering domestic profits tends to increase the domestic firm’s foreign market share, it also increases the intensity of price competition and therefore reduces equilibrium market power in the foreign market. If sufficiently strong, this reduction in market power undermines the export profitability of the domestic firm and therefore creates a rationale for permitting PIs as opposed to restricting them.\(^2\) It should be observed that this insight is novel to the existing literature on PIs that has tended to focus largely on the monopoly case.\(^3\) To see why this matters, note that if the domestic firm were a global monopolist, then ceteris paribus, a restriction on PIs should (at least weakly) increase its incentive to serve the foreign market – after all, a monopolist is always free to charge a common price in both markets if it is profit maximizing to do so.

We find that when price competition abroad is intense, the home country is ‘decisive’ in the sense that only its PI policy affects the market outcome. Similarly, when competition abroad is weak, only the foreign country’s policy is consequential. An important result of our analysis is that, despite the presence of strategic considerations, a country’s nationally optimal policy can sometimes be globally optimal. This congruence between national and global welfare

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\(^1\) PIs occur when a product protected by some form of intellectual property rights sold by the rights holder in one country is re-sold in another country without the right holder’s permission.

\(^2\) In their seminal contribution to optimal strategic trade policy under oligopolistic competition, Grossman and Eaton (1986) showed that it may be optimal to impose an export tax on the home firm in order to soften international price competition; our paper indicates that PI policy can play a similar role.

\(^3\) For example, Malueg and Schwartz (1994), Richardson (2002), Valletti (2006), all assume that the product market is monopolistic. There do exist several analyses of international oligopoly with integrated and segmented markets see, among others, Markusen and Venables (1988) and Venables (1990). Unlike this literature, in our model national PI policies endogenously determine whether markets are segmented or integrated.
obtains when the home country is decisive and the fixed costs of exporting are not too large so that inducing exports is nationally as well as globally optimal. Interestingly, we show that such a pro-trade (i.e. export inducing) PI policy is not unique; rather, underlying parameters determine whether permitting or prohibiting PIs induces exports.

On the other hand, when the foreign country is decisive, it always chooses to permit PIs. Such openness to PIs on its part can not only deter the home firm from exporting, but can also lower overall world welfare when the fixed cost of exporting is not too large. By showing that openness to PIs is not necessarily pro-trade and that such openness can create a significant international externality, the model helps gain some insight into the issue of when and why coordination over PI policies might be useful.

As is clear from above, an important aspect of our approach is that the home firm’s decision to export is endogenous. This formulation is motivated by a host of empirical evidence which indicates that pricing regulations (which also affect the ability of firms to price discriminate internationally) have a significant influence on the entry of firms into foreign markets – see the empirical evidence discussed in the recent overview article by Goldberg (2010). Furthermore, prior theoretical work on PIs has explicitly argued that price regulations and PI policies can lead firms to serve (or not serve) certain markets – see, for example, Malueg and Schwartz (1994).

In the current literature on PIs, the incentive for individual nations to impose restrictions on PIs primarily takes into account three sets of factors that result from the increased ability of firms to engage in international price discrimination. First, the change in domestic consumer welfare resulting from higher domestic retail prices in markets with more inelastic demand including the possibility that certain markets with very elastic demands may be served only when firms can price discriminate sufficiently – see Malueg and Schwarz (1994). Second, the increased ability of manufacturers to engage in vertical controls such as resale price maintenance and exclusive territories to protect retailers from competitive rent dissipation and free riding by foreign sellers which on the one hand, reduces retail competition thus increasing retail price, and on the other hand, increases the incentive of retailers to invest in marketing, advertising and retail infrastructure that eventually benefits domestic consumers and expands demand – see Maskus and Chen (2002 and 2004) and Raff and Schmitt (2007). Third, the increased ability of governments to regulate domestic market power for various purposes and to preserve rent for private investment in R&D and production of intellectual property without having to contend with the dissipation of this rent through international arbitrage – see Li and Maskus (2006), Valletti (2006), Valletti and Szymanski (2006), and Grossman and Lai (2008). The structure of our model highlights a novel consequence of a restrictive PI policy viz., the change in the competitiveness of the domestic firm in the foreign market arising from its ability to charge a low price abroad without suffering any erosion in its domestic market power, the consequent change in the rent earned by the firm abroad and, in the final analysis, its very incentive to export. In Roy and Saggi (2012) we analyze PI policies in a vertically differentiated international oligopoly where, unlike this paper, there is no asymmetry in potential market access for firms, and the focus is on relating equilibrium government policies to differences in the structure of demand between countries.

The literature on industrial organization contains extensive analysis of entry and oligopolis-
tic competition when firms have captive market segments and may or may not be able to price discriminate across market segments (see, Stole 2007). In particular, various authors have examined the consequence of regulations such as "universal service obligations" that prevent price discrimination across market segments (see, among others, Armstrong and Vickers 1993, Valletti et al 2002, Anton et al 2002). The comparison of market outcomes and regulations in this literature is often based on aggregate welfare of all market segments. By contrast, we assume that the ability to price discriminate across national boundaries is determined by independent policy decisions of various nations where each nation cares only about its own national surplus.

The paper is organized as follows. Section 2 describes the model while sections 3 and 4 derive equilibrium PI policies under strong and weak competition respectively. Section 5 discusses to what degree our results are robust to the mode of competition by considering a model where firms compete in quantities as opposed to prices. Section 6 concludes. Proofs and some mathematical details are contained in the Appendix.

2 Model

There are two countries: home (H) and foreign (F). Firm $h$, the home country's domestic firm, sells a patented product locally that it can also export to the foreign market if it incurs the fixed cost $\phi \geq 0$. The foreign country has its own domestic firm, called the foreign firm (denoted by $f$), whose product is horizontally differentiated from that of the home firm. Firm $f$ cannot sell its product in the country $H$, perhaps because its product infringes firm $h$'s patent.

We adopt the Hotelling linear city model of horizontal product differentiation where the product space is the unit interval $[0,1]$; the home firm is located at 0 and the foreign firm at 1. Both firms produce at zero cost. The market in each country consists of a continuum of consumers whose most desired product types are distributed uniformly on the unit interval. Each consumer buys one or zero unit of a product and earns gross surplus $V$ from consuming the product. If a consumer consumes a product whose actual product type is located at a distance $d$ from her "most desired" product type, she incurs a (psychological) transport cost $td$, $t > 0$, in addition to paying the price charged. The total mass of consumers in country $i$ is given by $n_i \geq 0$, $i = H, F$. Without loss of generality, we set $n_H = 1$ and $n_F = \beta$.

Each country chooses between one of two policy options: to allow PIs without any restrictions (P) or to not allow them at all (N). To focus on the strategic interaction between firms and governments, we assume that any price differentials between the two countries are perfectly arbitraged by the retail sector so long as PIs are permitted by the relevant/high-price country.\footnote{This simplifying assumption is common in the literature. However, under oligopoly, a firm can price discriminate internationally even if its home country is open to parallel trade, provided that the number of firms differs across the two markets (see, among others, Ganslandt and Maskus, 2007).}

Formally, the game proceeds in three stages. First, the two governments decide whether or not to allow PIs. Next, the home firm decides whether or not to enter the foreign market.
Finally, firms set prices in every market they serve. We determine the subgame perfect Nash equilibrium outcome of this game.

We assume that:

\[
\beta > \frac{2}{3} \\
\frac{3}{2}t \leq V < \frac{11}{3}t
\]  

(1)  

(2)

Restriction (1) and the second inequality in (2) together ensure that when the home firm does not pre-commit to exclude the foreign market, there exists a pure strategy equilibrium where it sells a strictly positive quantity in that market. The first inequality in (2) ensures that when both firms serve the foreign market, all consumers buy in equilibrium (complete market coverage); it also implies that \( V > t \) so that it is socially optimal for all consumers to buy.

For \( i = h, f \), denote the price, the quantity sold and the profit earned by firm \( i \) in its domestic and foreign markets by \((p_i, q_i, \pi_i)\) and \((p_i^*, q_i^*, \pi_i^*)\), respectively. If firm \( i \) is the only firm serving its local market, then the domestic demand it faces is given by:

\[
D_i(p_i) = n_i, p_i \leq V - t \\
= n_i \frac{V - p_i}{t}, p_i \geq V - t.
\]

(3)  

(4)

The domestic monopoly price \( p_i^m \) and monopoly quantity \( q_i^m \) of firm \( i \) that maximize its domestic profit are given by:

\[
p_i^m = V - t, q_i^m = 1, \text{ if } V \geq 2t
\]  

(5)

and

\[
p_i^m = \frac{V}{2}, q_i^m = \frac{V}{2t}, \text{ if } V \leq 2t.
\]  

(6)

If the home firm exports and all buyers buy, demand in the foreign country for the home firm’s product is given by:

\[
d_h(p_h^*, p_f) = \beta \left[ \frac{1}{2} + \frac{p_f - p_h^*}{2t} \right], \text{ if } (p_f - p_h^*) \in [-t, t]
\]  

(7)

\[
= 0, \text{ if } (p_f - p_h^*) \leq -t
\]

\[
= \beta, \text{ if } (p_f - p_h^*) \geq t,
\]

while demand facing the foreign firm is given by

\[
d_f(p_h^*, p_f) = \beta - d_h(p_h^*, p_f).
\]  

(8)

Using these demand functions, we can show that if the home firm can price discriminate across the two markets, its reaction function in the foreign market is:

\[
p_h^* = \frac{t + p_f}{2}.
\]  

(9)
while that of the foreign firm is:

\[ p_f = \frac{t + p_h^*}{2}. \]  

(10)

These reaction functions assume that the prices are not too large in the sense that the market is fully covered. Given these reaction functions, the unique Nash equilibrium outcome of price competition is given by:

\[ p_h^* = p_f = t \]  

(11)

with each firm selling to half the market. Each firm’s profits (gross of any fixed cost of serving the market) in the foreign country are given by:

\[ \pi_h^* = \pi_f = \beta \frac{t}{2}. \]  

(12)

Observe that in the above equilibrium, competitive price \((t)\) is lower than the monopoly price \((\max\{V - t, \frac{V}{2}\})\) if, and only if, \(V \geq 2t\). In particular, if \(V < 2t\), then the competitive outcome generates prices in the foreign country that are higher than the monopoly price. In fact, while the monopoly price depends on gross surplus \(V\), the competitive price is independent of \(V\). With competition, firms split the market and therefore the marginal buyer’s taste or desired product is closer to the product each firm sells which, in turn, induces the firms to charge higher prices relative to a monopoly situation (the marginal buyer’s taste is further away from the actual product type). We shall call this the niche effect.

In what follows, we refer to the situation where \(V \geq 2t\) as strong competition and the situation where \(V < 2t\) as weak competition; this also accords with the standard interpretation of higher values of \(t\) implying greater product differentiation and hence, softer price competition. As we shall show below, since only the home firm has the ability to export, only one country’s PI policy ends up mattering. Under strong competition, if the home country is open to PIs then the home firm cannot price discriminate internationally and the foreign country’s PI policy is irrelevant. Similarly, when competition is weak, only the PI policy of the foreign country matters whereas the PI policy of the home country is not consequential. We begin with the strong competition case.

### 3 PI policy under strong competition

In this section, we analyze the policy and market outcomes where \(V \geq 2t\) and competition in the foreign country is strong. Recall that under assumption (2), \(V \leq \frac{11}{3}t\).

#### 3.1 Market outcome

If the home firm decides not to export, then the market outcome in each country is independent of PI policies and is simply the autarkic monopoly outcome. In the rest of this subsection, we focus on the situation where the home firm chooses to export.

To begin, consider the situation where both countries prohibit parallel trade. In this policy environment, pricing decisions in the two markets are independent and the home firm charges its optimal monopoly price at home and all consumers buy. In the foreign country, equilibrium
prices are given by (11) and the two firms split the foreign market evenly. Profits (gross of the fixed cost of exporting) are given by:

\[ \pi_h^N = V - t, \quad \pi_f^N = \pi_f^B = \beta \frac{t}{2}. \]  

(13)

Observe that \( V \geq 2t \) implies that \( p_h^N = V - t \geq p_h^B = t \) i.e., the domestic price of the home firm exceeds its foreign price, so that, as long as the home country prohibits PIs, the equilibrium market outcome remains unchanged even if the foreign country allows PIs (i.e. it prevents the home firm from charging a lower price in its domestic market). Indeed, this is the unique equilibrium market outcome when the home country prohibits PIs, regardless of the PI policy of the foreign country.

Next, consider the market outcome when both countries allow PIs so that the home firm is constrained to charge identical prices in both markets, i.e., \( p_h = p_f^B \). The profit function for the home firm has a kink at \( p_h = V - t \) which is the highest price at which all consumers buy. The reaction function (44) is described in the Appendix. This reaction function has three parts. The first part of the reaction function corresponds to the situation where the rival’s price is sufficiently low so that the home firm also charges a low price (below its home monopoly price) to be competitive abroad; at such price, the home firm sells to all buyers at home. The second part of the reaction function (which is flat) reflects a situation where the price charged by the foreign firm is moderately high so that the home firm can charge its optimal monopoly price in the home market without losing much market share in the foreign market. In this range, even when the rival raises its price, the jump discontinuity in the marginal revenue of the home firm (at the home monopoly price where it sells to all home consumers) prevents the home firm from altering its best response. The last part of the reaction function corresponds to the situation where the foreign firm’s price is so high that the home firm is induced to expropriate more revenue out of foreign buyers that have a closer taste for its product by raising its home rice above the optimal monopoly price – under such a situation, the home firm forsakes some profit in the domestic market to increase its profit in the foreign market. The foreign firm’s reaction function is identical to that in (10). It can be checked that the (unique) Nash equilibrium outcome is given by:

\[ p_h^F = t \left( \frac{4}{3\beta} + 1 \right) \]  

and

\[ p_f^F = V - t \]  

if \( V > 2t \left( \frac{2}{3\beta} + 1 \right) \)

(14)

\[ \]  

and

\[ p_h^F = V - t \]  

and

\[ p_f^F = \frac{V}{2} \]  

if \( 2t \leq V \leq 2t \left( \frac{2}{3\beta} + 1 \right) \)

(15)

Note that if \( V > 2t \left( \frac{2}{3\beta} + 1 \right) \) then \( t \left( \frac{4}{3\beta} + 1 \right) < (V - t) \) so that the equilibrium described in (14) corresponds to a situation where the foreign firm’s reaction intersects the home firm’s reaction in the first of its three parts described in (44); the equilibrium described in (15) corresponds to an intersection in the second part of the home firm’s reaction. In both cases, the home firm charges a price less than or equal to \( V - t \), its optimal monopoly price at home. The Nash equilibrium outcome described above remains unperturbed even if the foreign
country does not allow PIs so that the home firm is free to charge a lower price in its domestic market in the home country. Indeed, for \( V \geq 2t \), this is the unique Nash equilibrium outcome when the home country allows PIs, independent of the PI policy of the foreign country. The quantities sold in this equilibrium are given by:

\[
q_h^P = 1, \quad q_h^P = \frac{\beta}{2} - \frac{1}{3}, \quad q_f^P = \frac{\beta}{2} + \frac{1}{3}, \text{ if } V > 2t \left( \frac{2}{3\beta} + 1 \right)
\]

and

\[
q_h^P = 1, \quad q_h^P = \beta \left( 1 - \frac{V}{4t} \right), \quad q_f^P = \frac{\beta V}{4t}, \text{ if } 2t \leq V \leq 2t \left( \frac{2}{3\beta} + 1 \right).
\]

Assumption (1) ensures that all quantities are strictly positive. Observe that, \( p_h^P > p_f^P \) which reflects the fact that the home firm is less aggressive in price competition than the foreign firm because it loses profit in its home market if it reduces price (below its monopoly price); this results in a lower market share for the home firm. Since \( p_h^P \leq V - t \), all consumers buy in the home country and therefore, the quantity sold in the home country is identical to that when the home firm is free to price discriminate between the two countries. Also observe that the prices are higher than what the two firms charge in the foreign market when the home firm can price discriminate: in other words, non-discrimination softens price competition.

The literature on PIs has emphasized that allowing PIs reduces domestic price and increase domestic consumers surplus. This effect can also be seen here as long the home firm serves the foreign market. Whether or not PIs are permitted, all consumers buy in the home market. If \( V > 2t \left( \frac{2}{3\beta} + 1 \right) \), then the home price falls from \( (V - t) \) to \( t \left( \frac{4}{3\beta} + 1 \right) \) when the home country moves from a policy of prohibiting PIs to allowing PIs, which raises the domestic consumer surplus at home (total transport cost remains unchanged). If \( V \leq 2t \left( \frac{2}{3\beta} + 1 \right) \), the home price and home consumers surplus remain unaffected by PI policy.

In the range of parameter values where the equilibrium price of the home firm is strictly below \( (V - t) \), the prices charged by both firms decline with \( \beta \), the relative size of the market in the foreign country. If \( V > 2t \left( \frac{4}{3\beta} + 1 \right) \) firm profits (gross of the fixed cost of exporting) are as follows:

\[
\pi_h^P = t \left( \frac{4}{3\beta} + 1 \right), \quad \pi_h^P = t \left( \frac{4}{3\beta} + 1 \right) \left( \frac{\beta}{2} - \frac{1}{3} \right), \quad \text{and } \pi_f^P = t \left( \frac{2}{3\beta} + 1 \right) \left( \frac{\beta}{2} + \frac{1}{3} \right)
\]

whereas if \( 2t \leq V \leq 2t \left( \frac{2}{3\beta} + 1 \right) \) we have

\[
\pi_h^P = V - t, \quad \pi_h^P = \beta(V - t) \left( 1 - \frac{V}{4t} \right), \quad \text{and } \pi_f^P = \frac{\beta V^2}{8t}.
\]

It can be checked that

\[
\pi_h^P \geq \pi_h^{N} \iff \beta \geq \beta^* \equiv \frac{4}{3} \max \left\{ 1, \frac{t}{V - 2t} \right\}.
\]
i.e., if the home firm exports, it earns higher profit under non-discriminatory pricing (than under price discrimination) if, and only if, the size of the foreign market ($\beta$) exceeds the critical threshold $\beta^*$. 

Using (1) and the second inequality in (2), we have that $\pi_h^P + \pi^P > V - t$, so that the home firm is always better off serving both markets than simply serving the home market if the fixed cost $\phi = 0$.  

To sum up, when $V \geq 2t$ (strong competition) and the home country allows PIs, the following hold: (i) If the home firm chooses to export, it charges a common price in both markets that does not exceed the monopoly price in its domestic market and lies strictly below the latter if competition is very strong (in which case it sacrifices domestic profit when it serves the foreign market). (ii) All consumers buy in the home country. (iii) Both firms charge prices that are higher than what they would if the home firm could price discriminate between the two markets. (iv) The home firm charges a higher price and has lower market share in the foreign country than the foreign firm and the gross foreign profit of the home firm is higher than what it earns if it is free to price discriminate between the two markets if, and only, if $\beta \geq \beta^*$ i.e., the foreign market is relatively large.

### 3.2 Policy outcome

From our discussion in the previous section, it follows that under strong competition, the market outcome is independent of the PI policy of the foreign country. All that matters is whether or not the home country allows PIs. The next proposition describes the optimal policy of the home country:

**Proposition 1** Suppose $V \geq 2t$ (strong competition). Then, the following hold:

(i) If $\beta \leq \beta^*$ then it is optimal for the home country to prohibit PIs. This is the unique optimal policy if $\beta < \beta^*$ and $\phi < \pi_h^N$ (otherwise the home country is indifferent between the two policies). Further, for $\beta < \beta^*$ and $\phi \in [\pi_h^P, \pi_h^N]$, the home country’s prohibition of PIs is pro-trade i.e. it induces the home firm to export.

(ii) If $\beta \geq \beta^*$ then it is optimal for the home country to allow PIs. This is the unique optimal policy if $\beta > \beta^*$ and $\phi < \pi_h^P$ (otherwise the home country is indifferent between the two policies). Further, for $\beta > \beta^*$ and $\phi \in [\pi_h^N, \pi_h^P]$, the home country’s openness to PIs is pro-trade i.e. it induces the home firm to export.

The proof of the proposition is straightforward. Regardless of the home country’s policy, the home firm sells to all consumers in the home market so that total domestic surplus generated in the home country is independent of its PI policy. Thus, the only way in which PI policy of the home country affects domestic welfare is via its impact on the net foreign rent acquired by the home firm in the foreign country. From our discussion in the previous section (and particularly, using (20)), we know that the home country can increase the rent acquired by the home firm in the foreign market by allowing PIs if, and only if, $\beta \geq \beta^*$. The rest of the proposition follows immediately.

---

5 For $V > 2t \left( \frac{2}{3\pi} + 1 \right)$, $t + \pi_h^P + \pi^P = t[1 + \left( \frac{1}{\phi + 1} \right) \left( \frac{1}{2} + \frac{1}{3} \right)]$ which is minimized at $\beta = \frac{1}{3}$ and therefore, is no larger than $\frac{11}{3}t < V$ (using (2)).
Thus, when competition in the foreign market is strong, the home country’s PI policy is based exclusively on the profitability of its firm. When the foreign market is not significantly larger a home prohibition on PIs allows the domestic firm to price discriminate internationally and thereby creates the most profitable conditions for it in the foreign market (and therefore provides the most inducement to export). On the other hand, if the foreign market is significantly larger, allowing PIs and preventing the domestic firm from price discrimination creates the best opportunity for it to extract rent from the foreign market. This is because such a policy softens price competition abroad by making the domestic firm less willing to lower its price, and the profit gain from being able to charge higher prices outweighs the competitive disadvantage that the domestic firm suffers by being constrained to charge the same price in both markets. The nationally optimal PI policy under strong competition is always pro-trade; in particular, when the foreign market is not significantly larger in size and the fixed cost of exporting is moderately large, it is the prohibition of PIs that induces the home firm to export.

3.3 Global welfare analysis under strong competition

In this section, we analyze the implications of the optimal policy choice by the decisive country (the home country in the case of strong competition) for global welfare which, in our model, equals the total net surplus of the two countries.

To begin, observe that as both markets are fully covered in equilibrium, as long as the home firm serves the foreign market, the only difference in global surplus across market outcomes induced by alternative PI policies of the home country is in the total transport cost incurred by consumers in the foreign market. If PIs are not allowed by the home country and the home firm exports, then the market outcome in the foreign country is one where each firm has equal market share; this is the "first best" outcome as it minimizes total transport cost. If PIs are allowed and the home firm exports, it sells to less than half the foreign market which adds to the transport cost in the foreign market and therefore leads to loss of welfare. However, this does not mean that prohibiting PIs is always globally efficient as the home firm may then choose to not serve the foreign market. If the home firm chooses to abandon the foreign market as a consequence of change in PI policy, then the global welfare implication is based on a comparison of the increase in transport cost when only one (instead of two) products are sold in the foreign market and the fixed cost of serving the foreign market. The next proposition outlines the welfare implications of optimal policy:

Proposition 2 Suppose $V \geq 2t$ (strong competition). Then, the following hold:

(i) Suppose $\phi \leq \min\{\pi_h^P, \pi_h^N\}$. If $\beta \leq \beta^*$ then the home country’s policy decision to prohibit PIs is globally efficient. On the other hand, if $\beta > \beta^*$ then the home country’s policy decision to permit PIs is globally inefficient.

(ii) Suppose $\min\{\pi_h^P, \pi_h^N\} \leq \phi \leq \max\{\pi_h^P, \pi_h^N\}$. Then, the following hold:

(ii.a) When $\beta \leq \beta^*$ the home country’s policy decision to prohibit PIs is globally efficient if $\phi \leq t\beta$: otherwise, it is inefficient.

(ii.b) When $\beta > \beta^*$ the home country’s policy decision to permit PIs is globally efficient if $\phi \leq t\beta(\frac{1}{\phi} - \frac{1}{\beta^*})$; otherwise it is inefficient.
A formal proof of this proposition is in the appendix.

Part (i) of Proposition 2 describes a situation where the fixed costs of exporting are small so that the home firm exports to the foreign country regardless of the PI policy of the home country. As indicated above, in that case, the equilibrium policy outcome is efficient (first best) if, and only if, the home country prohibits PIs and using Proposition 1, this occurs if, and only if, \( \beta \leq \beta^* \). Parts (ii.a) and (ii.b) refer to a situation where the PI policy of the home country does affect the home firm’s incentive to export. Under such a scenario, the home country’s optimal policy is one that induces its firm to export to the foreign country. However, this product market outcome is globally efficient only when the fixed cost of exporting is not larger than the reduction in total transport cost in the foreign market when the home firm exports (at uniform or discriminatory pricing depending on the nature of the optimal PI policy of the home government which, as we have seen in Proposition 1 depends on whether \( \beta \) is above or below \( \beta^* \)).

Proposition 2 generally indicates that unless the fixed cost of exporting is large and/or the foreign market is significantly larger than the home market, the home country’s policy choice is globally optimal and there may be little reason for international intervention or coordination over PI policies. Note that this conclusion also applies to nations that choose to prohibit PIs from relatively similar sized countries.

4 Weak competition and PI policy

In this section, we analyze the policy and market outcomes where \( V < 2t \) i.e., competition in the foreign country is weak. Recall that under assumption (2), \( V \geq \frac{2}{3}t \) so that we effectively confine attention to \( V \in (\frac{2}{3}t, 2t) \). In order to ensure that the duopoly outcome in the foreign market is always one with complete market coverage (all consumers buy), we need the following additional restriction:

\[
t < \frac{5 + 3\beta}{4 + 3\beta} \tag{21}
\]

Note that (21) is always satisfied if \( t < 1 \).

4.1 Market outcome with weak competition

As under strong competition, we focus on the situation where the home firm exports. To begin, consider the situation where both countries prohibit PIs. If so, in the foreign country, the equilibrium prices are as indicated in (11) and the firms split the market evenly. Profits (gross of the fixed cost of serving the foreign market) are given by:

\[
\pi_h^N = \frac{V^2}{4t}, \quad \pi_f^N = \pi_f^N = \beta \frac{t}{2}. \tag{22}
\]

Observe that \( V < 2t \) implies that \( p_h^N = \frac{V}{2} < p_h^N = t \) i.e., the domestic price of the home firm is below its competitive foreign price. Since the foreign country is "decisive" under weak competition, this equilibrium market outcome remains unchanged even if the home country allows PIs as long as the foreign country prohibits PIs. Net welfare generated in the foreign
country in the above market outcome is given by:

\[ W_F^N = \beta V - \beta \int_0^{q_N^*} tx dx - \beta \int_0^{q_N^*} tx dx - \pi_N^* = \beta \left( V - \frac{3t}{4} \right) \quad (23) \]

Next, suppose that both countries allow PIs so that the home firm cannot price discriminate. Recall that in this case the domestic monopoly price of the home firm is \( \frac{V}{2} > V - t \). Suppose the home firm serves the foreign market. The reaction functions of the two firms continue to be as given by (10) and (44) as in the previous section. However, the (unique) Nash equilibrium outcome is one where the foreign firm’s reaction function intersects the home firm’s reaction in the third part of the three parts described in (44). In particular, the equilibrium prices are:

\[ p_h^P = \left( \frac{4V + 3\beta t}{8 + 3\beta} \right) \quad \text{and} \quad p_f^P = \left( \frac{2V + (3\beta + 4)t}{8 + 3\beta} \right). \quad (24) \]

The quantities sold in this equilibrium are given by:

\[ q_h^P = \frac{1}{t} \left( \frac{4V + 3\beta(V - t)}{8 + 3\beta} \right), \quad q_h^* = \beta \left( \frac{1}{2} + \frac{1}{t} \frac{12t - V}{8 + 3\beta} \right), \quad \text{and} \quad q_f^P = \beta \left( \frac{1}{2} - \frac{1}{t} \frac{12t - V}{8 + 3\beta} \right). \quad (25) \]

It is easy to check that under (21), all consumers earn positive net surplus. The equilibrium common price \( p_h^P \) charged by the home firm satisfies:

\[ p_h^P > \frac{V}{2} > V - t \]

and further

\[ p_h^P < p_f^P \quad \text{and} \quad q_h^* > q_f^P. \]

In other words, in trying to compete in the foreign market under non-discriminatory pricing, the home firm actually ends up raising both its own price (as well as its rival’s price) above its domestic monopoly price. As a result, the home firm is more reluctant to raise its price than the foreign firm, and hence relatively more aggressive in price competition (over this range of prices) despite the fact that the foreign firm has no captive market. This reflects the niche effect that we discussed earlier; as competition is weak and consumers care strongly about taste, firms have an incentive to raise prices sharply when they serve a small number of consumers whose tastes are close to their product type.

The fact that \( p_h^P \) exceeds the optimal monopoly price \( \left( \frac{V}{2} \right) \) of the home firm also implies that the Nash equilibrium described above remains unperturbed if the home country were to prohibit parallel trade i.e., if the home firm were allowed to charge a higher price in its domestic market. Indeed, for \( V < 2t \), this is the unique Nash equilibrium outcome when the foreign country allows PIs, independent of the PI policy of the home country.

The gross foreign profit earned by the home firm when it charges a common price in both
markets is given by:

\[
\pi_h^P = p_h q_h^P = \beta \left( \frac{4V + 3\beta t}{8 + 3\beta} \right) \left( \frac{1}{2} + \frac{12t - V}{t(8 + 3\beta)} \right). \tag{26}
\]

Even though the price charged by the home firm is higher than its domestic monopoly price (i.e. \(p_f^P > \frac{V}{2}\)), it is lower than what it would charge in the foreign country if it could price discriminate (wherein it charges \(t\) abroad) since \(V < 2t\) implies \(p_h^P < t\). It is easy to check that even though the home firm earns a higher market share in the foreign country than it would if it could price discriminate (where firms split the market evenly), the profit it earns under non-discriminatory pricing in the foreign country is lower:

\[
\pi_h^P < \pi_h^N = \frac{t\beta}{2}. \tag{27}
\]

The aggregate profit of the home firm exceeds its monopoly profit at home and the home firm always serves the foreign market if the fixed cost \(\phi = 0\).^6

Total foreign welfare (when \(V < 2t\) and the home firm exports) is given by

\[
W_F^P = \beta V - \beta \int_0^{q_f^P} tx \, dx - \beta \int_0^{q_h^P} tx \, dx - \pi_h^P
= q_h^P \left( \frac{t}{\beta} q_f^P - p_h^P \right) + \frac{\beta}{2}(2V - t). \tag{28}
\]

It can be checked that \(W_F^P > W_F^N\): i.e., the home firm generates higher net welfare in the foreign country when it serves that market with nondiscriminatory pricing rather than with discrimination. Even though the home firm holds higher market share under non-discrimination and, in particular, causes loss of welfare by increasing the taste related "psychological cost" incurred by buyers, it also expropriates less rent and the latter effect dominates.

4.2 Policy outcome with weak competition

From our discussion in the previous subsection, it follows that the market outcome is independent of the PI policy of the home country, the exporting nation. All that matters is whether or not the foreign country, the importing nation, allows PIs. We have:

\textbf{Proposition 3} Suppose \(V < 2t\). If \(\phi \leq \pi_h^N\), then it is optimal for the foreign country to permit PIs, while for \(\phi > \pi_h^N\) the PI policy of the foreign country has no impact on the market outcome. In particular, if \(\phi \leq \pi_h^P\), if the foreign country allows PIs then the home firm exports to its market charging a non-discriminatory price in both countries whereas if \(\phi \in [\pi_h^P, \pi_h^N]\), then the foreign country’s openness to PIs deters the home firm from exporting and preserves the foreign firm’s local monopoly.

The proof of this proposition is outlined in the appendix.

---

^6In particular, using \(V < 2t\) and (2), we have \(\pi_h^P + \pi_h^N = \frac{(4V + 3\beta t)^2(2 + \beta)}{2t(8 + 3\beta)^2} > \frac{V^2}{4t}\).
Proposition 3 indicates that unlike the case of strong competition, for the range of parameters for which the choice of PI policy matters for the market outcome, the decisive country under weak competition has a unique nationally optimal policy choice and it is one of allowing PIs. By allowing PIs, the foreign country prevents price discrimination by the home firm that, in turn, actually reduces the rent that the home firm can extract via exporting (though it increases the firm’s market share in the foreign country). With weak competition, reducing rent transfer abroad becomes the driving motive of the foreign country’s policy. In fact, if the fixed cost of exporting exceeds a certain level, the optimal policy of allowing PIs by the foreign country deters entry by the home firm and leads to autarky.

4.3 Global welfare under weak competition

We now analyze the global welfare implication when competition is weak. Since the foreign country is decisive here, it is sufficient to focus on its policy. We can state the following result (proved in the appendix):

**Proposition 4** Suppose \( V < 2 \tau \) (Weak Competition). Then, the following hold:

(i) If \( \phi \leq \pi^P_h \) then the foreign country’s decision to permit PIs is globally inefficient.

(ii) If \( \pi^P_h < \phi \leq \pi^N_h \) then the foreign country’s policy to permit PIs is globally suboptimal if \( \phi \) is small whereas it is globally optimal if \( \phi \) is large enough i.e. it lies within the interval \( (\pi^P_h, \pi^N_h] \).

Thus, under weak competition, not only is the market outcome dependent only on the PI policy of the importing nation (the foreign country), but the nationally optimal policy choice of the foreign country generates an outcome that is globally inefficient unless the fixed cost \( \tau \) of serving the foreign market is very large. In particular, with weak competition the foreign country’s optimal policy of allowing PIs to prevent price discrimination is geared towards reducing the rent expropriated by the foreign firm, and this is what leads to global inefficiency.

5 Alternative modeling: quantity competition

In this section, we examine whether the qualitative nature of our results extends to Cournot quantity competition. To this end, consider a Cournot version of our two country model with one firm in each country. For simplicity, the fixed cost of exporting is ignored and production cost is normalized to zero. As before, only the home firm \((h)\) can sell in the foreign market while the foreign firm \((f)\) only serves its domestic market. Market demand at home is given by \( Q_H = a - p \) while that in the foreign country is given by \( Q_F = 1 - p \) where

\[
a > \frac{1}{4}
\]  

(29)

Suppose the home firm serves both markets. If neither country allows PIs, we obtain the
usual monopoly and Cournot duopoly outcomes where the home firm produces quantities

\[ x_h = \frac{a}{2}, x_h^* = \frac{1}{3} \]  

(30)

in the home and foreign markets respectively, while the foreign firm produces

\[ x_f = \frac{1}{3} \]  

(31)

Prices in the two markets are

\[ p_H^D = \frac{a}{2}, p_F^D = \frac{1}{3}. \]  

(32)

In the above discriminatory outcome (denoted with superscript \( D \)), firm profits are given by:

\[ \pi_h^D = \frac{a^2}{4} + \frac{1}{9}, \pi_f^D = \frac{1}{9} \]  

(33)

while the consumer surplus and welfare in the two countries equal

\[ CS_H^D = \frac{a^2}{8}, CS_F^D = \frac{4}{18} \]  

(34)

and

\[ W_H^D = \frac{3a^2}{8} + \frac{1}{9}, W_F^D = \frac{1}{3} \]  

(35)

respectively. Observe that

\[ p_H^D \geq p_F^D \text{ if and only if } a \geq a^* = \frac{2}{3}. \]

Thus, if \( a > a^* \) i.e., home demand is not much smaller, then the above discriminating outcome continues to be an equilibrium even if the foreign country allows PIs and only the PI policy of the home country can be consequential. On the other hand, if \( a < a^* \) i.e., home demand is significantly smaller, then the above discriminating outcome continues to be an equilibrium even if the home country allows PI, and only the PI policy of the foreign country is consequential.

Now, suppose that the home firm cannot price discriminate because of the prevalent PI policies. Let firm \( i \)'s output in the absence of price discrimination be denoted by \( q_i \). We look for an equilibrium where the home firm sells in both markets: \( q_h > 0 \) at home and \( q_f^* > 0 \) in the foreign market. Obviously, such an outcome requires that home demand is not too large relative to foreign demand and in particular, we require that

\[ a < \frac{1}{a^*} \]  

(36)

The reaction functions (45) and (46) of the two firms are described in the Appendix. If \( q_f \) is zero, the home firm produces a higher quantity under the no discrimination constraint as long
as home demand is smaller i.e., \( a < 1 \). However, the no discrimination constraint increases the slope of the home firm’s reaction function i.e., the home firm is much more willing to contract its output in response to rival’s expansion of output. Under strategic substitutability, the first effect (i.e. the outward shift in its reaction function) increases the market share of the home firm while the second effect (i.e. an increase in the slope of its reaction function) depresses it. Whether the first effect dominates the second depends on the value of \( a \), the parameter which determines the relative size of two markets. Using the reaction functions (45) and (46), the equilibrium values \( q_h^* \), \( q_f \) and \( q_f \) can be easily derived:

\[
q_h^* = \frac{3 - 2a}{5}, q_f = \frac{1 + a}{5}
\]  
\[
q_f = \frac{4a - 1}{5}
\]

Note that \( q_h^* > 0 \), \( q_h > 0 \) under restrictions (29) and (36) i.e., for \( a \in (\frac{3a^*}{4}, \frac{1}{4}) \). The uniform price in the two markets in this equilibrium is given by:

\[
p^U = \frac{a + 1}{5}
\]

The profits of the two firms under the uniform pricing constraint are as follows:

\[
\pi_h^U = p^U(q_h + q_h^*) = \frac{2}{25}(1 + a)^2
\]
\[
\pi_f^U = \frac{1}{25}(1 + a)^2.
\]

Comparing the equilibrium quantities, prices and profits under uniform pricing constraint (given by (37) - (41)) to the outcome in the absence of any such constraint (given by (30) to (33)) we have the following:

(a) \( q_h^* \leq x_h^* \) if, and only if, \( a \geq a^* \)
(b) \( q_f \geq x_f \) if, and only if, \( a \geq a^* \)
(c) \( p^U \geq p_f^D \) if, and only if, \( a \geq a^* \)
(d) \( p^U < p_f^D \) if, and only if, \( a \leq a^* \).
(e) \( \pi_f^U \geq \pi_f^D \) if, and only if, \( a \geq a^* \)
(f) \( \pi_h^U \geq \pi_h^D \) if, and only if, \( a \in [\frac{14}{51}, a^*] \).

If home demand is relatively small \( (a < a^*) \), the home firm has a strong incentive to keep price low and therefore, is rather aggressive in competing in the foreign market under the uniform pricing constraint which, in turn, leads to higher quantity being sold by the home firm in the foreign market; under strategic substitutability, this reduces the quantity sold by the foreign firm, its profit and the price in the foreign market. The profit of the home firm is higher under the uniform pricing constraint (except for a narrow range of parameters where the size of home demand is extremely small i.e., \( a \in (0.25, 0.28) \)). This shows that even under Cournot competition, a liberal PI regime that forces the home firm to not price discriminate across markets, can actually raise its total profit and increase its incentive to serve the foreign market. The difference with the price competition case is that the rival foreign firm is hurt
under Cournot competition (because of strategic substitutability) whereas it benefits under price competition. If home demand is relatively large \((a \in (a^*, 1/a^*))\), the opposite holds. Under uniform pricing constraint, the home firm is more conservative in selling in the foreign market because it takes into account the loss in its home profit as it reduces the price below its optimal monopoly price at home in order to compete abroad (the second effect outlined above dominates). The foreign firm sells more and earns higher profit, trade is smaller and the profit of the home firm is lower than under price discrimination. More generally, the uniform pricing constraint reduces the incentive of the home firm to serve the foreign market.

The consumers surplus and total welfare generated in each country under the uniform pricing constraint are as follows:

\[
CS_H^U = \frac{(4a - 1)^2}{50}, \quad CS_F^U = \frac{(4 - a)^2}{50}
\]

\[
W_H^U = \frac{(4a - 1)^2}{50} + \frac{2}{25}(1 + a)^2, \quad W_F^U = \frac{(4 - a)^2}{50} + \frac{1}{25}(1 + a)^2
\]

Comparing (34), (35) with (42),(43) we obtain:

(g) \(CS_H^U \geq CS_F^U\) if and only if \(a \geq a^*\)

(h) \(CS_F^U \geq CS_F^D\) if and only if \(a \leq a^*\)

(i) \(W_H^U \geq W_F^D\) if and only if \(a \geq a^*\)

(j) \(W_F^U > W_F^D\) (under (36) i.e., \(a < 1/a^*\)).

Thus, for the entire range for which the interior uniform pricing equilibrium exists, the foreign country prefers the uniform pricing outcome. As the foreign country’s PI policy is decisive when home demand is relatively smaller i.e., for \(a \leq a^*\), it will allow PIs in this range leading to the uniform pricing outcome; for this range, the home country prefers the discriminating outcome but its own PI policy is inconsequential. This works to the advantage of foreign consumers, to the disadvantage of home consumers; paradoxically, it works to the advantage of the home firm and against the interest of the foreign firm. On the other hand, if home demand is somewhat large and in particular, \(a \in (a^*, \frac{1}{a^*})\), the home government is decisive and it allows PI to ensure the uniform pricing outcome; though that is not in the interest of the home firm, it benefits home consumers, foreign consumers and the foreign firm; the policy is anti-trade. Thus, for the entire range of parameters for which there is an interior uniform pricing equilibrium, PIs are permitted by whichever government is decisive.

What if home demand is significantly larger and \(a \geq 1/a^*?\) In that case, under uniform pricing, there is no interior equilibrium with \(q_h^* > 0\). The home firm simply sells zero in the foreign market and we have the monopoly outcome in each market. It is easy to see that the home government, whose PI policy is decisive in this range, would prefer to prohibit PIs in this range so that the home firm can get rent from the foreign market without losing monopoly profit at home. Here, the optimal policy of prohibiting PIs is pro trade.

As is clear from the above analysis, several key qualitative results obtained in the model with price competition continue to hold in the Cournot framework. First, a permissive PI policy regime that forces the home firm to engage in uniform pricing can increase its total profit, and therefore its incentive to serve the foreign market. This is one of the key effects
underlying our results in Section 3. Under price competition, the captive market at home makes the home firm unwilling to price low in the foreign market under uniform pricing, and due to strategic complementarity it also induces to the foreign firm to charge a higher price. In the Cournot competition case, the mechanism through which uniform pricing benefits the home firm is somewhat different. When home demand is relatively smaller than foreign demand, the captive market at home induces the home firm to maintain low uniform price across the two markets which, in turn, induces it to produce large quantity in the foreign markets; the no discrimination constraint in effect helps the home firm to credibly commit to sell large quantities and shifts its reaction function out. Because of strategic substitutability, this tends to reduce the market share of the foreign firm thus creating an advantage for the home firm. But there is an opposing effect of the no discrimination constraint: the home firm is much more willing to contract its output in response to any expansion of the rival’s output (i.e. it makes the home firm’s reaction function steeper). This is because the home firm may sell more at home to equalize prices suffering loss in its home profit and, to reduce this loss, it is willing to cut back its foreign output more aggressively. This "more accommodating" stance of the home firm in response to expansion of output by the foreign firm works against the first effect. Whether the first effect dominates the second depends on the relative size of home demand. When home demand is relatively low, the uniform pricing constraint induced by a permissive PI policy raises the home firm’s profit and in fact, increases its market share in the foreign market as well as the volume of trade.

Second, in the Cournot case when home demand is significantly large relative to foreign demand, the home government prohibits PIs in order to induce the home firm to serve the foreign market; if there were a positive fixed cost of serving the foreign market this effect would be further enhanced. This is very similar to the result obtained with price competition.

Third, in the Cournot case, if home demand is not significantly larger than foreign demand and the home government’s PI policy is decisive, it prefers to allow PIs; this is comparable to our result that with price competition, the home government permits PIs under price competition when the foreign market is significantly larger and the home government is decisive (which happens when competition is strong). Finally, wherever the foreign government’s PIs policy is decisive, it allows PIs (as in the weak competition case under price competition).

As one would expect, not all results under quantity competition are qualitatively similar to those under price competition. The main differences between quantity and price competition are regarding the effect of policy on quantity exported and whether the optimal policy is pro-trade. Further, unlike the case of price competition, the effects of PI policy on profits of the two firms may go in opposite directions; this is also true about the effect on home welfare and the profit of home firm.

6 Conclusion

This paper derives optimal national PI policies in an environment where such policies affect strategic price competition. This is in sharp contrast with the existing literature on PIs that has tended to focus almost exclusively on monopoly. Our findings suggest that a country’s PI policy can act as a strategic trade policy by altering the competitiveness of its firms engaged
in oligopolistic competition abroad. More specifically, when competition is intense in our model, a prohibition of PIs by the home country allows the home firm to lower its price abroad without suffering any reduction in its domestic market power. This increased ability to compete abroad without having to lower its domestic price increases the firm’s incentive to export and its overall profit provided that the foreign market is not significantly larger than the domestic one. On the other hand, when the foreign market is significantly larger, allowing PIs and preventing the home firm from engaging in price discrimination softens price competition abroad by making the domestic firm less willing to lower its price, and the profit gain from being able to charge higher prices abroad outweighs the competitive disadvantage that the domestic firm suffers by being constrained to charge the same price in both markets. Regardless of the relative size of the two markets, under strong competition, the nationally optimal PI policy is always pro-trade, i.e., it induces the home firm to export.

Our analysis also points out that when market competition is weak, openness to PIs on the part of the home country makes its firm less willing to lower price abroad thereby softening international price competition and making exporting more attractive. Thus, whether forbidding PIs is in the national interest or not depends upon whether the home firm is better off having the freedom to price discriminate internationally or not.

We also investigate the welfare properties of national PI policies. An important and somewhat surprising result of our analysis is that nationally optimal PI policies can sometimes be globally optimal, eliminating the need for international coordination over such policies. Such congruence between national and global interests occurs when the policy chosen is pro-trade (i.e., export inducing) and the fixed costs of exporting small. On the other hand, openness to PIs that results in the preservation of a local monopoly is not only anti-trade but can also be globally inefficient.

An important feature of our model is that the home firm enjoys monopoly power at home but faces competition in the foreign market. While the existence of asymmetry in market power is important for our results, the precise nature of this asymmetry is less so. We expect that our qualitative results should hold even if the home firm faces some competition in the home market (from, say, a local firm) as long as the intensity of competition is significantly lower in the home market than in the foreign market.

Appendix

Details of Section 3.1 The gross total profit of the home firm if it exports is given by:

\[ p_h [1 + d_h(p_h, p_f)], \text{ for } p_h \geq V - t \]

and

\[ p_h \left[ \frac{V - p_h}{t} + d_h(p_h, p_f) \right], \text{ for } p_h \in [V - t, V] \]
where $d_h$ is given by (7). Maximizing the two parts of the profit function with respect to $p_h$ taking into account the boundary constraints, we obtain the reaction function of the home firm. Let $p_f$ and $\overline{p}_f$ be defined as follows:

$$p_f = 2V - t \left( 3 + \frac{2}{\beta} \right) \quad \text{and} \quad \overline{p}_f = 2 \left( 1 + \frac{1}{\beta} \right) V - t \left( 3 + \frac{4}{\beta} \right).$$

It is easy to check that $p_f < \overline{p}_f$ and that $p_f$ and $\overline{p}_f$ are strictly positive if $V$ is large relative to $t$, and less than zero if $V$ is close to $t$.

The reaction function of the home firm is given by:

$$\begin{align*}
\rho_h &= \left( \frac{2 + \beta}{\beta} \right) \frac{t}{2} + \frac{p_f}{2}, \text{ if } p_f > 0 \text{ and } p_f \in \left[ 0, \overline{p}_f \right] \\
&= V - t, \text{ if } \overline{p}_f > 0 \text{ and } p_f \in \left[ \max\{0, p_f\}, \overline{p}_f \right] \\
&= \frac{1}{2(2 + \beta)} [(2V + \beta t) + \beta p_f], \text{ if } p_f \geq \max\{0, \overline{p}_f\}.
\end{align*}$$

**Details of Section 5.** Consider the case where the home firm must charge uniform prices at home and abroad. Given $(q_h, q_f^*)$, the foreign firm sets its output $q_f$ to maximize $q_f(1 - (q_h^* + q_f))$ which yields the usual Cournot reaction function:

$$q_f = \frac{1 - q_h^*}{f}$$

Given $q_f$, the quantity produced by the foreign firm, the home firm sets $(q_h, q_h^*)$ to equalize home and foreign prices $a - q_h = 1 - (q_h^* + q_f)$ which yields:

$$q_h = (a - 1) + (q_h^* + q_f)$$

In other words, when price discrimination across markets is not possible, the home firm’s output levels are chosen so as to ensure that prices in the two markets are equalized. The objective of the home firm is to maximize its joint profit in both markets:

$$\begin{align*}
&[1 - (q_h^* + q_f)][q_h + q_h^*] \\
&= [1 - (q_h^* + q_f)][(a - 1) + (2q_h^* + q_f)], \text{ using (46)},
\end{align*}$$

Writing the first order condition with respect to $q_h^*$ yields the following reaction of the home firm’s export:

$$q_h^* = \frac{3 - a}{4} - \frac{3}{4}q_f.$$

It is worth comparing the reaction function of the home firm (47) in the foreign market under the no discrimination constraint with its reaction function if the markets were segmented, the latter being given by:

$$q_h^* = \frac{1}{2} - \frac{1}{2}q_f.$$
First, observe that if \( q_f \) is zero, the reaction of the home firm is to produce higher quantity under the no discrimination constraint as long as home demand is smaller i.e., \( a < 1 \). Second, observe that the no discrimination constraint increases the slope of the home firm’s reaction function, i.e. \( \left| \frac{\partial q_h}{\partial q_f} \right| \), from \( \frac{1}{2} \) to \( \frac{2}{3} \) which means that the home firm is much more willing to contract its output in response to rival’s expansion of output.

**Proof of Proposition 2.** Suppose the home country permits PIs. Then, the home firm serves the foreign market as long as \( \phi \leq \pi_h^* \) with the market outcome described by (14) - (19). Note that all consumers buy in the home country so that there is no domestic welfare distortion in that country. For \( \phi \leq \pi_h^* \), global welfare is given by (using (16) and (17)):

\[
W^P = (1 + \beta) \left( V - \frac{t}{2} \right) + t\beta \left( 1 - \frac{1}{3\beta^2} \right) - \phi, \text{ if } V > 2t \left( \frac{2}{3\beta} + 1 \right) \tag{49}
\]

\[
W^P = (1 + \beta) \left( V - \frac{t}{2} \right) + t\beta \left( \frac{1}{4t} \right) \frac{V}{4t} - \phi, \text{ if } V \leq 2t \left( \frac{2}{3\beta} + 1 \right). \tag{50}
\]

If \( \phi > \pi_h^* \), then the home firm does not serve the foreign market and global welfare is given by:

\[
W^P = (1 + \beta) \left( V - \frac{t}{2} \right). \tag{51}
\]

Next, suppose that the home country prohibits PI. As before, all consumers in the home country buy so that there is no distortion in the home country. If the home firm serves the market in the foreign country, it price discriminates between the two markets and the market in the foreign country is split evenly between the two firms. The home firm chooses to export as long as \( \phi \leq \pi_h^{\star N} \) where \( \pi_h^{\star N} = \frac{t\beta}{2} \) and in that case, global welfare is given by:

\[
W^N = (1 + \beta) \left( V - \frac{t}{2} \right) + \frac{t\beta}{4} - \phi. \tag{52}
\]

If \( \phi > \pi_h^{\star N} \), then the home firm does not export and global welfare is given by:

\[
W^N = (1 + \beta) \left( V - \frac{t}{2} \right). \tag{53}
\]

Observe that for \( \phi \leq \pi_h^* \), from (49) and (50), when the home country allows PIs global welfare satisfies:\footnote{For \( V \leq 2t \left( \frac{2}{3\beta} + 1 \right), \beta > \frac{2}{3} \) implies \( \frac{V}{4t} < 1 \) and therefore \( (1 - \frac{V}{4t}) \frac{V}{4t} \leq \frac{1}{4} \).}

\[
W^P < (1 + \beta) \left( V - \frac{t}{2} \right) + \frac{t\beta}{4} - \phi.
\]

Comparing to the expression in (52), it follows therefore that for \( \phi \leq \min \{ \pi_h^* , \pi_h^{\star N} \} \), \( W^P < W^N \) i.e., it is globally efficient for the home country to prohibit PIs and thereby permit international price discrimination. Part (i) of the proposition follows immediately from Proposition 1.
try size $\beta^*$ as defined in (20). If $\beta \leq \beta^*$, $\pi^{N}_h \geq \pi^{P}_h$ and in that case for $\phi \in [\pi^{P}_h, \pi^{N}_h]$, global welfare is given by (51) when the home country allows PIs and by (52) when it does not which, in turn, implies that it is globally efficient for the home country to permit PIs if $\max\{t\beta, \pi^{P}_h\} \leq \phi \leq \phi^{N}_h$ and to not permit if $\phi^{N}_h \leq \phi \leq \min\{t\beta, \pi^{N}_h\}$. If $\beta \geq \beta^*$ then $\phi^{N}_h \leq \phi \leq \phi^{P}_h$ and in that case, for $\phi \in [\pi^{N}_h, \pi^{P}_h]$, global welfare is given by (49) when the home country allows PIs, and by (53) when the home country prohibits PIs which, in turn, implies that it is globally efficient for the home country to permit PIs if $\phi^{N}_h \leq \phi \leq \min\{t\beta, \pi^{N}_h\}$ and to not permit if $\phi \leq \min\{t\beta, \pi^{N}_h\}$. Finally, note that for $\phi \geq \max\{\pi^{P}_h, \phi^{N}_h\}$, global welfare is independent of the policy choice of the home country.

Proof of Proposition 3. The proof of the proposition follows directly from the discussion in Section 4.1. When the foreign country permits PIs it generates the nondiscriminatory pricing outcome, while prohibiting PIs allows the home firm to price discriminate in equilibrium. As shown in the previous subsection, the home firm generates higher net welfare in the foreign country when it serves that market with nondiscriminatory pricing rather than with discrimination i.e., $W^P_F > W^N_F$. However, we have also seen that the gross foreign profit of the home firm under the two PI policy options of the foreign country satisfy: $\pi^{P}_h < \pi^{N}_h$. It follows that if $\phi \leq \pi^{P}_h$, the home firm serves the foreign market independent of the PI policy of the foreign country and in that case, it is optimal for the foreign country to allow PIs. On the other hand, if $\phi \in [\pi^{P}_h, \pi^{N}_h]$, then the home firm serves the foreign market only if the foreign country prohibits PIs, in which case the welfare of the foreign country is given by $W^N_F$; if the foreign country allows PIs, the market in the foreign country is monopolized by the foreign firm which then charges the monopoly price $\frac{V}{2t}$, sells to $\beta \frac{V}{2t}$ buyers and leads to welfare:

$$\hat{W}_F = \beta \left( \frac{V^2}{2t} - \int_0^{\frac{V}{2t}} tx \, dx \right)$$

It can be shown that $W^N_F < \hat{W}_F$ for $V \in (\frac{3}{2}t, 2t)$ so that it is optimal for the foreign country to permit PIs to prevent the home firm from entering its market.\footnote{It is straightforward to establish that $W^N_F < \hat{W}_F$ if $3V^2 + 6t^2 - 8tV > 0$. Furthermore, we have $3V^2 + 6t^2 - 8tV = (2t - V)^2 + 2t(\frac{3}{2}V - t)$ which is positive for $V \geq \frac{3}{2}t$ and $3V^2 + 6t^2 - 8tV = (V - t)^2 + t(t - \frac{3}{2}V)$ which is positive for $V \leq \frac{3}{2}t$.}

Proof of Proposition 4. Suppose the foreign country permits PI. Then, if the home firm serves the foreign market it charges identical price in both markets and the market outcome described by (24), (25) and (26). The home firm exports as long as $\phi \leq \pi^{P}_h$ where

$$\pi^{P}_h = \beta \left( \frac{1}{2} + \frac{2t - V}{8 + 3\beta} \right) \left( \frac{4V + 3\beta t}{8 + 3\beta} \right)$$

For $\phi \leq \pi^{P}_h$, global welfare is given by (25), $W^P = \beta(V - \frac{t}{2}) + q^P_h(V - \frac{t}{2}q^P_h) + t\beta \left( \frac{1}{2} + \frac{1}{8 + 3\beta} \right) \left( \frac{1}{2} - \frac{1}{8 + 3\beta} \right) - \phi < \beta(V - \frac{t}{2}) + q^P_h(V - \frac{t}{2}q^P_h) + \frac{t\beta}{8 + 3\beta} - \phi$, where (using (25) and $V < 2t$), $q^P_h = \frac{1}{7} \left( \frac{4V + 3\beta(V - t)}{8 + 3\beta} \right) < \frac{V}{2t}$ so that $\frac{t^2 q^P_h}{2t} < \frac{t}{2}$ and since the function $x(V - x)$ is
increasing on \([0, \frac{V}{2t}]\), we have \(q^P_h(V - \frac{t}{2} q^P_h) = \frac{2}{t} \left[ \frac{t}{2} q^P_h (V - \frac{t}{2} q^P_h) \right] \leq \frac{2V^2}{3t} = \frac{3V^2}{6t}\). Thus,

\[
W^P < \beta \left( V - \frac{t}{2} \right) + \frac{3V^2}{8t} + \frac{t\beta}{4} - \phi, \text{ for } \phi \leq \pi^*_{h}.
\] 

If \(\phi > \pi^*_{h}\), then the home firm does not serve the foreign market and we have local monopoly in each country with the monopoly price being \(\frac{V}{2t}\). In this case, global welfare is given by:

\[
W^P = (1 + \beta) \left[ \left( \frac{V}{2t} \right) V - \int_0^{\frac{V}{2t}} txdx \right] = (1 + \beta) \frac{3V^2}{8t}, \text{ for } \phi > \pi^*_{h}.
\] 

Next, suppose that the foreign country prohibits PIs. If the home firm exports, it price discriminates between the two markets, sells the monopoly quantity \(\frac{V}{2t}\) in its domestic market while the foreign market is split evenly between the two firms. The home firm serves the foreign market as long as \(\phi \leq \pi^*_{h} = \frac{t\beta}{2}\). Thus, when the foreign country prohibits PIs, global welfare is given by:

\[
W^N = \beta(V - \frac{t}{2}) + \frac{t\beta}{4} + \frac{3}{8t} V^2 - \phi, \text{ for } \phi \leq \pi^*_{h}.
\] 

If \(\phi > \pi^*_{h}\), then the home firm does not export and we have \(W^N = (1 + \beta) \frac{3V^2}{8t}\) for \(\phi > \pi^*_{h}\). Note that \(\pi^*_{h} = \beta \left( \frac{1}{2} + \frac{1}{t} \frac{V}{8 + 3\beta} \right) \left( \frac{4V + 3t}{8 + 3\beta} \right) < \pi^*_{h} = \frac{t\beta}{2}\). If \(\phi \leq \pi^*_{h}\), then the home firm exports whether or not the foreign country allows PIs, and comparing (55) and (57), we have \(W^P < W^N\): i.e. it is globally efficient for the foreign country to prohibit PIs. If \(\phi \in (\pi^*_{h}, \pi^*_{h})\), then the home firm exports only if PIs are prohibited by the foreign country. Comparing (56) and (57), we have\(W^P - W^N = (1 + \beta) \frac{3V^2}{8t} - \beta (V - \frac{t}{2}) - \frac{t\beta}{4} - \frac{3}{8t} V^2 + \phi = \beta \left( \frac{3V^2}{8t} - V + \frac{t}{4} \right) + \phi\) which is positive if \(\phi\) is close to \(\pi^*_{h}\) but, depending on the parameters \(V\) and \(t\), may be negative for smaller values of \(\phi\). Finally, if \(\phi > \pi^*_{h}\), global welfare is independent of PI policy since the home firm does not export to the foreign country regardless of its PI policy.
References


