Product differentiation, competition, and international trade

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Abstract. In this paper the two workhorse theories of international trade under imperfect competition – Krugman’s taste for variety model and Brander’s strategic intra-industry trade model – are integrated into a single analytical framework. A quadratic utility function allows for a nesting of these two theories by postulating a consumer taste for variety over differentiated products, where the extent of product differentiation is linked to the intensity of strategic interaction among firms. The model yields intuitive predictions on the effects of the degree of product differentiation on the volume of trade and on the composition of the gains from trade under imperfect competition. JEL classification: F12

Différenciation de produits, concurrence et commerce international. Ce mémoire intègre deux théories connues du commerce international en régime de concurrence imparfaite – le modèle du goût pour la variété de Krugman et celui du commerce intra-industrie de Brander – en un seul cadre analytique. Une fonction d’utilité quadratique permet d’encadrer ces deux théories en postulant que le consommateur a un goût pour la variété dans une gamme de produits différenciés où le degré de différenciation est relié à l’intensité de l’interaction stratégique entre les entreprises. Le modèle engendre des prévisions quant aux effets du degré de différenciation des produits sur le volume de commerce international et la composition des gains résultant de ce commerce en régime de concurrence imparfaite.

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1. Introduction

The new trade theory under increasing returns to scale has been able to model two features of international trade that had been perceived to be beyond the domain of competitive trade theory. Owing to the presence of economies of scale, only a limited number of goods can be produced domestically. Through international trade, consumers are able to have access to a wider variety of products. At the same time, scale economies cause domestic firms to possess market power. Since trade leads to import competition, it can reduce the market power of domestic firms. These two important aspects of international trade, (i) product expansion and (ii) import competition, have been analysed separately in two ‘workhorse models’ of international trade under imperfect competition.1

The monopolistic competition intra-industry trade model, pioneered by Krugman (1979, 1980), emphasizes the product expansion aspect of international trade. Consumers are assumed to have a taste for a variety of differentiated goods, all of which, in the case of economies of scale, cannot be produced by domestic firms. In this model, trade liberalization leads to welfare gains, since it allows consumers to consume from a larger menu of products.

In stark contrast to the Krugman model, Brander (1981) has demonstrated that oligopolistic rivalry among firms can give rise to intra-industry trade even in identical commodities.2 In this model, scale economies lead to monopoly rents that induce domestic and foreign firms to penetrate into each other’s market. The resulting import competition leads to welfare gains to consumers in the form of lower prices.

In this paper we develop a simple oligopoly model of international trade that integrates the product expansion and the import competition features of trade into a single analytical framework. Like Krugman (1979, 1980), we assume that consumers have a taste for a variety of differentiated products. The goods are linked through a single parameter \( \theta \) (\( 0 \leq \theta \leq 1 \)), which measures the extent to which consumers perceive the products to be differentiated. A key feature of our specification, however, is the link between product differentiation and strategic interaction. In particular, utility maximization implies that the degree of product differentiation in the industry is inversely related to the intensity of competition among firms.

The model yields some insights on the interrelationship between product differentiation and international trade that, in our judgment, are quite new. In particular, the overall contributions of this paper are of three distinct natures.

(i) The two principal causes of international trade under increasing returns (consumer taste for variety and strategic interaction) can be integrated into a common analytical framework. It is shown that in the polar case of maximum product dif-

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1 A condensed, formal presentation of these two models can be found in Krugman (1989) and Helpman and Krugman (1989).

2 An extension of the model by Brander and Krugman (1983), which emphasizes the role of transportation costs, has given rise to the reciprocal dumping model.
ferentiation ($\theta = 0$), international trade is solely caused by consumers' taste for variety, and it has a pure product expansion effect. The model resembles, then, the monopolistic competition trade 'story' of Krugman (1980). On the other hand, in the polar case of minimum product differentiation ($\theta = 1$), international trade is solely due to strategic interaction, and it has a pure import competition effect. Under this scenario, the model coincides with the Brander (1981) model of two-way trade in identical products. In all other cases ($0 < \theta < 1$), both the product expansion and the import competition effects are present.

(ii) It is widely believed that product differentiation is a cause of the substantial amount of intra-industry trade among industrialized countries. Consequently, international trade theory should be able to provide us with a formal model in which the volume of trade increases in the degree of product differentiation. Although the existence of product differentiation is central to the monopolistic competition trade model of Krugman (1980), the model implies that the volume of intra-industry trade is non-increasing in the degree of product differentiation. In the present model, which links product differentiation to the intensity of import competition, a higher degree of product differentiation encourages firms to increase their supplies to the domestic and the foreign market. Hence, we establish that the volume of intra-industry trade increases continuously in the degree of product differentiation. It is shown that the positive relationship is robust with respect to (a) the postulated mode of oligopolistic competition (Cournot versus Bertrand) and (b) the assumption of free versus restricted entry into the industry.

(iii) The extent to which consumers and firms gain from trade liberalization in the presence of scale economies is an important policy question. In the existing literature, however, the gains from trade due to product expansion and increased competition have always been treated separately.

Linking product differentiation to the intensity of strategic interaction allows for an integrated treatment of the consumer gains from trade resulting from product expansion and import competition. In particular, the higher the degree of product differentiation in the market, the higher are product expansion gains from trade. In the case of restricted entry, we identify a trade-off between the pro-competitive gains from trade and the product expansion gains from trade.

Under restricted entry, the extent to which oligopolistic firms will benefit from trade liberalization will depend on the degree of product differentiation and the concentration level in the industry. In particular, since firm profits increase in the degree of product differentiation, the minimum degree of product differentiation at which oligopolistic firms will always benefit from trade liberalization is shown to be higher, the lower the degree of industry concentration. From a policy point of

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3 Although a higher degree of product differentiation increases the equilibrium price of a good, the absence of any cross-price effects of demand, which is a key characteristic of the monopolistic competition market structure, implies that the price increase is accompanied by a lower total output level. This – somewhat counterintuitive – prediction of the monopolistic competition trade model was first noticed by Ethier (1982, 402).
view, the model predicts that trade liberalization should find the highest resistance from firms in industries characterized by low industry concentration and low product differentiation.

The paper is organized as follows. In section 2 the basic model is introduced. In order to reveal the essential features of the model in the most transparent and simple way, we initially assume that there is only a single domestic and a single foreign good. In section 3 the model is extended to the more realistic case of multiple domestic and foreign goods. In section 4 we investigate the free-entry long-run equilibrium and compare the results to the CES (constant elasticity of substitution) taste for variety specification. Concluding remarks are contained in section 5.

2. The basic model

Consider a two-country, two-good model where a domestic and a foreign good are produced by a home and a foreign monopolist, respectively. Since we assume that the two countries are perfectly symmetric, it is sufficient to describe only the domestic economy.

Consumers

A continuum of identical consumers are assumed to have a taste for a domestic good $z$ and a foreign good $z^*$, which are part of what we call the monopolistic sector. In addition to this monopolistic sector, there is a competitive numeraire sector. Since the utility function of the representative consumer is assumed to be separable and linear in the numeraire good, however, there are no income effects in the monopolistic sector. Hence, one can perform partial equilibrium analysis on the monopolistic sector. The utility of each consumer, with respect to the home and the foreign good, is assumed to be quadratic and strictly concave:

$$U(z, z^*) = v(z) + v(z^*) - \theta z z^*$$

with $v(z) = z - z^2/2$ and $0 \leq \theta \leq 1$. (1)

The utility function consists of two parts: (i) $v(z) + v(z^*)$ and (ii) $-\theta z z^*$. Consumer preference for product diversity is captured in (i). We assume that there is no innate preference for the home or the foreign good. The parameter $\theta$ in (ii), which is treated as exogenous throughout this paper, is a measure of the extent to which consumers perceive the domestic and the foreign good to be differentiated. It is important to note that $U$ is strictly decreasing in $\theta$, for given quantity levels $(z, z^*)$. Since preference maximization will imply that the cross-price effects of demand decrease in $\theta$, the goods will be less substitutable for each other, the lower

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4 This type of utility function has been used by Spence (1976) to investigate product selection bias. Eaton and Lipsey (1989) provide a nice general introduction to the different models of product differentiation.

5 The sub-utility function $v$ is characterized by diminishing marginal utility for a good (i.e., $v' > 0$ and $v'' < 0$ for $z < 1$).
the value of this parameter. Hence, ceteris paribus, consumer utility is assumed to increase in the degree of product differentiation.

The specific functional forms imply that utility maximization gives rise to a linear inverse demand structure:

\[ p = 1 - z - \theta z^* \]  
\[ p^* = 1 - z^* - \theta z, \]

where \( p \) and \( p^* \) are the prices of the home and the foreign good, respectively. If \( \theta = 0 \), the utility function given in equation (1) is separable in its arguments, and utility maximization yields inverse demand curves with no cross-price effects: \( p = 1 - z \) and \( p^* = 1 - z^* \). This is the polar case of the maximum degree of product differentiation between the home and the foreign good. From equations (2) and (3) we can see that the cross-price effects of demand become larger, the higher the value of \( \theta \). Hence, higher values of \( \theta \) pertain to a lower degree of product differentiation. If \( \theta = 1 \), consumers perceive the products as perfect substitutes. In this polar case of minimum product differentiation, there is only a single inverse demand curve: \( p = 1 - (z + z^*) \).

Production and market structure
Owing to the existence of scale economies (or fixed costs), each good can be produced by only a single firm. The home and foreign monopolists have constant marginal production costs, which, for simplicity, are assumed to be zero. Furthermore, we also abstract from any capacity constraints. Since firms are profit maximizers and each consumer has a taste for the domestic and the foreign good, each firm will have an incentive to supply – under free trade – home and foreign consumers. If \( \theta > 0 \), the existence of cross-price effects of demand implies that strategic interaction will occur between the home and the foreign firm. Furthermore, since it is assumed that there are no transportation costs, the results will be invariant to whether firms perceive – under free trade – the home and the foreign market as integrated or segmented. Throughout the main part of the paper, we postulate that firms are engaged in Cournot competition. In the appendix, we show that the main results also carry over to the case of Bertrand competition.

Welfare
Total surplus, \( TS \), in a country is the sum of consumer surplus, \( CS \), and producer surplus, \( PS \). For a given quantity pair \((z, z^*)\), total surplus is \( TS = U(z, z^*) \), producer surplus is equal to the domestic profitability, \( \Pi \), and consumer surplus is \( TS(z, z^*) = \Pi \).

2.1. Autarky
In autarky, domestic consumers can consume only the good provided by the domestic monopolist. The equilibrium monopoly supply is \( z^* = 1/2 \), and the correspond-
ing monopoly price is \( p^a = 1/2 \). Total surplus is \( TS^a(z^a,0) = 3/8 \), producer surplus is \( PS^a = p^a z^a = 1/4 \), and consumer surplus is \( CS^a(z^a,0) = TS^a(z^a,0) - p^a z^a = 1/8 \).

2.2. Free trade

Solving for the Cournot-Nash equilibrium prices and quantities under free trade, we obtain

\[
p^f = p^f^* = \frac{1}{2 + \theta} \tag{4}
\]
\[
z^f = z^f^* = \frac{1}{2 + \theta}. \tag{5}
\]

Since a higher degree of product differentiation (i.e., a lower value of \( \theta \)) increases the market power position of both firms, equation (4) states that producers, like the monopolistic competition model, are able to charge a higher price. In contrast to the monopolistic competition trade model, however, where the absence of cross-price effects of demand forces the monopolistic competitors to reduce their output levels, according to equation (5), a higher degree of product differentiation leads to higher output levels in this model. This result is due to the fact that product differentiation reduces the intensity of import competition, which in turn induces firms to produce more. Hence, equations (4) and (5) imply that the volume of trade, \( VT = p^f z^f + p^f^* z^f^* \), increases the more differentiated the products are.

Proposition 1. The volume of intra-industry trade increases in the degree of product differentiation.\(^6\)

2.2.1. Two special cases

We consider now the special cases of maximum (i.e., \( \theta = 0 \)) and minimum product differentiation (i.e., \( \theta = 1 \)) differentiation.

If there are no cross-price effects of demand (i.e., \( \theta = 0 \)) between the home and the domestic good, each firm will be a monopolist in the domestic and the foreign market. Hence, there is intra-industry trade in differentiated products in the absence of any strategic interaction. Trade has a pure market expansion effect that benefits both consumers and producers. Since each firm is able to supply to foreign consumers without facing any import competition, the free trade equilibrium quantities and prices are \( z^f = z^f^* = 1/2 \), \( p^f = p^f^* = 1/2 \). Since free trade allows the domestic firm to operate in the home market and the foreign market, trade liberalization will double its profits to \( IV^f = 1/2 \). As domestic consumers are now able to enjoy the domestic and the foreign good, consumer welfare increases to \( CS^f = 1/4 \) and total surplus increases to \( TS^f = U^f(1/2, 1/2) = 3/4 \). The consumer gains from trade stem from the increase in the volume of trade.

\(^6\) We thank an anonymous referee for pointing out that proposition 1 is invariant to whether the volume of intra-industry trade is measured in values or in physical quantities.
solely, as is the case in the monopolistic competition trade model, from an increase in product variety.

If the cross-price effects of demand are at their highest possible level (i.e., \( \theta = 1 \)), the domestic and the foreign good become perfect substitutes. Under the assumption of Cournot competition, we obtain the Brander model of intra-industry trade in homogeneous products. In this case, trade has a pure market discipline effect. The pro-competitive effect of trade reduces the equilibrium prices of the goods to \( p^f = p^{f^*} = 1/3 \). However, import competition induces firms to reduce their equilibrium supplies to \( z^f = z^{f^*} = 1/3 \). Since the sum of the duopolistic profits from supplying to the domestic and the foreign market (2/9), is lower than a firm’s monopoly profit under autarky (1/4), trade liberalization has a negative effect on domestic profitability. Since import competition increases consumer welfare to \( CS^f = 2/9 \), however, free trade increases total surplus to \( U^f(1/3, 1/3) = 4/9 \).

2.2.2. Gains from trade
Our discussion of the cases of maximum and minimum product differentiation already suggests that product differentiation also plays an important role in determining the source and the magnitude of the gains from trade to consumers and producers.

In the previous section we saw that firms lose from trade liberalization if they compete over homogeneous products. A lower substitutability between the products decreases the intensity of import competition, however, and firms will gain from trade liberalization in the case of maximum product differentiation. Since equations (4) and (5) imply that producer profits are decreasing in \( \theta \), there exists a minimum degree of product differentiation, \( \theta_{\text{min}} \), at which both firms will always gain from trade: \( \theta < \theta_{\text{min}} = 0.83 \). This implies that trade liberalization should find less resistance in industries where products are sufficiently differentiated.

Our modelling framework allows us also to contrast and compare the two principal causes of the consumer gains from trade under increasing returns to scale. In particular, the gain in consumer surplus, \( \Delta CS = CS^f(z^f, z^f) - CS^a(z^a, 0) \), can be decomposed into two terms:

\[
\Delta CS = [2u(z^f) - u(z^a) - p^f z^f - \theta z^f z^f] + [p^a z^a - p^f z^f].
\]

The trade-induced product expansion gain of trade is captured by the first term, where \( 2u(z^f) - u(z^a) - p^f z^f \) gives the increase in sub-utility from being able to consume both the foreign and the domestic good. The expression \(-\theta z^f z^f\) corrects for the degree of similarity between the domestic and the foreign good. The second term, \( p^a z^a - p^f z^f \), can be interpreted as the consumers’ gain in revenue from having to spend less on the domestic good. If \( \theta = 0 \), the latter term is equal to zero and trade has no competitive effect on the domestic good. In this case, the consumer’s gain from trade is identical to the product expansion gain from trade. As the goods become less differentiated (i.e., \( \theta \) increases in value), however, substituting
and (5) into (6) implies that the product expansion gain of trade falls while the competitive effect of trade, captured by the second term, rises. Hence, there is substitutability between the two forms of consumer gains from trade under imperfect competition.

3. Oligopolistic competition: restricted entry

We generalize the model now to the case of multiple domestic and foreign firms each of whom produce a different variety of a differentiated product. Under free trade, the representative consumer will consume all varieties that are produced in equilibrium. Assuming, again, perfect symmetry between the domestic and the foreign economy, it is sufficient to describe the domestic economy under autarky.

To keep the model analytically tractable, we assume that the degree of product differentiation between each pair of varieties is the same. The utility function of the representative consumer is then specified as

$$U(z_1, \ldots, z_n) = \sum_{i=1}^n v(z_i) - \theta \sum_{i<j, i \neq j} z_iz_j \text{ with } v(z) = z - z^2/2.$$  \hspace{1cm} (7)

Utility maximization then yields the following inverse demand system:

$$p_i = 1 - z_i - \theta \sum_{j \neq i} z_j, \quad (i = 1, \ldots, n).$$  \hspace{1cm} (8)

On the production side, we continue to assume that the marginal production cost of each firm is equal to zero. Again, the market structure ranges from the case where the goods are independent ($\theta = 0$) to the homogeneous good case ($\theta = 1$). Given the symmetry assumed among the firms and goods, the equilibrium supplies and prices will be the same for each firm. The Cournot-Nash equilibrium quantity and price of the representative firm depends only on the degree of product differentiation and on the number of firms in the market.

$$z(\theta, n) = \frac{1}{2 + (n-1)\theta}$$ \hspace{1cm} (9)

$$p(\theta, n) = \frac{1}{2 + (n-1)\theta}.$$ \hspace{1cm} (10)

If there are a fixed number of $n$ domestic and $n$ foreign firms in the market, each consumer is going to consume $2n$ varieties of the differentiated good under free trade. When we use the equilibrium quantities in (9) and (10), it is straightforward to show that the volume of trade, $VT = 2np(\theta, 2n)z(\theta, 2n)$, is strictly decreasing in $\theta$ for all values of $n$. Hence, proposition 1 holds also in the case of multiple goods.

We can now investigate under which industry configurations oligopolistic firms will gain from trade liberalization. In the case of homogeneous products, where the intensity of import competition is at its highest, Anderson, Donsimoni, and Gab-
szewicz (1989) have shown that some oligopolistic firms will lose from trade liberalization for any given number of firms in each country’s industry. In the context of our differentiated-products oligopoly, however, we have seen that the intensity of import competition becomes weaker the less substitutable the products are for each other. Since our discussion from above has shown that firm profits are strictly increasing in the degree of product differentiation, one can solve for the minimum degree of product differentiation, \( \theta_{\text{min}} \), at which oligopolistic firms will always prefer international trade to autarky. Since firm profits also depend on the number of firms in the market, however, \( \theta_{\text{min}} \) will be a function of \( n \). Formally, for each \( n \) we can find a \( \theta_{\text{min}}(n) \) such that a firm’s profit under free trade exceeds its profit under autarky trade, i.e., \( 2z(\theta,2n)p(\theta,2n) > z(\theta,n)p(\theta,n) \) for all \( \theta < \theta_{\text{min}}(n) \). In particular, it can be shown that \( \theta_{\text{min}}(n) \) is strictly decreasing in \( n \).

**Proposition 2.** The minimum degree of product differentiation at which oligopolistic industries will benefit from trade liberalization is higher, the lower the degree of industry concentration.

**Proof.** Let us define the function \( F(\theta, n) = 2z(\theta,2n)p(\theta,2n) - z(\theta,n)p(\theta,n) \). By applying (9) and (10), it can be shown \( F(\theta, n) > 0 \) if and only if \( \theta < 2/(n\sqrt{2} + 1) \). Since \( \theta_{\text{min}}(n) = 2/(n\sqrt{2} + 1) \) is strictly decreasing in \( n \), the proof is completed.

The intuition is as follows. Since the profits of a representative firm decrease the less concentrated the industry, a higher degree of product differentiation is required such that the profit gains from selling into the foreign market exceed the profit losses resulting from import competition. Owing to the symmetry of the model, a relatively competitive domestic industry faces also more competition from abroad. Proposition 2 implies that trade liberalization should find the highest resistance in relatively competitive industries producing goods characterized by a low degree of product differentiation.\(^7\)

4. Long-run equilibrium: a comparison with the CES taste for variety specification

It is probably fair to say that Krugman’s (1980) monopolistic competition trade model has become the most popular model used to study the effects of international trade in the presence of product differentiation. The wide applicability of the Krugman model is due to the fact that the assumption of the CES (constant elasticity of substitution) utility function allows for a closed-form solution of a trading equilibrium in the presence of scale economies. A counterintuitive feature of the CES taste for variety specification, however, is that an economy’s move from autarky to free trade has no effect on the prices and the output levels of each good. Specifically,

\(^7\) As pointed out by a referee, we implicitly abstract away from any free-rider problem, which might be influenced by the number of firms in the market.
international trade increases the number of products available to consumers, but it has no effect on a firm’s market power (as measured by the price-cost margin) or its production level.8

The basic model from section 2 is now extended to the case where free entry and exit allow the number of goods produced to be endogenous. Under the assumption that the home and the foreign economies are perfectly symmetric, trade liberalization is equivalent to an increase in the size of the population of the domestic economy.

A population of \( S \) consumers is assumed to have a taste of variety for \( n \) goods, each offered by a single firm. The utility function of the representative consumer is characterized by \( \theta \). Given the firm-specific fixed cost, \( F \), and by applying (9) and (10), the equilibrium number of firms under free entry is given by the following zero-profit condition:

\[
\Pi = \frac{S}{(2 + (n - 1)\theta)^2} - F = 0. \tag{11}
\]

The equilibrium number of varieties \( n \), the price \( p \), and the production level \( z \) of a single variety are then as follows:

\[
n = \frac{\sqrt{S}}{\sqrt{F}} - 2 + 1 \tag{12}
\]

\[
p = \frac{\sqrt{F}}{\sqrt{S}} \tag{13}
\]

\[
z = \sqrt{S}\sqrt{F}. \tag{14}
\]

Since trade is equivalent to an increase in the population size \( S \), the effects of trade liberalization can be directly inferred from (12)–(14). In comparison to the CES taste for variety specification, (13) and (14) reveal that the quadratic utility specification yields more intuitive predictions about international trade. Owing to increased competition, trade reduces the price \( p \) that a firm is able to charge for its product in equilibrium. However, the market expansion effect induces a firm to increase its overall production level \( z \).

The opening up of international trade between two identical countries increases the number of available varieties to consumers relative to autarky. In contrast to the restricted entry scenario discussed in section 3, however, the number of varieties

8 This – in Krugman's own words (1980, 953) – 'unsatisfactory result' stems from the CES utility specification. In an earlier paper, Krugman (1979) postulates a taste of variety specification that yields an elasticity of demand that increases with the number of firms. However, the latter specification doesn’t allow for a closed form solution.

9 To guarantee the existence of the equilibrium, we need to rule out now that \( \theta = 0 \).
under free trade is smaller than the sum of varieties that these economies would provide under autarky. The findings are summarized in proposition 3.

**PROPOSITION 3.** Under a quadratic taste for variety specification, international trade

(i) increases the number of varieties available to consumers,
(ii) reduces a firm’s price-cost margin,
(iii) increases the scale level of the representative firm.

It should be noted that in a free-entry equilibrium the price of a product variety does not depend on the product differentiation parameter $\theta$. Consequently, in contrast to the restricted entry scenarios in sections 2 and 3, the pro-competitive gains from trade are invariant to the degree of product differentiation in the industry. This finding can be easily understood by taking a closer look at (12) and (10).

Equation (10) implies that the price a firm is able to charge depends on two factors: (i) the degree of product differentiation and (ii) the number of competitors. A lower level of $\theta$ leads to an increase in price only if the number of competitors is fixed at $(n - 1)$. However, from equation (12) we know that under free entry, a higher degree of product differentiation accommodates a larger number of firms. Since an increase in the number of competitors leads to a reduction in price, the net effect of the degree of product differentiation on price is zero. However, equations (12)–(14) imply that a higher degree of product differentiation increases the volume of intra-industry trade, measured by $v_T = npz$. Hence, proposition 1 is also valid in the case of free entry.

5. Concluding remarks

Although product differentiation has been perceived to play a key role in the new trade theory under increasing returns to scale, the interrelationship between product differentiation and international trade has been relatively unexplored so far. In this paper, we developed a simple model of intra-industry trade where, as in the standard monopolistic competition trade model, consumers are assumed to have a preference for a variety of horizontally differentiated products. However, our consumer preference specification also postulates that, ceteris paribus, consumers are better off if the varieties are less substitutable for each other. Consequently, the degree of product differentiation in the industry is inversely related to the intensity of strategic interaction among firms. Treating product differentiation as exogenous to the industry, our model implies that the volume of intra-industry trade increases continuously in the degree of product differentiation. In particular, our predictions are invariant with respect to the mode of oligopolistic competition (Cournot versus Bertrand) and the existence of entry barriers.

The phenomenon of intra-industry trade has spawned a voluminous empirical literature. However, the majority of the empirical studies in this literature have no formal links to economic theory. The few theory-based empirical studies of intra-
industry trade have been focused on testing propositions that are derived from a specific theory. For example, Helpman (1987) and Hummels and Levinsohn (1995) have investigated empirically some hypotheses derived from the monopolistic competition trade model. In the context of a single-industry study, Bernhofen (1999) has investigated industry hypotheses stemming from Brander’s (1981) strategic trade model in homogeneous products. However, I am not aware of any study that tests the intra-industry trade theories against each other.\(^{10}\)

In this paper we imply that the monopolistic competition trade model and our oligopoly trade model can be empirically distinguished with regard to their different predictions of how product differentiation affects the volume of trade. In particular, our analysis is suggestive of an empirical specification that investigates how cross-industry variations in product differentiation affect cross-industry variations in the volume of two-way trade.\(^{11}\) Given that we know so little about the usefulness of the new trade theories in explaining the patterns of intra-industry trade, our theoretical framework might be a promising guide for future empirical work.

Appendix

Bertrand competition
In order to calculate the Bertrand-Nash equilibrium, we use the inverse demand system given in equation (8) to solve for the direct demand curves:

\[
z_i = \frac{\theta - 1 + p_i + \theta(n - 2)p_i - \theta \sum_{j \neq i} p_j}{(\theta - 1)(1 + (n - 1)\theta)} \quad (i = 1, \ldots, n). \tag{A1}
\]

Using the equation system (A1), one can solve for the Bertrand-Nash equilibrium prices and quantities:

\[
p^B(\theta, n) = \frac{(1 - \theta)}{2 + (n - 3)\theta}, \tag{A2}
\]

\[
z^B(\theta, n) = \frac{1 + (n - 2)\theta}{(2 + (n - 3)\theta)(1 + (n - 1)\theta)}. \tag{A3}
\]

By using the equilibrium quantities in (A2) and (A3), it is straightforward to show that the volume of trade, \(v_T = 2np^B(\theta, 2n)z^B(\theta, 2n)\), is strictly decreasing in \(\theta\) for all values of \(n\). Hence, proposition 1 also holds under Bertrand competition.

\(^{10}\) Applying a unit value approach, Greenaway, Hine, and Milner (1995) try to disentangle horizontal from vertical intra-industry trade. However, their empirical study does not test hypotheses derived from specific theoretical models.

\(^{11}\) As a measure of the degree of product differentiation, one could use the ratio of advertising to sales within an industry – which has been widely used in the industrial organization literature – or the index suggested by Rauch (1999).
The proof of proposition 2 is slightly more involved. Again using equations (A2) and (A3), we define the following function:

\[
F_B(\theta, n) = \frac{2(1 - \theta)(1 + (2n - 2)\theta)}{(2 + (2n - 3)\theta)^2(1 + (2n - 1)\theta)} - \frac{(1 - \theta)(1 + (n - 2)\theta)}{(2 + (n - 3)\theta)^2(1 + (n - 1)\theta)}.
\]

Because of the relative complexity of \(F_B(\theta, n)\), we follow a two-step numerical procedure:

(i) It can be shown that for any given value of \(n\), the function \(F_B(\theta, n)\) has a unique root \(\theta^B(n)\) in the interval \((0, 1)\). Furthermore, it is also the case that \(F_B(\theta, n) > 0\) if \(\theta < \theta^B(n)\) for \(\theta \in (0, 1)\) and all \(n\).

(ii) Applying the Newton iteration method, one can compute numerically the roots of \(F_B(\theta, n)\) in \((0, 1)\) for each value of \(n\), with the results shown in figure A1.

From figure A1 it can be seen that \(\theta^B(n)\) is strictly decreasing in \(n\). Hence, proposition 2 holds also in the case of Bertrand competition.

References


