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DOMESTIC COMPETITION AND INTERNATIONAL TRADE: A CONCEPTUAL FRAMEWORK FOR HOMOGENOUS PRODUCTS

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I. Introduction

The direct effect of oligopolistic markets on international trade flows has been an interesting research topic. Firms having substantial market power may behave differently in international markets from those without market power. In several empirical studies, variables representing the degree of domestic competition were included as major explanatory variables for trade flows (Pagoulatos and Sorensen, 1976; Marvel, 1980; Koo and Martin, 1984). Furthermore, Porter (1990) recognized firm rivalry as the most important determinant of success in global markets.

Limiting ourselves to the homogenous product case, the present paper addresses the following questions: How do firms having market power behave in international markets as compared to firms in competitively structured market? More specifically, under which market structure do firms export more to foreign countries?

Addressing these questions directly, White(1974) theoretically demonstrated that domestic market structure could indeed influence trade flows. A monopolist was predicted to allow more imports than a competitive industry, but the effects on exports were ambiguous. In addition to the ambiguity, his model dealt only with the small country case in which firms in that country are facing perfectly elastic export demand. In reality, export demand and import supply curves are not perfectly elastic in the case of large countries. To complete the

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discussion, this paper deals with more general cases.

The current framework also takes into account the case in which the market is internationally oligopolistic. In this situation, only a small number of firms compete with each other in international markets. Although such a case has been successfully modeled by Brander(1981), Brander and Krugman(1983), Helpman and Krugman (1985), and Eaton and Grossman(1989), their main focus was the evaluation of various trade policies based on simple *duopoly* models. They did not pay much attention to the direct effect of market power on trade flows under international oligopoly. If an industry is oligopolistic internationally, there will be recognized interdependence between domestic firms and foreign firms. The resulting competitive behavior may differ from the behavior when firms in the rest of the world are competitively structured. In analyzing interactions among firms, the current framework adopts conjectural variations approach.

The remainder of this paper is organized as follows. Section two describes the equilibrium of an oligopolistic market and its properties. This framework serves as a basic analytical tool in later sections. Section three investigates the relationship between domestic seller concentration and trade flows when firms in other countries behave competitively. Section four deals with the more general case in which domestic and foreign firms compete with each other in both domestic and foreign markets. Oligopolistic interactions in different countries are modeled. The final section summarizes the results and discusses their empirical implications.

II. Oligopolistic Equilibrium and Its Properties

Suppose that n firms produce homogenous products in a country. The number of firms is assumed to be exogenously fixed, not allowing free entry. Entry may be limited due to the existence of governmental regulations or other barriers. The inverse demand function for the good is given by $P=P(Q)$ where P and Q denotes price and quantity, respectively. As a twice differentiable function, it is assumed to strictly decrease in quantity. Having increasing return to scale technology, each firm has an identical linear cost function which is expressed as:

$$C(q_i) = cq_i + F \tag{1}$$

where, q_i denotes output of firm i, and c and F represent constant marginal cost and fixed cost, respectively.

Under these demand and cost conditions, a firm in an oligopolistic market maximizes its profit subject to its rival's reaction to its action. Oligopoly models developed by economists vary from those that assume competitive behavior for two or more firms to those that assume perfect collusion. Cournot or Stackelberg models assume behavior that falls between these two extremes. It is often restrictive to assume a certain type of behavioral premises. Since industry equilibrium is highly sensitive to assumptions about firm competition, it is more interesting to use conjectural variations which can deal with various firm behavior under oligopolistic market structure.[1]

The term conjectural variation is defined as a firm's anticipation of the change in industry output as a result of a unit change in its own output. The mathematical expression would be $\alpha_i = \partial Q / \partial q_i$, where $Q = \sum q_i$. Competitive or Bertrand behavior implies $\alpha_i = 0$ since a firm's output change does not affect industry price. Cournot competition and joint profit maximization(collusion) are represented by $\alpha_i = 1$ and $\alpha_i = n$, respectively. A conjectural variation is therefore defined when $\alpha_i \geq 0$. In this model, conjectural variation is also supposed to be identical ($\alpha_i = \alpha$) across firms in an industry since all domestic firms are assumed identical. Only symmetric equilibrium is dealt with in the current framework.

Firm i's profit is represented as $\pi_i = P(Q)q_i - C(q_i)$ and profit maximization requires

$$P(Q) + \frac{\partial P(Q)}{\partial Q} \alpha q_i = c \tag{2}$$

from which we see $P(Q) \geq c$ as long as α is greater than zero. Summing over all n firms, market equilibrium is determined by:

[1] Brander (1981), Brander and Krugman(1983), and Brander and Spencer(1985) utilized the Cournot model in which a firm assumes the other firm will hold output fixed. Extending these models, Hwang(1984) and Anderson et al.(1989) adopted a conjectural variation approach that is more general than the Cournot assumption.

$$nP(Q) + \frac{\partial P(Q)}{\partial Q} \alpha Q = nc. \tag{3}$$

It is also assumed that derivative of the left hand side of condition (3) is negative:

$$(n + \alpha)\frac{\partial P(Q)}{\partial Q} + \alpha Q\frac{\partial^2 P(Q)}{\partial Q^2} < 0. \tag{4}$$

This condition is both necessary and sufficient for stability of equilibrium (Seade 1980).

Under these conditions, equilibrium is characterized as unique and symmetric across n firms:

$$Q^* = nq^* \tag{5}$$

where, Q^* and q^* represent equilibrium output of the industry and individual firm, respectively.[2]

Thus, condition (2) can be re-written as:

$$P(Q) = [1 - \frac{\alpha}{n\varepsilon}]^{-1}c \tag{6}$$

where, $\varepsilon = -(\partial Q/\partial P)(P/Q)$ represents(negative) elasticity of demand. We need a condition $n\varepsilon > \alpha$ so that price can be defined in the positive domain.

Unlike the Cournot or competitive market model, equation (6) provides more flexible expression of equilibrium price, and the existence of market power in oligopoly is explicitly represented by price distortions.

Since we are interested in price distortions exercised by oligopolistic firms, it is interesting to analyze the comparative statics of equilibrium price with respect to the number of firms. If α is greater than 0, then equilibrium output is an increasing function, and equilibrium price is a decreasing function of the number of firms:

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[2] The uniqueness and symmetry of equilibrium can be proved as follows: From condition (4), we obtain a unique $Q^* > 0$ in equation (3). Since every firm has an identical cost function, equation (2) implies firm's output is identical across n firms ($q_i = q^*$).

$$\frac{dQ}{dn} > 0, \quad \frac{dP}{dn} < 0 \tag{7}$$

This property is proved by total differentiation of condition (3):

$$\frac{dQ}{dn} = \frac{c - P}{\{(n+\alpha)\frac{\partial P}{\partial Q} + \alpha Q \frac{\partial^2 P}{\partial Q^2}\}} \tag{7}$$

Since $P > c$ and the denominator is also negative from condition (4), $dQ/dn > 0$ as long as α is greater than zero. This inequality leads to $dP/dn < 0$.

This property shows that, as long as oligopolistic firms interact with each other, equilibrium price would increase as the number of firms decreases. Conversely, more competition in an industry implies less price distortions. The relationships, however, depend on behavioral assumptions as represented by conjectural variations. If firms are assumed to behave competitively ($\alpha = 0$) regardless of market structure, the number of firms cannot affect equilibrium price in the market. In addition, equilibrium price does not have any relationship with the number of firms if demand is perfectly elastic (ε is infinite).

The effects of changes in other parameters on equilibrium price are straightforward. As in the competitive model, marginal costs affect price positively. The elasticity of demand has negative impact on the wedge between price and marginal cost; highly elastic demand reduces the extent to which firms exercise oligopolistic power. It is also clear that equilibrium price increases as a firm's behavior is more collusive.

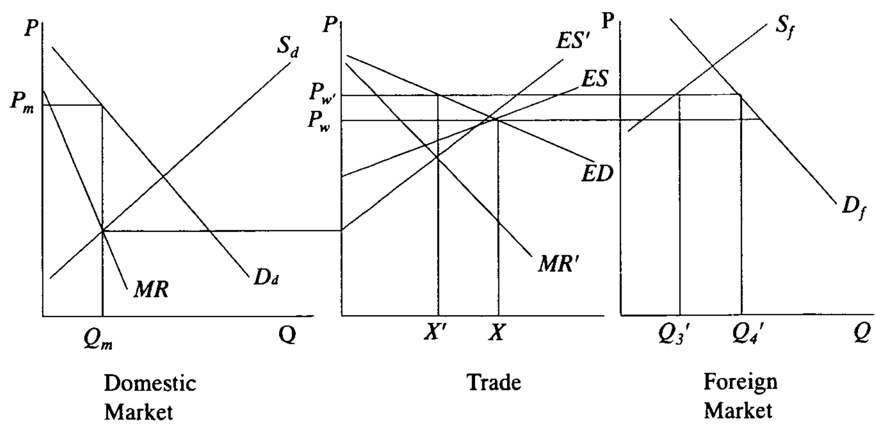
III. Case 1: When Firms in Foreign Countries Behave Competitively

For the analysis of international trade, it is assumed that there exist only two countries: the home country and a foreign country which represents the rest of the world. The model also assumes that domestic and foreign markets are segmented; each firm perceives each country as a separate market and makes distinct quantity decisions for each market (Brander and Krugman 1983). Firms are therefore allowed to price discriminate across different markets. Accordingly, prices are not necessarily equalized by international trade as predicted in free trade models. However, transportation costs are not explicitly considered for simplicity of the model. Firms are also assumed to know their costs and market demand with certainty.[3] Lastly, we assume that the cost condition of a monopoly is the same as that of competitive firms. This allows us to focus exclusively on analyzing market power's impact on international trade.

This section deals with the case in which firms in foreign countries behave competitively. In many industries, there exists a large number of producers in the rest of the world, so that firms in foreign countries are not able to exercise market power, and thus behave like firms in competitive markets. On the other hand, domestic firms are allowed to interact with each other when they are exporting or importing.

If the home firm engages in exporting, it faces both domestic and export demand. In the case of linear demand and supply curves, equilibria under competitive market structure and monopoly are shown in Figure 1. The amount of exports under a competitive

FIGURE 1 Export Flows under Alternative Market Structures



[3] White(1974) examined the impact of market structure on trade flows when price is subject to uncertainty.

structured market is X at which excess supply and excess demand are equalized. On the contrary, a monopolist exports X' by equating marginal revenue with marginal cost. Graphically, it is clear that export under monopoly is smaller than export under a competitively structured market.

Using algebraic expressions, we can derive this relationship more generally. The profit of the oligopolistic firm i which sells in the home market and exports to the foreign country is represented as $\pi_i = P(Q)q_i + P_w(X)x_i - cq_i - cx_i - F$, where q_i and x_i represent domestic sales and foreign sales of firm i, respectively. $P(Q)$ is inverse demand in the home country and $P_w(X)$ denotes the inverse of excess demand from the foreign country. Given the assumption of symmetry, the equilibrium export price is expressed as in equation (6):

$$P_w(X) = [1- \frac{\alpha}{n\varepsilon_x}]^{-1}c \qquad (9)$$

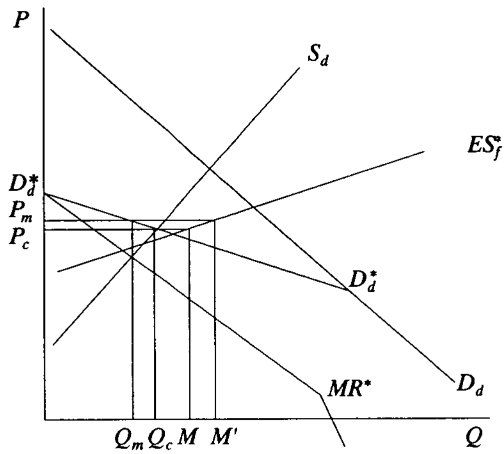
where, ε_x represents the elasticity of excess demand by the foreign country.

Equation (9) also indicates that export price and the amount of exports are functions of marginal costs, conjectural variations, elasticity of excess demand, and the number of firms. If we assume moderately that ε is not infinite and $\alpha > 0$, it is expected that exports from the home country are positively related to the number of domestic firms ($\partial x/\partial n > 0$).

In the case of imports, a group of domestic firms can be characterized as dominant firms. If imports are relatively small compared to domestic sales and restricted by some trade barriers, domestic firms in a large country may be price leaders, and importing firms from the foreign country would follow the price that the domestic firms set. The domestic firms may behave like dominant firms, and importers become a competitive fringe.

Given excess supply from the foreign country $ES_f^*(P)$, residual demand by domestic firms can be expressed as $D_d^*(P) = D_d(P) - ES_f^*(P)$, which is drawn as $D_d^*D_d^*$ in Figure 2. The slope of residual demand is flatter than the demand curve because $|\partial D_d^*/\partial P| = |\partial D_d/\partial P| + |\partial ES_f^*/\partial P|$. Also, excess supply from the foreign country is more elastic than the domestic supply, rendering ES_f^* flatter than S_d, domestic supply curve. Competitive equilibrium will be attained by

FIGURE 2 Import Flows under Alternative Market Structures



equating domestic supply $S_d(P)$ with residual demand for the home firms, $D_d{}^*$. In Figure 2, competitive firms produce Q_c and import M at the price P_c. In contrast, by equating marginal revenue with marginal cost, the monopolist will produce Q_m at P_m at which domestic country imports M′ that is greater than M.

In the dominant firm model, the profit of domestic firm i can be expressed as $\pi_i = P(D_d{}^*)q_i - cq_i - F$, where $P(D_d{}^*)$ is the inverse of the residual demand. The price charged by the domestic firms would be:

$$P(D_d^*) = [1 - \frac{\alpha}{n\varepsilon_d^*}]^{-1}c \tag{10}$$

where, $\varepsilon_d{}^*$ represents the elasticity of residual demand. If the residual demand is not perfectly elastic and $\alpha > 0$, the country's imports decrease as the number of domestic firms increase ($\partial M/\partial n < 0$, where $M = ES_f$ represents imports by the home country).

Proof of the above proposition is as follows: Since $M = ES_f(P) = D_d(P) - D_d{}^*(P)$, where $D_d{}^*(P)$ denotes residual demand for home firms. And, $\partial ES_f(P)/\partial n = \{\partial D_d(P)/\partial P)(\partial P/\partial n) - (\partial D_d{}^*(P)/\partial P\}(\partial P/\partial n) = (\partial D_d(P)/\partial P - \partial D_d{}^*(P)/\partial P)(\partial P/\partial n)$. By definition, $|\partial D_d{}^*(P)/\partial P| > |\partial D_d(P)/\partial P|$, and $\partial P/\partial$n < 0. Thus, $ES_f(P)/\partial n < 0$.

IV. Case 2: International Oligopoly

Next, consider the more general case in which domestic and foreign firms can interact in the domestic market as well as in the foreign market. This is the case where there are only a small number of producers in the world. Suppose that the number of consumers and demand elasticity are identical in both countries.

In this case, firms have two strategies: participating and nonparticipating in trade. If domestic and foreign firms cross-haul their products, profit of domestic firm *i* becomes

$$\pi_{di}{}^{*} = [P(Q_d + X_F) - c]q_{di} + [P(Q_f + X_d) - c]x_{di} - F \tag{11}$$

where, X_d and X_F denote total export of domestic firms to the foreign market, and total export of foreign firms to the domestic market, respectively. Foreign firms will have the same profit function. Trade reduces the price of the product and hence increase the welfare of consumers in both country, but profit of a firm is less than the profit in the case when firms do not engage in trade. Profit of the firm serving only its home market is

$$\pi_{di} = [P(Q_d - c]q_{di} - F \tag{12}$$

which is greater than equation (7) since symmetry across firms implies that $q_{di}{}^{*} = x_{di}{}^{*} = q_{di}$[4]

Although trade leads to smaller profit, firms have strong incentives to participate in trade, given strategies of foreign firms. If domestic firms enter foreign market and foreign firms stay at their market without intention to ship to the domestic market, home firms can realize the highest profit than any other case. In this case, profit of the home firm *i* becomes

$$\pi_{di}{}^{**} = [P(Q_d) - c]q_{di}{}^{**} + [P(Q_f + X_d) - c]x_{di}{}^{**} - F \tag{13}$$

On the other hand, profit of the firm which stays in its own market

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[4] For the comparison of the profit, it is temporarily assumed that the number of firms is the same in both countries.

without shipping to domestic market is:

$$\pi_{di}^{***} = [P(Q_d X_f) - c]q_{di}^{***} - F \tag{14}$$

which is less than π_{di}^{*}. In summary, profits of a firm in different situations are arranged as:

$$\pi_{di}^{**} > \pi_{di} > \pi_{di}^{*} > \pi_{di}^{***} \tag{15}$$

This is the same for foreign firms. Hence, strategic choice of firms collapse into the prisoner's dilemma game (Figure 3). In this game, participating in trade becomes dominant strategies for both domestic firms and foreign firms. In a nutshell, intra-industry trade in identical products becomes a viable equilibrium when firms are in international oligopoly situation as shown in Brander(1981) and Brander and Krugman(1983).

Trade flows of the product in this case can be shown by examining a country's share of world market as in Helpman and Krugman(1985). If there are n_d firms in the home market and n_f in the foreign market, symmetric equilibrium leads to identical output for each firm. A firm's share of the world becomes $1/(n_d + n_f)$. The domestic firms' aggregate share of the combined market is $S_d = n_d/(n_d + n_f)$ and the foreign firms' aggregate share is $S_f = n_f/(n_d + n_f)$. Then, net exports of the home country (NX_d) is expressed as:

$$NX_d = (S_d - S_f)(D_d + D_f) \tag{16}$$

where, D_d and D_f denote domestic and foreign demand, respectively. From this, we can easily see that a country's net exports are an

FIGURE 3 Payoff Matrix of the Game

		Foreign Firm's Strategy: no trade	Foreign Firm's Strategy: trade
Home Firm's Strategy	no trade	π_{di}, π_{fj}	$\pi_{di}^{***}, \pi_{fj}^{**}$
	trade	$\pi_{di}^{**}, \pi_{fj}^{***}$	$\pi_{di}^{*}, \pi_{fj}^{*}$

increasing function of the number of domestic firms if the number of foreign firms are fixed and $\alpha > 0$ ($\partial NX_d / \partial n_d > 0$)[5].

V. Summary and Conclusions

This paper has examined the impact of market concentration, as measured by the number of firms, on trade flows of homogenous goods. Assuming more general forms of export demand and import supply curves, the current framework has shown that exports are positively related to he number of firms in home countries, and imports negatively so. This paper also dealt with the case that there are only a small number of firms worldwide in a relevant industry. In this case, oligopolistic interactions occur among domestic and foreign firms. It is also expected that the number of domestic firms is positively related to net exports.

In summary, the results of this paper imply that the degree of domestic competition is positively related to trade performance of a country. Increased concentration in domestic markets may have a negative impact on home firms competing against foreign counterparts in international markets.

The relationship between the number of firms and trade flows, however, is sensitive to the shape of export demand and import supply curves that domestic firms face. The negative influence of industry concentration on net exports seems to be valid only if a country's firms face downward sloping export demand curves and upward sloping import supply curves. The propositions in this paper also depend on behavioral assumptions. If firms behave competitively regardless of market structure(Bertrand's assumption), domestic industry concentration does not affect trade flows. The negative influence of industry concentration on net exports occurs under the

[5] This comparative static holds even when we relax some assumptions. If marginal costs are different across countries, firms in the country with lower marginal costs have larger net exports. In addition, if transportation costs are small enough to allow trade, intra-industry trade across two identical countries would still be a plausible outcome of the model. The existence of transportation costs allows the market share of home firms to increase and those of foreign firms to decrease. Nevertheless, the effect on net exports of the number of domestic firms does not change in both cases.

assumption that conjectural variation is other than zero.

The current model can be extended by incorporating the dynamic aspects of the problem. Domestic market structure is widely regarded as an important determinant of process innovations which can lower production costs. If innovation is taken into account, domestic industry concentration might have implications for trade competitiveness over time.

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