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INDUSTRIAL ORGANIZATION AS A DETERMINANT OF INTERNATIONAL COMPETITIVENESS IN FOOD

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ABSTRACT

International trade is increasingly being viewed in the context of imperfect competition. This is particularly appropriate for food and other processed agricultural products as most food processing and manufacturing industries are oligopolistic. Industrial organization theory demonstrates a negative relationship between concentration of market power and domestic market performance. One theme emerging from the integration of industrial organization and international trade theories is, seller concentration is also negatively related to international market performance. This theme is tested, and validated for U.S. food manufacturing industries.

KEY WORDS

International food markets, industrial organization, international trade, international market performance, imperfect competition.

INDUSTRIAL ORGANIZATION AS A DETERMINANT OF INTERNATIONAL COMPETITIVENESS IN FOOD

INTRODUCTION

Most international trade is in products of industries that would be generally classified as oligopolies when viewed in their domestic context. However, only recently have international markets been examined from the perspective of imperfect competition. This is giving rise to a considerable body of literature that links trade theory and industrial organization. But, little of this literature addresses trade in the food and agricultural sector.

It is widely recognized that food processing and manufacturing industries deviate significantly from the perfectly competitive model. Competitive imperfections such as relatively high levels of seller concentration, extensive product differentiation, and scale economies are prominent characteristics. For example, more than half of the food processing industries in the U.S. have high seller concentration[1] (Connor et al.). The aggregate market share held by the 20 largest firms across all food manufacturing industries exceeds 25 percent in the European Community and 35 percent in the U.S. (Handy and Henderson). Among the most heavily advertised of all consumer goods, many consumer-ready manufactured foods are recognized as highly differentiated products. Scale economies in food manufacturing are of such magnitude that per unit costs would be as much as 21 percent higher if plants were operated at 50 percent of current levels (Pratten).

Given the oligopolistic nature of many food manufacturing industries, the purpose of this paper is to examine the extent to which the performance of these industries in international markets is a function of market power and other competitive imperfections. In essence, following Porter's findings from a four-year study of more than 100 industries in the 10 industrialized countries that account for fully 50 percent of all world trade, our hypothesis

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[1]Defined as a four-firm concentration ratio of at least 50 percent or an eight-firm ratio of at least 65 percent.

is, food manufacturing industries with the most competitively structured domestic markets are the most competitive industries in international markets.

A BRIEF ON INDUSTRIAL ORGANIZATION AND MARKET PERFORMANCE

Economic theory holds that the way in which industries and markets are structured affects the performance of firms in those industries and thus economic welfare. The best understood structure-performance relationships are at the extremes of market organization, i.e., perfect competition and perfect monopoly. Perfect competition, when universally obtained, leads to Pareto optimal social welfare. By contrast, monopoly results in deadweight social loss from reduced production, higher prices, and the reallocation of economic surplus from consumers to the monopolist.

In practice, it is well understood that most of the commercial world is imperfectly competitive. That is, it falls somewhere between the two "perfect" extremes of competition and monopoly. This is where controversy over industrial structure and market performance is born. There is no single, generally received explanation of how economic performance and social welfare change as industry structure changes from one extreme of the competitive continuum to the other.

Microeconomic theory includes numerous models of imperfect competition: duopolies, kinked demand oligopolies, dominant firm oligopolies, and monopolistic competition among the more common. However, none of these generate sufficient certainty about how firms behave under imperfectly competitive conditions to generate unassailable predictions of market performance.

Industrial organization theory has been built up specifically to explain imperfectly competitive markets. The old school of industrial organization, prevalent through the 1970s, followed the structure-conduct-performance paradigm pioneered by Bain. This school is replete with ad hoc econometric studies showing statistically significant relationships between

various measures of market structure, dominated by seller concentration, and various measures of market performance, dominated by price levels and profits.

A new school of industrial organization has emerged since the early 1980s. This includes specifications of strategic firm behavior in imperfectly competitive markets, and includes conceptual descriptions of strategic behaviors such as non-cooperative games, Cournot competition, Stackelberg leaders, and Bertrand-Nash pricing. These behavioral variations are aimed at developing a deterministic understanding of how the "real world" of imperfect competition relates to economic performance. While progress has been made, efforts still fall somewhat short of the deterministic objective.

The new industrial economics does demonstrate that old school econometric models of imperfectly competitive markets which do not include structural equations of price and quantity behavior are misspecified and thus may yield unreliable results. Yet, despite advances in the application of game theory to firm behavior, unambiguous specification of changes in a firm's price and output decisions in reaction to strategic moves by its rivals has not yet been fully achieved.

Nonetheless, many useful insights have been gained. Schmalensee reviewed more than 250 published results from inter-industry (cross sectional) econometric studies that reported empirical findings on structure-performance relationships in imperfectly competitive industries. He concluded that such studies "...rarely if ever yield consistent estimates of structural parameters, but they can produce useful stylized facts..." (p. 952). Given the potential for econometric misspecification that is inherent in such studies, the lack of consistent parameter estimates is not surprising. What is impressive, however, is that the collection of studies persuaded a scholar of Schmalensee's stature that empirical regularities do exist in the relationship between industry structure and economic performance.

In an ambitious empirical analysis, Weiss and colleagues re-examined 121 industry data sets that had been used in econometric studies of the concentration-price relationship. Positive correlations between seller concentration and price levels were found in 106 of these cases; 15 had negative correlations, of which only 4 were statistically significant.

Empirical work following the dictates of the new industrial organization school is beginning to emerge. This is conceptually attractive because data from single industries are used to estimate a system of structural equations that is derived from a clearly specified firm-level optimization problem. That is, these studies include behavioral equations by which firms determine price and quantity. As such, parameter estimates can be tested against values with explicit economic interpretations, e.g. infinite price elasticity of demand equates with perfect competition. This work represents an important step in removing ambiguity associated with possible specification error. But, in order to confine strategic behavior to that which can be represented in behavioral equations, these tend to be intra-industry studies.

Bresnahan has recently reviewed much of the new empirical industrial organization research. He found 12 intra-industry studies from which conclusions could be drawn regarding empirical relationships between market power and performance, specified in terms of price-cost margins (PCMs). In all cases the industries examined were highly concentrated. PCMs ranged from 2.5 percent of costs for the 2nd largest U.S. coffee roasting firm to 88 percent for large Uruguayan banks prior to deregulation, and averaged 29.5 percent across 16 observations.

From his review, Bresnahan drew three conclusions: (1) only a little has been learned so far from the new methods about industrial structure and market performance, (2) one significant cause of poor performance is collusive market behavior, and (3) some concentrated industries exercise a great deal of market power. Given the relatively recent attention to empirical analysis in the new school, the first conclusion is not surprising. The second and

third seem to be validations of the general although imprecise conclusions drawn from a couple decades of empirical work in the old school. Furthermore, about the new studies Bresnahan states, "the individual studies of particular industries are specific and detailed enough that alternative explanations of the findings can be rebutted" (p. 1053).

Thus, despite the lack of a clearly specified functional form for oligopolistic behavior, the link between industrial organization and market performance is well established. Empirical studies based on both the old and new industrial organization theories validate the generalized expectation that industrial concentration is negatively related to domestic market performance. But, does this also hold true for international market performance?

INTERNATIONAL TRADE IN IMPERFECTLY COMPETITIVE INDUSTRIES

Traditionally, international trade has been viewed in the context of perfect competition. Early concern for market imperfections rose from empirical observations that patterns of trade did not accord very well with expectations based on the traditional Heckscher-Ohlin model of comparative advantage. Initially, this concern was dealt with by developing methods for getting the issue of market structure out of the way as easily as possible. The Armington model for treating products as differentiated by source, and the Chamberlinian model of monopolistic competition for treating scale economies, have been the most common approaches for doing so.

By contrast, the new international trade theory explicitly recognizes competitive imperfections such as scale economies, product differentiation, and seller concentration as the core of the story rather than as unavoidable nuisances. This has resulted in an integration of industrial organization and international trade theories, from which at least three themes emerge: import market competition, strategic trade policy, and export competitiveness.

Perhaps the most obvious industrial organization-international trade linkage is the impact of import competition on domestic market performance, or what we label import

market competition. In essence, the idea is that imports are more likely in highly concentrated markets and that such imports have a pro-competitive impact on performance in the host market. Indeed, empirical studies routinely find that high seller concentration stimulates imports (see Caves, for example), that import penetration improves domestic market performance by reducing PCMs and increasing technical efficiency (see Roberts for example), and that the positive effect of imports on market performance increases as domestic seller concentration increases (see Exposito and Exposito for example).

Another theme generated by the integration of industrial organization and international trade has been strategic trade policy. In brief, this concept begins with the observation that, in a world of imperfect competition, a lucky firm can earn excess profits if other firms are dissuaded from entering the market. A country can, accordingly, raise its national income at the expense of other countries if it can somehow ensure that the lucky firm is domestic rather than foreign.

In two highly influential papers, Brander and Spencer demonstrated theoretically that government policies such as export subsidies and import restrictions can preclude foreign firms from competing for lucrative markets in industries that are characterized by significant scale economies and thus increase national income. In essence, these policies are used to enhance the market power of domestic firms in international markets, the purpose being to enable them to shift excess profits away from foreign firms.

A stylized example, drawing heavily on Krugman (1987), is illustrative. Assume that there are two countries, call them Europe and the U.S., each with one firm, call them Airbus (A) and Boeing (B), that can produce a product, call it wide-body passenger aircraft, for sale in the global market. Assume that demand and production costs are such that if either firm produces, it will earn profits of 100 (call it millions of dollars). But if both produce and share the market, each will lose 5. Left alone, the firm with a head start would be the sole

producer. Assume this is B. A will not produce and Europe's earnings are 0. Now suppose that Europe's government commits to pay a subsidy of 10 to A regardless of what B does. This means that A will earn profits of 5 even if B also produces, but B will lose 5 for doing so. Thus, B is induced not to produce. The result is, Europe's subsidy of 10 raises profits of Europe's firm from 0 to 110. In this example, 100 represents the transfer of national income from the U.S. to Europe brought about by Europe's policy of reducing competition or increasing market power.

However, strategic trade policy may be a trivial concept. That is, the circumstances necessary to produce the Brander and Spencer results may so seldom exist in the real world that it has no practical application. Most of the analysis of strategic trade policy to date has been theoretical; a few studies are emerging that attempt to produce quantifiable results by calibrating conceptual models to data from actual industries. Krugman (1989) reviewed much of this work and found little support of either a theoretical or quantitative nature, at one point concluding that "The government would have been better off if it had never heard of Brander and Spencer, or had a constitutional prohibition against listening to them" (p. 1206).

A third theme examines the line of causation from domestic market structure to international competitiveness. This is less well developed theoretically, but perhaps more intuitively obvious. The essence of this concept is, there is a negative relationship between industrial concentration in home markets and the competitiveness of home firms in export markets.

We refer to this as the "Porter paradigm," based on empirical observations reported by Porter from his study of the determinants of international competitive advantage in more than 100 industries located in the U.S., the U.K., Switzerland, Sweden, Singapore, Korea, Japan, Italy, Germany, and Denmark. He found that in every nation the industries that perform best in international markets are those where there are a number of local competitors. That is,

domestic industries with low concentration of market power are the most successful in penetrating foreign markets. He concludes, "This study, in a way I could not anticipate, has led me to a conviction that incentives, effort, perseverance, innovation, and **especially competition** are the source of economic progress in any nation and the basis for productive, satisfied citizens" (p. 736, emphasis added).

This theme was the basis for our analysis of export market performance in the food manufacturing industries. Our research hypothesis was, an inverse relationship exists between market power in food manufacturing industries and their export competitiveness.

EXPORT PERFORMANCE OF U.S. FOOD MANUFACTURERS

In this study, we used export propensity[2] (XP) as the measure of export competitiveness. Using multiple regression, the relationship between XP and industrial organization was estimated for a cross section of 30 U.S. food manufacturing industries defined at the 4-digit SIC[3] level, based primarily on 1982 Census of Manufactures data. Data were available for 12 structural and behavioral characteristics that represent various dimensions of imperfect competition. These included measures of market power, product differentiation, scale and size economies in plant operations, and entry barriers.

Two variables were used to measure market power: the Herfindahl-Hirschman Index (HHI) that aggregates weighted market shares of the largest 50 firms in an industry, and a derived vertical coordination index (VCI) that represents vertical industry tie-in arrangements such as integration and contracts[4].

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[2]Export propensity is defined as exports as a percent of total shipments.

[3]Standard Industrial Classification, as developed by the Bureau of Census, U.S. Department of Commerce.

[4]see Frank for a detailed discussion of the vertical coordination index, VCI.

Three variables measured product differentiation: (1) advertising expenditures as a percent of sales (AS), recognizing that one purpose of advertising to distinguish a seller's product from those of competitors, (2) expenditures on research and development as a percent of sales (RD), recognizing that much R&D is directed to product innovations, and (3) a binary variable that distinguishes between crop- and livestock-based foods (C/L), based on the assumption that crop-based products are more homogeneous.

To measure plant size and scale economies, four variables were used: (1) minimum efficient plant size (MES), based on plant size at the value-added midpoint for each industry as a percent of industry shipments, (2) average enterprise size (AES), specified as the average value of annual shipments from plants in an industry, (3) shipments per employee (SER), to represent labor productivity, and (4) hourly wages (W), to represent labor costs.

Entry barriers were represented by three measures: (1) foreign import barriers (FIB), specified as the percent increase in expected U.S. exports if such barriers were removed, (2) the geographic dispersion index (GDI), which measures the share of output that is produced and consumed in the same region and is an indicator of interregional barriers to shipment, and (3) a binary variable representing industries with leading firms that operate foreign plants (FP), assuming that such firms would be more inclined to serve foreign markets from foreign than domestic plants.

The estimated regression results are shown in Table 1. These results are consistent with our hypothesis: there is a statistically significant, inverse relationship between market power, as measured by both seller concentration and vertical tie-in arrangements, and export market performance, as measured by export propensity. Further, we found a significant inverse relationship between export propensity and product differentiation, as measured by advertising-to-sales ratio and crop- vs. livestock-based products. As would be expected, export performance was positively related to plant efficiencies and negatively to entry barriers.

Overall, the regression results were highly robust, explaining more than 85 percent of the inter-industry variability in export propensity. Based on the F-test, the estimated equation was statistically significant at the 99 percent confidence level.

CONCLUSIONS

These findings confirm the importance of explicitly considering industrial organization when assessing performance in international markets. That more than 85 percent of the export propensity of U.S. food manufacturers can be explained by market structure and behavior variables, using a rather simple regression model, is convincing evidence that industrial organization and international trade are inexorably intertwined, at least in industries characterized by imperfect competition.

Both market power and product differentiation are prominent characteristics of imperfectly competitive market structures. Both are negatively related to export market performance in the U.S. food manufacturing industries. This finding strongly supports the less quantitatively-specific but broader-based findings reported by Porter: competitively structured industries are more successful competitors internationally than are highly concentrated industries. In short, competitive industrial structure and behavior appears to be desirable not only for domestic but also international market performance. That is, competition helps, and more is preferable to less be the market national or global.

In the end, research regarding the determinants and performance implications of international trade in food and other processed agricultural products--and probably virtually all other goods that are products of imperfectly competitive industries--needs to endogenize industrial organization. Likewise, industrial structure policies need to explicitly recognize that leniency toward industrial mergers, cartels, alliances, industrial combines, and other forms of "national champion" in the name of international competitiveness is a trap.

Table 1. Determinants of Export Propensity in U.S. Food Manufacturing Industries: Regression Results

Independent Variable	Estimated Regression Coefficient	t-value
Constant	0.2811	5.0546
Market Power		
Herfindahl-Hirschman Index (HHI)	-0.000041	2.0196
Vertical Coordination Index (VCI)	-0.094398	6.6764
Product Differentiation		
Advertising (AS)	-0.91009	4.7596
Research and Development (RD)	-0.78873	0.6272*
Crop vs. Livestock Based Products (C/L)	-0.020972	1.6414
Plant Efficiencies		
Minimum Efficient Plant Size (MES)	0.013331	3.2915
Average Enterprise Size (AES)	0.0012619	2.5658
Shipments per Employee (SER)	0.0000098	0.2813*
Production Worker Wages (W)	-0.023956	3.0196
Entry Barriers		
Foreign Import Barriers (FIB)	-0.0000171	4.4961
Geographic Dispersion Index (GDI)	0.04891	2.8170
Firms Operating Foreign Plants (FP)	-0.024929	2.6272
F-value	8.378	
R^2	0.8553	
Sample Size	30	

*Not statistically significant at the 0.90 confidence level or above.

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