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International Agricultural Trade  
Research Consortium

**Analyzing Vertical Market Structure and Its Implications  
for Trade Liberalization and Market Access**

by  
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**Working Paper #03-8**

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## **Introduction**

The Doha Round of trade negotiations in the World Trade Organization (WTO) has been labeled the ‘development round’, a key part of which will be increasing developing countries’ access to both developed country and other developing country markets. This process will involve the reduction of tariffs on agricultural goods given that many developing countries are still major agricultural exporters and that agriculture still accounts for a large share of GDP particularly in the poorest developing countries.

In aggregate, agricultural and food trade is dominated by the developed countries, who over the period 1990-2000, accounted for, on average, 66 percent of the value of world exports of all food items (UNCTAD, 2003). In addition, when trade is disaggregated to specific products, the developed countries account for most of the value of world trade, both exports and imports, in high-value and processed food and agricultural products, whereas the developing countries account for a large proportion of the value of exports in traditional unprocessed commodities such as rice, sugar, coffee, cocoa and tea, most of which have continued to suffer from declining world prices over this period (UNCTAD, 2000; 2003).

In terms of tariffs in this sector, a recent survey by USDA (2001) indicates that on average, world tariffs in the food and agricultural sector stand at 62 percent for bound, most favored nation (MFN) rates. However, average food and agricultural tariffs for WTO members by region vary from 25 percent for North America and 30 percent for the EU to 113 percent for South Asia. This compares with average developed country MFN tariffs of 5 percent across all sectors (Hoekman, Ng, and Olarreaga, 2002).<sup>2</sup> While the level of average tariffs is in some way informative, it should also be noted that products in this sector are often characterized by tariff

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<sup>2</sup> It should also be noted that tariff levels in developing countries are also high (in many cases higher than those in developed countries), making developing country access to other developing countries more restricted than to developed countries.

peaks in the developed countries, even for countries that have preferential access to these markets (Hoekman, Ng and Olarreaga, *op. cit.*).<sup>3</sup>

In conjunction with the trade data, the tariff data suggest that developing country access to developed country markets for food and agricultural products could be improved through trade liberalization, particularly in the case of products that exhibit tariff peaks in developed countries and limited preferential access beyond MFN tariffs. However, in terms of the potential benefits to developing countries, there are three outstanding issues. First, recognizing the vertically linked nature of the food chain between agriculture, food processing and retailing, the increasing consolidation of the food industry in developed countries, and also some developing countries, may influence the magnitude of the benefits that developing countries receive from increased market access.

Second, in terms of the total value of the product that reaches consumers, the raw agricultural component typically represents a small share. This has caused many in developing countries as well as international institutions to advocate diversification in developing countries, involving the additional processing of and adding value to the raw agricultural commodity. However, developing countries considering this option face the problem of tariff escalation in that tariffs on processed exports from developing countries are often higher than tariffs on raw agricultural commodities.

Tariff escalation occurs when tariffs on imports of processed goods are higher than the tariffs on the corresponding raw commodity. This issue is well known from the work of Balassa (1965)

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<sup>3</sup> Across all products, the average MFN tariff on food and agricultural products is 38.3 percent in the EU, and 30 percent in the United States, with developing countries getting preferences that imply on average they pay duty up to 50 percent of the MFN tariff. However, there are some clear tariff peaks in the EU for products such as meat and edible offal, cereals, and oil seeds where preferential access for the developing countries is small, and likewise in the United States for oil seeds.

and Corden (1971). UNCTAD (2002a) has recently cited tariff escalation as one of the main problems facing developing country exporters in diversifying their export profile.

The recent evidence on the extent of tariff escalation is rather mixed. For many agricultural commodities supported by government intervention in the developed countries, the tariff on the raw commodity is often exceptionally high. For example, USDA (*op. cit.*) reports higher levels of tariffs on grain compared to grain products in several developed countries including the United States and the EU. Nevertheless, tariff escalation is still perceived to be a major issue facing developing country exporters (Lindland, 1998). The World Bank (2003) reports high levels of tariff escalation for products exported solely from developing countries. For example, for coffee, the average tariff across the EU, the United States and Japan is 4.5 per cent for raw coffee and 13.6 per cent in the case of processed coffee. In the case of cocoa and sugar, the average tariff across these same countries on the raw commodity is 0.16 and 15.57 percent respectively, and 22.5 percent and 28.25 respectively on the final product. In spite of the decline in tariff escalation following the Uruguay Round, it still remains a problem for developing countries diversifying their exports and attaining market access for the processed good.

Third, discussion of access to the retailing sector in developed countries has to recognize the increasing market power of food retailing particularly with respect to suppliers, and that the increasingly ‘buyer driven’ nature of the food chain may be a difficult barrier for many developing country exporters of processed products to circumvent.

The goal of this paper is to shed some light on the aforementioned three issues. In section 1, we discuss the increasing concentration of the food processing and retailing sectors in developed countries, and also in some of the developing countries. In section 2, we summarize the results of the empirical work estimating market power in food processing and retailing, while section 3

outlines a generic vertical market model that characterizes the vertically-linked nature of developed country food markets and how the market structure may influence the gains from the reduction in tariffs on raw agricultural commodity exports. In section 4, we simulate the effects of tariff reduction through this vertical market model, and also apply the analysis to the problem of tariff escalation. Additional issues associated with developing countries increasing their exports of higher value products are presented in section 5, and in section 6 we summarize and conclude.

## **1. Market Structure in the Food Sector in Developed Economies**

As noted in the introduction, the food industry is typically highly concentrated in developed countries at both the retail and processing stages, and this is also becoming a characteristic of the food sector in some developing countries. By way of illustration, we focus specifically on these sectors in the United States and the EU.

### *(i) Food Processing*

In the United States, a small number of large firms dominate the food-processing sector, with the top-20 food- and tobacco-manufacturing firms accounting for over 52 percent of the sector's value added in 1995. If food manufacturing is separated from beverage and tobacco manufacturing, the top-20 food-manufacturing firms accounted for 37 percent of value added in 1997, while the top-20 beverage- and tobacco-manufacturing firms accounted for 79 percent of value added (US Census Bureau, 2001). In Table 1, the 4-firm concentration ratios measured by value added are reported for specific industries in US food manufacturing in 1997. The average 4-firm concentration ratio across these industries is just under 40 percent, which is not particularly high. However, these industry definitions are quite aggregated, hiding higher levels

of seller concentration for particular products. Therefore, in Table 2, we list those specific food products where the 4-firm concentration ratio was over 60 percent in 1997, the average being just below 76 percent.

Turning to food manufacturing in the EU, the data in Table 3 show that typically at the country level, average seller concentration is higher than in the United States, ranging from an average 3-firm concentration ratio of 55 percent in Germany to 89 percent in Ireland, with an average 3-firm concentration ratio across 9 EU countries of 67 percent. As in the United States, these averages hide some high levels of seller concentration for specific products in each EU country, most notably baby foods, canned soup, pet food, and coffee. It should be noted, however, that while seller concentration at the product level is high in many individual EU country markets, there are few examples of firms that dominate sales across EU countries as a whole (Cotterill, 1999).

As well as exhibiting high levels of seller concentration, both the US and EU food industries are characterized by large, diversified corporations selling a range of branded food products. In the United States, firms such as Coca-Cola, PepsiCo, Mars, and Anheuser-Busch sell a range of well-known brands in the beverage, snack and chocolate confectionary sectors, while Philip Morris is a brand leader in the cigarette industry, but also owns Kraft Foods, and until recently, the Miller Brewing Company. Likewise in the EU, several of the largest food manufacturers sell a range of well-known, branded food products such as Nestlé, Danone, Cadbury Schweppes, and Tate and Lyle. In addition, many of these US, and EU-based firms are also multinational in nature, selling global brands.

United States and EU-based multinational food manufacturing firms are also very prominent in some developing countries. For example, Nestlé is the leading processing firm in terms of



sales in Brazil (Farina, 2002). Belik and Santos (2002) also report on the extent to which foreign-based multinational firms such as Parmalat, Danone, Unilever, and Philip Morris, have been entering the Latin American market through mergers and acquisitions, and how this, along with merger and acquisitions by regional multinational firms, has resulted in rapid consolidation of food processing in the region.

(ii) *Food Retailing*

Several important differences are apparent in the food retailing market structures in the US and EU. As Table 4 reports, 5-firm seller concentration in food retailing at the national level is much higher in EU countries than it is in the US, with average 5-firm seller concentration in the former being 65 percent, compared to 35 percent in the latter. However, at the EU-wide level, 5-firm seller concentration is much lower at 26 percent (Hughes, 2002). In addition, in the US, it is important to examine concentration in food retailing at the local and regional level. Cotterill (*op. cit.*) reports that in 1998, 4-firm seller concentration averaged 74 percent across the top 100 US cities, while across major US regions, 4-firm seller concentration averaged 58 percent.

As well as the high levels of concentration in US and EU food retailing, it is important to recognize that several firms in this industry, which were previously national in origin, are now becoming international in scope. Hughes (*op. cit.*) reports that in the 1980s, food retailers in the EU, such as the French firm Carrefour, began expanding beyond their national base, while the US-based firm Wal-Mart expanded into Canada and Mexico. This phenomenon continued in the 1990s, with EU-based retailers such as Royal Ahold and Sainsbury expanding into the US market (Cotterill, *op. cit.*), Carrefour and Royal Ahold expanding into various developing country markets in Central and Latin America (Chavez, 2002; Farina, *op. cit.*; Gutman, 2002), and Wal-Mart expanding into the EU (Hughes) and Central and Latin America (Chavez *op. cit.*;

Farina). As a result, food retailing is becoming increasingly multinational. For example, three food retailers, Wal-Mart, Carrefour, and Royal Ahold now appear in the world's top 100 multinational corporations (UNCTAD, 2002b). In addition, food retailing in developing countries, most notably Latin America, is becoming more concentrated, with multinational firms accounting for the largest share of sales in several countries (Reardon and Berdegúe, 2002). For example, the average share of the top five supermarket chains in supermarket sales in Latin America for 2001/2 was 75 percent, ranging from 47 percent in Brazil in to 99 per cent in Guatemala. At the same time the share of multinational firms in the sales of the top five supermarket chains averaged 88 percent, ranging from 18 percent in Chile to 94 percent in Guatemala (Reardon and Berdegúe, *op. cit.*).

## **2. Evidence for Market Power in the Food System**

In the previous section, it was shown that the food manufacturing and retailing sectors in developed countries such as the United States and EU are concentrated, so that the structure of the food marketing system in these countries can best be characterized as one of successive oligopoly and/or oligopsony. Given that concentrated markets may be associated with horizontally imperfectly competitive behavior by food manufacturers and/or retailers, a key question arises as to how much market power is actually exerted in the food system?

Considerable empirical investigation has occurred in recent years regarding the extent and severity of market power in food processing and retailing. Sexton (2000), Sexton and Lavoie (2001), and Sheldon and Sperling (2003) provide summaries of this work. On balance, the studies conducted to date have indicated that in highly concentrated industries, a positive (negative) correlation between concentration and selling (purchasing) price exists. This

correlation has been found rather consistently across many structure-conduct-performance (SCP) studies of food processor oligopoly and oligopsony power and food retailer oligopoly power.

Dissatisfaction with the SCP framework motivated the so-called new empirical industrial organization (NEIO). This approach draws on models of imperfectly competitive, profit-maximizing firms to guide specification, estimation, and testing of structural econometric time-series models of industry behavior (Bresnahan, 1989). Although game theory has revolutionized industrial organization, it poses something of a problem for the applied researcher. Specifically, multiple models that are capable of explaining observed behavior, and multiple equilibria within a given model, raise questions about the types of behavior game theoretic models can exclude. NEIO studies attempt to resolve this problem by limiting analysis to single or related industries. This strategy allows use of detailed industry knowledge to restrict the class of admissible specifications. In contrast, SCP studies have typically studied a large number of disparate industries, in which case it becomes difficult to capture inter-industry differences within a single model (Sutton, 1990).

The objective of most NEIO studies is to estimate one or more parameters to measure the degree of market power in a specific industry. Although the formulation and interpretation of these parameters differ somewhat across studies, a common approach in the case of oligopoly power is to define a market-power parameter,  $\mu$ , that is bounded on the unit interval:  $\mu \in [0, 1]$ . This parameter is either interpreted as a “conjectural elasticity” or, more simply, as a measure of the mark up of price relative to marginal cost (MC), where  $\mu = 0$  corresponds to perfect competition, and  $\mu = 1$  represents pure monopoly.<sup>4</sup> Intermediate values of  $\mu$  in the open interval

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<sup>4</sup> The notion of a conjectural variation is that any firm in an oligopoly or oligopsony industry must take account of the manner in which its rivals will react to a change in the firm’s strategy variable, e.g., its level of output. Thus, if

(0,1) represent degrees of oligopoly power, with larger values of  $\theta$  indicating greater departures from competition.<sup>5</sup> In addition, given that most of NEIO studies estimate a demand function as part of the empirical model (or adopt an extraneous estimate of the market demand elasticity,  $\theta > 0$ ), a value for the well-known Lerner index of the mark up of price (P) relative to MC can also be calculated:  $(P-MC)/P = \theta / \theta + 1$ .

A closely parallel approach is available to estimate the extent of oligopsony power. In this case, the market power parameter,  $\beta \in [0, 1]$ , represents the mark down of an input's price, W, relative to the value of its marginal product (VMP). Here  $\beta = 0$  corresponds to perfect competition,  $\beta = 1$  corresponds to pure monopsony and values in the open interval (0, 1) represent various degrees of oligopsony power. An estimate of  $\beta$ , coupled with an estimate of the market elasticity of supply ( $\eta$ ) of the input, enables one to compute the Lerner index of monopsony power as  $(VMP - W)/W = \beta / \eta$ .

Estimates of these parameters for a range of industries in the food sector are presented in Table 5. Several comments can be made concerning these results: first, the majority of the listed studies concern the US food industry; second, estimates of both market power and the Lerner index vary quite widely across industries, and it is clear that the value of the Lerner index depends not only on the value of the market power parameter, but also the price elasticity of demand (supply). Third, the measured departures from competition have often been quite small, with point estimates of  $\theta$  and  $\beta$  usually being less than 0.2, equivalent to the market power produced in a five-firm, symmetric Cournot equilibrium. Fourth, the US meat marketing system

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we denote firm  $i$ 's output as  $q_i$ , then the expression  $V_i = \sum_{j \neq i} \partial q_j / \partial q_i$  represents the firm's "conjecture" of its rivals' reaction.  $V_i$  is easily converted to an elasticity expression,  $\eta_i$ , which, as noted, is bounded in the unit interval.

<sup>5</sup> An alternative practice is the approach of Gasmi and Vuong (1991) and Gasmi, Laffont, and Vuong (1992) to econometrically impose the parameter restrictions implied by specific oligopoly/oligopsony models and use nonnested methods of hypothesis testing to distinguish among the various models.

has been subject to most analysis, and the studies listed in the table only represent a portion of the NEIO literature on this particular industry.<sup>6</sup>

In addition, analysis of food retailing has received little attention in terms of the NEIO methodology, with exceptions being the studies of Australian meat retailing by Hyde and Perloff (1998), and French food retailing by Gohin and Guyomard (2000). In summary, if one accepts that the methodology is robust, we have learned a moderate amount about the exercise of market power, most notably in the US food industry. However, virtually nothing has been learned about the extent to which food retailers exert market power, because the NEIO methods typically applied to the food manufacturing sector do not really capture the breadth and complexity of vertical arrangements between manufacturers and retailers and the multi-product nature of the food retailing sector.

(i) *Critique of the Extant Empirical Work*

Since static NEIO models are widely used and are the foundation for most of the recent empirical results regarding market power in the food chain, it is important to note some key issues that arise with their use.<sup>7</sup> First, with the exception of Karp and Perloff (1989), and Deodhar and Sheldon (1996), the studies listed in Table 5 are based on static models of oligopsony/oligopoly.<sup>8</sup> A general criticism of these, and other studies in the field, is that they attempt to model dynamic interactions between agents, namely, reactions to each other's quantity or price strategies in a static framework, using the concept of conjectural variations.<sup>9</sup> This is surprising in light of the

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<sup>6</sup> See Azzam and Anderson (1996) and Ward (2002) for recent surveys on competition in US meat processing.

<sup>7</sup> This is not a comprehensive discussion of all of the issues relating to use of the NEIO methodology, a more thorough discussion can be found in Sexton (*op. cit.*), and Sexton and Lavoie (*op. cit.*).

<sup>8</sup> Steen and Salvanes (1999) use an error correction framework to test for short-run dynamics, but they do not use a dynamic model of oligopoly. Sperling (2002) has recently used this framework to test for oligopsony in the US market for live hogs.

<sup>9</sup> An additional criticism has been put forward by Corts (1998). He shows that with high seasonality in demand, it may be incorrect to make inferences about market power based on a static conjectural variations approach. Typically, most NEIO studies treat the market power parameter as a constant. If, however, it is treated as variable, it

fact that perhaps the most important advance made in the field of industrial organization has been the ability to analyze multi-period games that have oligopolistic equilibria. This point is reinforced by a survey of the empirical industrial organization literature by Slade (1995), suggesting that static one-shot Nash games in either quantities or prices are nearly always rejected by the data.

In contrast to static models, dynamic models attempt to capture the underlying strategic behavior of market participants. A characteristic of dynamic models that has limited their use, however, is the fact that they can be very difficult to solve, and usually require firm-level data. For the sake of tractability, most dynamic models have restricted attention to linear-quadratic games, an approach frequently used in theoretical models of oligopoly (Fershtman and Kamien, 1987; Reynolds, 1987; Dockner, 1992; and Karp and Perloff, 1993a), and also applied in analysis of the food industry (Karp and Perloff, 1989, 1993b; and Deodhar and Sheldon, 1996).

A second issue concerns whether to model production technology as one of either fixed or variable-proportions. Some critics have attacked findings of market power in the US beef packing industry as a failure to allow for input substitution in production, e.g., Muth and Wohlgenant (1999a; 1999b). Studies appealing to a variable-proportions technology, however, typically use very aggregate data, where substitution relates to allocation of an input among several end uses, and, Sexton (*op. cit.*) questions whether this approach is actually a very relevant way to define both product markets and technology. His argument suggests that the general problem with many studies in the NEIO literature is not so much that inappropriate specifications of production technology are used, but instead that researchers often use very poorly defined (and often overly broad) product markets in their empirical analysis.

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is likely correlated with the instruments used to identify it, and is, therefore, a biased estimate of the mean level of market power. Corts' point is that an average level of market power cannot be estimated independently of any dynamic model of oligopolistic behavior.

Antitrust actions that evolve around market power begin with definitions of the relevant market, both in geographic and product form dimensions. Only when these issues are settled does the action proceed to assess the actual exercise of market power. This sequence is fundamental to studying market power. Of what relevance is it to ask whether a firm or group of firms exercise market power without having first answered what are the relevant geographic and product markets within which the firms operate? Most NEIO applications in agriculture have treated market definition issues superficially at best. Sexton conjectures that working with data that is too aggregate and markets that are too broad likely biases analyses against findings of market power.

A third category of criticisms of NEIO studies concerns econometric issues. Most NEIO studies are based on specific *ex ante* choices of functional forms for the demand function, supply relation, and processing technology (Sexton). Consequently, the NEIO researcher is always testing a joint hypothesis, i.e., a test of whether a market is competitive or not, along with a test of the maintained hypotheses concerning functional forms for demand and cost. Sexton suggests that this problem is perhaps not too serious in terms of processing technology where researchers have commonly used flexible functional forms, but may be a problem with respect to demand specification.

Genesove and Mullin (1998), and Bettendorf and Verboven (2000) have both explicitly examined how sensitive estimates of market power are to the functional form of demand. In the former study, focusing on historical data for US sugar processing, estimates of market power were found to be very similar across linear, log-linear, quadratic, and exponential specifications

for demand.<sup>10</sup> In the latter study, which analyzed the Dutch coffee roasting sector, it was found that the estimate of the conjectural elasticity was quite sensitive to whether a logarithmic as opposed to either a linear or quadratic specification of demand was used. This suggests that NEIO researchers should take more care in examining how robust their estimates of market power are to the underlying demand specification.

Most studies of the food industry have also failed to account for the possibility of economies of scale and/or technical change. This latter problem may be particularly severe, when, as is often the case, analysts study a long historical time series, over which technical change will almost surely have occurred. In the context of economies of scale at the industry level, Bhuyan and Lopez (1997), in analyzing oligopoly power in forty US, 4-digit SIC food industries, found that twenty industries exhibited increasing returns to scale. Morrison Paul (1999b) has also analyzed the impact of scale effects and market power on mark-ups of price over marginal cost. Importantly, she has analyzed short- and long-run changes in costs internal to firms, as well as external factors that shift cost functions. Using data for the US food and fiber industries, Morrison Paul (1999b) found scale economies and mark-ups were larger for textiles compared to the food industry, and that scale economies underlay the mark-up behavior of both industries.

Fourth, there has been a tendency for NEIO studies to investigate processor oligopoly or oligopsony power at one stage of the market, typically the processing sector, while maintaining implicitly an assumption of perfect competition at other stages of the market.<sup>11</sup> Although there may sometimes be good economic rationale for this decision, often there is not because any

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<sup>10</sup> Genoseve and Mullin (*op. cit.*) were also able to estimate an elasticity-adjusted Lerner index directly using historical price and cost data. Their econometric estimates of the market power parameter were very close to the direct estimate.

<sup>11</sup> An alternative approach has been to assume that market power is identical in both the farm product and finished product markets, i.e.,  $\lambda = 2$  (Schroeter, 1988, and Schroeter and Azzam, 1990). Because of likely differences in the relevant geographic and product markets for the farm product versus the finished product, this practice also has limitations. Azzam and Pagoulatos (1990) and Wann and Sexton (1992) present two alternative approaches that allow  $\lambda$  and 2 to differ within a vertical market.



structural basis for concern about oligopoly power usually implies parallel concerns about oligopsony power and vice versa. In addition, the consolidation of agricultural markets has involved both the manufacturing and retailing sectors, so market power at successive stages in the market channel is often a relevant issue.<sup>12</sup>

### 3. Agricultural Trade and Importing Country Market Power

We consider a market setting where a primary agricultural product is exported from a developing economy, and it is processed and sold in a developed economy.<sup>13</sup> The market structure in the developed economy features independent processing and retailing sectors, both of which may exhibit market power.<sup>14</sup>

Consumers' inverse excess demand in the developed economy for the retail product is

$$(1) \quad P^r = D(Q^r, | X),$$

where  $Q^r$  is the market quantity of the retail product,  $P^r$  is the market price, and  $X$  denotes unspecified demand shifters. Farmers in the developing country are assumed to be price takers in their output market. Inverse excess farm supply of the raw commodity is expressed as

$$(2) \quad P^f = S(Q^f | Y),$$

Where  $P^f$  is the price received at the farm,  $Q^f$  is the total volume of farm shipments, and  $Y$  represents unspecified supply shifters. The raw product is subject to a per-unit import tariff of  $T$ .

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<sup>12</sup> For example, a plausible theory of behavior in US meat markets is that processors exercise oligopsony power over producers, and retailers exercise oligopsony power over processors. If this vision of the market is true, the farm-wholesale price spread is reduced by retailer oligopsony power and enlarged by processor oligopsony power. An analyst who uses this price spread to study only processor oligopsony power will be led astray unless he/she considers that the wholesale price is reduced by retailer oligopsony power.

<sup>13</sup> The model need not be interpreted narrowly in the context of bilateral trade. The excess demand function in (1) can refer to world demand for the commodity produced in the developing economy, in which case market power could arise due to the behavior of multinational firms and also state trading agencies (Sexton and Lavoie, *op. cit.*).

<sup>14</sup> This model is adapted from prior work by Huang and Sexton (1996), Alston, Sexton, and Zhang (1997), and Sexton and Zhang (2001)

To focus the model on the implications of possible market power in the marketing sector of the developed economy, we make a number of simplifying assumptions about the technologies for the processing and retailing sectors. Processors are assumed to utilize a fixed-proportions, constant-returns technology to convert the raw farm product into a finished product and, similarly, food retailers' technology also exhibits both fixed proportions and constant returns and is separable across the various products sold at retail. For convenience and without further loss of generality, we choose to measure units so that  $Q^f = Q^w = Q^r = Q$ , where the superscripts f, w, and r denote the farm, wholesale, and retail sectors, respectively. Given these assumptions, changes in market concentration have no cost-side effects, enabling the analysis to focus solely on the competition impacts.

Denote a representative processing firm's volume of raw product purchases by  $q^f$ . Given our assumptions, the representative firm's variable cost function can be written as

$$(3) \quad C^w = c^w(\mathbf{V}^w)q^f + (P^f + T)q^f,$$

where  $c^w(\mathbf{V}^w)$  represents the constant processing costs per unit of raw product processed,  $\mathbf{V}^w$  is the vector of prices for variable processing inputs, and  $P^f$  is the raw product price received by producers in the developing economy.

Denote a representative retailer's volume of wholesale purchases by  $q^w$ . A representative retailer's variable cost function for selling the product is

$$(4) \quad C^r = c^r(\mathbf{V}^r)q^w + P^w q^w,$$

where  $P^w$  is the wholesale price,  $c^r(\mathbf{V}^r)$  represents the constant retailing costs per unit of wholesale product sold, and  $\mathbf{V}^r$  is the vector of prices for variable retailing inputs.

We now derive the implications of various combinations of oligopoly and oligopsony power in the processing and/or the retailing sector on total market surplus, and the distribution of

surplus among consumers, producers, and marketers (i.e., processors and retailers), given price-taking behavior by farm producers in the developing country and by consumers in the importing country. To simplify notation, we drop further reference to the exogenous variables  $\mathbf{X}$ ,  $\mathbf{Y}$ ,  $\mathbf{V}^w$ , and  $\mathbf{V}^r$ .<sup>15</sup>

(i) *Manufacturers or Retailers May Have Both Oligopsony and Oligopoly Power*

In this case we assume that *either* retailers *or* manufacturers are price takers, i.e., given market power in one of the marketing sectors, the other sector is competitive. Given the model structure, the output, farm price, consumer price, and aggregate welfare effects are identical for a given degree of market power regardless of whether the power is held by food processors or by food retailers. To simplify the exposition, we develop the case where food manufacturers may exercise market power and retailers are competitive. In this case, the retail price is  $P^r = P^w + c^r$ .

A representative processing firm's profit function can be expressed as

$$(5) \quad \pi^w = (D(Q^w) - c^r)q - S(Q^f)q - (c^w + T)q,$$

where  $q = q^w = q^f$  is the firm's level of output and volume of farm product purchases. The first-order necessary condition for maximizing equation (5) is

$$(6) \quad \frac{\partial \pi^w}{\partial q} = P^w + \frac{\partial D(Q^w)}{\partial Q^w} \frac{\partial Q^w}{\partial q} q - (P^f + c^w + T) - \frac{\partial S(Q^f)}{\partial Q^f} \frac{\partial Q^f}{\partial q} q = 0.$$

Equation (6) can be written in elasticity form as

$$(6') \quad P^w \left( 1 - \frac{\xi^w}{\eta_l^w} \right) = P^f \left( 1 + \frac{\theta^f}{\varepsilon^f} \right) + (c^w + T),$$

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<sup>15</sup> In the modeling framework set forth here, these "shift" variables have particular relevance as policy variables that can be set at a prior time by government or industry members to affect the subsequent market competition. The tariff variable,  $T$ , is one example of such a shift variable, but the concept applies generally. Sexton (2000) provides more discussion of this two-stage modeling approach.

where  $\varepsilon^f = \frac{\partial Q^f}{\partial P^f} \frac{P^f}{Q^f}$  is the market price elasticity of supply of the farm product,  $\eta_l^w = -\frac{\partial Q^w}{\partial P^w} \frac{P^w}{Q^w}$

is the absolute value of the market price elasticity of derived demand for the processed product when the retailer behaves competitively, and  $\theta^f = \frac{\partial Q^f}{\partial q} \frac{q}{Q^f}$ ,  $\xi^w = \frac{\partial Q^w}{\partial q} \frac{q}{Q^w}$  are market-power parameters or conjectural elasticities, as introduced previously. Here  $2^f$ ,  $[0,1]$  measures the processing firm's oligopsony market power in procuring the farm product and  $2^w$ ,  $[0,1]$  measures the firm's oligopoly power in selling the product to retailers. By focusing directly on the end product of oligopoly/oligopsony power, as measured by the parameters  $2$  and  $2^f$ , we need not be concerned with particular market structures or oligopoly/oligopsony games. This makes the model a very convenient tool for conducting simulations of alternative competitive scenarios.

Aggregation from the firm to the industry is accomplished readily within this model framework. Because firms produce a homogeneous product and have identical technologies, optimizing behavior compels that *ex post* all firms' conjectures are identical (Wann and Sexton, 1992). Equation (6') thus represents an equilibrium condition that, in conjunction with the retail demand and farm supply functions specified in (1) and (2), respectively, and the retailer cost function, (4), yields equilibrium values for  $P^f$ ,  $P^w$ ,  $P^f$ , and  $Q$ .

## (ii) *Market Power at Successive Market Stages*

Here we consider scenarios where retailers in the importing country may exercise oligopoly power over consumers and domestic processors may exercise oligopsony power over farmers in procuring the raw product, and, in addition, processor-retailer interactions may be characterized by imperfect competition. We consider two alternative cases for the processor-retailer interactions. The first involves processor oligopoly power and retailer price taking in the processor-retailer interactions (successive oligopoly), and the second involves retailer oligopsony

power and processor price taking (successive oligopsony) in the processor-retailer interactions. The case where both retailers and processors attempt to exercise market power in their mutual interactions must be studied within a bargaining environment, which is beyond the scope of the present study.<sup>16</sup>

For the case of successive oligopoly power, a representative retailer's profit function can be expressed as

$$(7) \quad \pi^r = D(Q)q - P^w q - c^r q,$$

The first order condition for maximizing equation (7) is

$$(8) \quad P^r \left( 1 - \frac{\xi^r}{\eta^r} \right) = P^w + c^r.$$

Using the retail demand function,  $D(Q)$ , to substitute for  $P^r$  in (8), we can solve equation (8) for the retailer's inverse derived demand function for the processed product:  $P^w = D^w(Q^{*r}, c^r)$ .

A representative processing firm's profit function can then be expressed as

$$(9) \quad \pi^w = D^w(Q)q - S(Q)q - (c^w + T)q.$$

The first order condition for maximizing equation (9) is

$$(10) \quad P^w \left( 1 - \frac{\xi^w}{\eta_2^w} \right) = P^r \left( 1 + \frac{\theta^r}{\varepsilon^r} \right) + (c^w + T),$$

where  $\xi^w$  denotes the degree of the processors' oligopoly power, and  $\eta_2^w$  is the elasticity of derived demand, given retailer oligopoly power (in general,  $\eta_1^w \neq \eta_2^w$ ). Equations (1), (2), (8), and (10) define the market equilibrium for the case of successive oligopoly power, and, given

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<sup>16</sup> One plausible outcome of processor-retailer bargaining is that they would agree on the volume of trade that maximized their mutual benefit, with bargaining restricted to determining the division of surplus between the bargainers. This outcome is identical in terms of output, retail price, farm price, and welfare distribution to the equilibria described in the previous subsection when only processors *or* retailers exercised market power.

functional forms for (1) and (2), they can be used to solve for the endogenous variables,  $P^f$ ,  $P^w$ ,  $P^r$ , and  $Q$ .

For the case of successive oligopsony power, a representative processor's profit function can be expressed as

$$(11) \quad \pi^w = P^w q - S(Q)q - (c^w + T)q,$$

The first order condition for maximizing equation (11) is

$$(12) \quad P^w = P^f \left( 1 + \frac{\theta^f}{\varepsilon^f} \right) + (c^w + T).$$

Equation (12) can be used in conjunction with the inverse farm supply curve  $S(Q)$  to yield the inverse derived supply curve,  $P^w = S^w(Q, c^w, T)$ .

A representative retailer's profit function can be expressed as

$$(13) \quad \pi^r = D(Q)q - S^w(Q)q - c^r q.$$

The first order condition for maximizing equation (13) is

$$(14) \quad P^r \left( 1 - \frac{\xi^r}{\eta^r} \right) = P^w \left( 1 + \frac{\theta^w}{\varepsilon^w} \right) + c^r.$$

Market equilibrium for this case is defined by equations (1), (2), (12), and (14).

### (iii) *Market Power and Tariff Escalation*

Here we evaluate the oft-suggested economic-development strategy that developing countries integrate downstream in the market channel by undertaking processing activities for agricultural products produced in their economy. As noted in the introduction, implementation of this strategy may be limited in practice by tariff escalation. However, this disadvantage is offset by potential improvements in the competitive environment when, in the absence of downstream integration, the developing country must sell to processors in the importing country who have

market power. Even if the processing sector that evolves in a developing economy is itself oligopsonistic, at least the oligopsony profits are apt to be captured locally.<sup>17</sup> However, downstream processing is more beneficial to the developing economy if it takes place under conditions of perfect competition. One way to induce competitive behavior in the processing sector would be to organize it around producer-owned cooperatives, which would operate on a zero-profit basis, which in the context of the present model is analytically equivalent to a competitive basis.

To model this scenario, assume that the developing-country processing sector always sells to the retail sector in the importing country as a perfect competitor, and may be subject to oligopsony power exercised by the retail sector. The optimization problem for the integrated farm-processing sector is as follows:

$$\max\{Q\} \quad \pi^{w+f}(Q) = P^w Q - (c^w + T^w)Q - \int_0^Q S(\tau) d\tau,$$

where  $T^w$  is the per-unit tariff imposed on the processed product, and  $T^w > T$  to represent tariff escalation. We assume for simplicity that the developing country can undertake processing with the same unit costs,  $c^w$ , as the developed economy.

The optimal quantity for the developing economy to produce and to process given the objective function is characterized by the condition  $P^w - c^w - T^w = S(Q)$ . Denote this output as  $Q^*(P^w, c^w, T^w)$ . Economic surplus to the developing economy from producing and processing  $Q^*$  is simply the producer surplus, PS, associated with producing  $Q^*$  at net price  $P^w - c^w - T^w$ :

$$PS(Q^*) = (P^w - c^w - T^w)Q^* - \int_0^{Q^*} S(Q) dQ. \text{ Given farm price } P^f(T^f) \text{ under any of the scenarios of}$$

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<sup>17</sup> For example in the case of the Mozambique raw cashew nut sector, McMillan, Rodrik and Welch (2002) assumed that traders downstream from farmers were competitive in selling cashews, but had monopsony power in the purchase of cashews.

developed economy market power discussed in this section and raw-product tariff  $T^f$ , then optimal farm output is  $Q^f = Q(P^f)$  and producer surplus is  $PS(Q^f) = P^f Q^f - \int_0^{Q^f} S(Q)dQ$ .  $PS(Q)$  is a monotone increasing function of farm sector output, so the developing country's welfare is advanced by integrating downstream into the processing sector whenever  $Q^* > Q^f$ .

#### 4. Simulation Analysis

To conduct simulations, it is necessary to assign specific functional forms for the retail demand and farm excess supply functions specified in general form in equations (1) and (2). We chose linear models for this purpose:

$$(1') \quad Q^r = a - \alpha P^r, \quad \text{importing country excess demand at retail,}$$

$$(2') \quad P^f = b + \beta Q^f, \quad \text{exporting country inverse farm excess supply.}$$

In addition, we invoke the normalizations that are available without loss of generality by choosing units so that the quantity and retail price in the competitive, no-tariff equilibrium,  $(Q_c, P_c^r)$ , are each unity:

$Q_c = 1, P_c^r = 1$ , in which case  $P_c^w = 1 - c^r$ ,  $P_c^f = 1 - c^r - c^w = f$ , where  $f$  is farmers' revenue share under the no-tariff competitive equilibrium, and, thus  $f$  measures the intrinsic importance of the farm product in producing the final product. Given the normalizations, the following relationships among the model's parameters are readily derived:

$$(15) \quad \alpha = \eta_c^r, \quad \beta = \frac{f}{\varepsilon_c^f}, \quad a = 1 + \alpha, \quad b = f - \beta,$$

where  $\eta_c^r$  is the absolute value of retail price elasticity of demand and  $\varepsilon_c^f$  is the price elasticity of farm supply elasticity, each evaluated at the no-tariff, competitive equilibrium.



Introducing a per-unit tariff,  $T$ , charged to the farm product causes supply of the farm product to the domestic-country processing sector to become:

$$(2'') \quad P^f + T = b + \beta Q^f + T.$$

(i) *Equilibrium under Processor Oligopoly and/or Oligopsony Power*

We consider first the case where either the processing sector or the retailing sector may exercise oligopoly and/or oligopsony power, but the other downstream sector is competitive. Given the structure of the model, equilibrium output, farm price, retail price, and distribution of welfare among producers, marketers (i.e., processors and retailers), and consumers are identical if the same magnitudes of market power are exercised by either the retail sector or the manufacturing sector. The same results also hold for the rather plausible case where processors exercise oligopsony power over farmers and retailers exercise oligopoly power over consumers, but the interactions between processors and retailers are conducted under conditions of perfect competition.

For consistency with the prior section, we develop the case where retailers behave competitively, and processors may exercise market power. Thus,  $P^r = P^w + c^r$ , and we can solve (1'), (2''), and (6') simultaneously to obtain the following equilibrium solutions for the linear model:

$$(16) \quad Q_1 = \frac{1 + \alpha(\beta - T)}{\Omega_1}, \quad P_1^w = \frac{a - Q_1}{\alpha} - c^r, \quad P_1^r = P_1^w + c^r, \quad P_1^f = b + \beta Q_1,$$

where  $\Omega_1 = (1 + \xi^w) + (1 + \theta^f)\alpha\beta = (1 + \xi^w) + (1 + \theta^f)f\eta_c^r / \varepsilon_c^f$ . The expression  $S_1$  measures the total distortion due to oligopoly and oligopsony power in the linear model, and  $Q_1 < 1 = Q_c$

whenever either  $2^f$  or  $>^w$  is positive. Figure 1 illustrates the model.<sup>18</sup> Note also that this general specification nests the competitive equilibrium, which is obtained when  $>^w = 2^f = 0$ .

Economic surplus (ES) under processor market power is distributed as follows:

$$(17) \quad CS_1 = \int_{P_1^r}^{\frac{a}{\alpha}} (a - \alpha P) dP = \frac{(a - \alpha P_1^r)^2}{2\alpha},$$

$$(18) \quad PS_1 = \int_b^{P_1^f} \frac{P - b}{\beta} dP = \frac{(P_1^f - b)^2}{2\beta},$$

$$(19) \quad \Pi_1 = \Pi_1^w + \Pi_1^r = [P_1^r - P_1^f - 1 + f - T]Q_1.$$

$$(20) \quad R_1 = TQ_1$$

$$(21) \quad ES_1 = CS_1 + PS_1 + A_1 + R_1$$

Given the constant-cost characterization of the marketing sector (processing and retailing), the sector earns zero profits in competitive equilibrium:  $A_1 = 0$ .

In the linear version of the model, the market equilibrium prices, output, and distribution of economic welfare are determined by six parameters:  $\xi^w$  (seller oligopoly power),  $\theta^f$  (buyer oligopsony power),  $\eta_c^r$  (price elasticity of retail demand evaluated at the no-tariff competitive equilibrium),  $\varepsilon_c^f$  (price elasticity of farm supply evaluated at the no-tariff competitive equilibrium),  $f$  (farm revenue share in the no-tariff competitive equilibrium), and  $T$  (magnitude of the per-unit tariff). In this model, the per-unit tariff functions identically to the constant per-unit costs,  $c^r$  and  $c^w$ , incurred by retailers and processors, respectively. The larger is  $T$ , *ceteris paribus*, the less important is processor oligopsony power as a factor in determining the market

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<sup>18</sup> Figures 1-3 rely on Melnick and Shalit's (1985) observation that an industry with oligopoly power acts as if it faces a perceived marginal revenue (PMR) curve that consists of a linear combination of the marginal revenue curve,  $\partial[D(Q)Q]/\partial Q$ , and the market demand curve,  $D(Q)$ , with  $>$  representing the weight attributed to the marginal revenue curve and  $(1->)$  representing the weight attributed to the demand curve. Similarly, for an industry with oligopsony power, the perceived marginal factor cost curve is  $2MC(Q) + (1-2)S(Q)$ , where  $MC = M[S(Q)Q]/MQ$  denotes the marginal factor cost curve.

equilibrium. Intuitively,  $T$  represents an additional wedge (along with processor and retailer costs) between consumers and farm producers. When the farm input price is a small component of retail value, the structure of the market for procurement of the input does not matter much in determining the market equilibrium at retail.

(ii) *Market Power at Successive Vertical Stages*

We consider first the case of successive oligopoly power. For the linear version of the model, the market equilibrium under successive oligopoly power is defined by equations (1'), (2''), (8), and (10):

$$Q_2 = \frac{1 + \alpha(\beta - T)}{\Omega_2}, \quad P_2^w = b + \beta Q_2 + c^w, \quad P_2^r = \frac{a - Q_2}{\alpha}, \quad P_2^f = b + \beta Q_2,$$

where  $\Omega_2 = (1 + \xi^r)(1 + \xi^w) + (1 + \theta^f)\alpha\beta = (1 + \xi^r)(1 + \xi^w) + (1 + \theta^f)f\eta_c^r / \varepsilon_c^f$ . In this case the market equilibrium and welfare distribution are determined by seven parameters:  $\xi^r$ ,  $\xi^w$ ,  $\theta^f$ ,  $\eta_c^r$ ,  $\varepsilon_c^f$ ,  $f$  and  $T$ . In addition to the parameters contained in the preceding case, a second  $>$  parameter reflects the degree of seller market power at successive stages of the market chain. Figure 2 illustrates this scenario. The curve  $P^w = PMR^r - c^r$  in figures 2 and 3 represents the retail sector's derived demand for the farm product at the wholesale level, given the retailers' oligopoly power—see footnote 18. The reduction in output from  $Q_1$  to  $Q_2$  in figure 2 represents the incremental distortion to output from successive oligopoly power.

Finally, the market equilibrium with successive oligopsony power is defined for the linear version of the model by equations (1'), (2''), (12) and (14). Solving the system yields the following solutions for the endogenous variables:

$$Q_3 = \frac{1 + \alpha(\beta - T)}{\Omega_3}, \quad P_3^w = b + \beta Q_3 + c^w, \quad P_3^r = \frac{a - Q_3}{\alpha}, \quad P_3^f = b + \beta Q_3,$$

where  $\Omega_3 = (1 + \xi^r) + (1 + \theta^f)(1 + \theta^w)\alpha\beta = (1 + \xi^r) + (1 + \theta^f)(1 + \theta^w)f\eta_c^r / \varepsilon_c^f$ . The market equilibrium and welfare distribution are determined by seven parameters:  $\xi^r$ ,  $\theta^w$ ,  $\theta^f$ ,  $\eta_c^r$ ,  $\varepsilon_c^f$ ,  $f$ , and  $T$ , with the seventh parameter in this case reflecting the possibility of oligopsony power at successive stages. The successive oligopsony case is illustrated in figure 3, where the reduction in output from  $Q_1$  to  $Q_3$  represents the incremental distortion in output due to successive oligopsony power.

In structuring simulations for these various competition scenarios, the parameter  $f$ , the farm share of revenue under the no-tariff competitive equilibrium was fixed at  $f = 1 - c^w - c^r = 0.5$ . The primary effect of  $f$  in the model is to influence the importance of oligopsony power on output and welfare in the market. When  $f$  is small, the farm input is not an important determinant of the final product value, and, thus, oligopsony power in the farm sector has only a minor impact on total market output and consumer welfare. The presence of a tariff diminishes the farm share of the total retail expenditure under any form of competition, and, thus, a tariff reduces the relative importance of processor oligopsony power in determining the market equilibrium.

We consider  $\eta_c^r = \varepsilon_c^f = 1.0$  as a base case for the farm supply and retail demand elasticities (evaluated at the no-tariff competitive equilibrium). Given  $\varepsilon_c^f = 1.0$  and  $f = 0.5$ , the retail supply elasticity evaluated at the competitive equilibrium is  $\varepsilon_c^r = 2.0$ .<sup>19</sup> Given the linear formulations for retail supply and farm demand, the elasticities change as output changes along the curves to reflect alternative forms of imperfectly competitive equilibria. However, the relative magnitudes of alternative elasticity specifications are the same across the various imperfect competition equilibria,

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<sup>19</sup> The distortion from a given degree of market power market power is always proportional to the elasticity of the demand curve (in the case of oligopoly power) or supply curve (in the case of oligopsony power) that is being exploited. Setting  $\eta_c^r = \varepsilon_c^f$  has the virtue that the relative importance of oligopoly vs. oligopsony power is not distorted by differences in the underlying elasticities of retail demand or farm supply.

and, thus, it suffices to fix the elasticities at a particular point, such as the competitive equilibrium, to simulate the effects of alternative elasticity specifications.

The most important parameters for the purposes of the simulation analysis are the market power parameters,  $\alpha$  and  $\beta$ , which both range in the unit interval. As illustrated in table 5, most point estimates of  $\alpha$  and/or  $\beta$  from prior empirical studies, are quite low--0.2 or less. However, Bhuyan and Lopez (*op. cit.*) obtained estimates of  $\beta$  that were considerably higher for some industries in their ambitious study of oligopoly power for all U.S. four-digit SIC food and beverage industries. For example, 2043 cereal preparation, 2041 flour & grain mills, 2075 soybean oil mills yielded estimates of  $\beta$  of about 0.5. Given the recent increases in consolidation of food manufacturing and food retailing in many countries, the past studies may understate current levels of market power. In addition, the limitations of the extant empirical literature discussed in section 2 probably serve on balance to understate the extent of market power.<sup>20</sup> To gain a broad perspective of the effects of market power on the impacts of tariff reduction, we conduct simulations over the entire unit interval for the market conduct parameters. However, to facilitate a graphical presentation of results, we always consider equal relative departures from competition for each sector that is exercising market power in the simulation. For example, in simulating market behavior under successive oligopsony and retailer oligopoly, we will always set  $\alpha^f = \alpha^w = \beta^r$ .

### (iii) *Simulation Results*

The primary purpose of the simulations is to examine the impact of trade liberalization in a market environment characterized by buyer and/or seller market power in the importing country. However, it is first useful to gain a perspective as to how market power, including market power at successive

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<sup>20</sup> For example, this conclusion would apply to (i) analysis of inappropriately broad product markets, (ii) failure to account for the possibility of market power upstream or downstream from the stage being analyzed, and (iii) failure to account for technical change and/or economies of scale in costs.

vertical stages, can affect market performance. Figure 4 depicts the effect of market power on producer welfare. Five market power scenarios are considered: (i) oligopsony only (ii) oligopoly only, (iii) both oligopoly, and oligopsony, (iv) successive oligopsony and retailer oligopsony, and (v) successive oligopoly and processor oligopsony. It bears repeating that, given the structure of the model, it does not matter in terms of output, farm price, retail price, and the distribution of welfare among producers, consumers, and marketers whether oligopoly or oligopsony is exercised by the processing sector or by the retailing sector.

Figure 4 shows the percent change in producer welfare relative to perfect competition, as a function of the degree of downstream market power. A given degree of downstream oligopoly power is always more damaging to producer welfare than the same degree of downstream oligopsony power because the oligopoly power affects the entire final product, whereas the oligopsony power applies only to the raw product input. Thus, *ceteris paribus*, a given degree of oligopoly power will always reduce market output more than will a given degree of oligopsony power. Figure 4 makes clear that, even modest levels of market power, such as have been found in the empirical literature, can in combination have a very damaging impact upon the welfare of producers in the developing economy. For example, successive oligopoly power combined with processor oligopsony power of 0.2 ( $\alpha^r = \alpha^w = \alpha^f = 0.2$ ) combine to reduce producer surplus by about 45 percent relative to perfect competition in all downstream sectors. Extreme cases of high levels of market power occurring at multiple stages can erode three fourths or more of producer surplus relative to the competitive equilibrium.

Figure 5 illustrates the effect of downstream market power on total economic surplus (the sum of producer surplus, consumer surplus, and marketer profits) in the market. Figure 6 illustrates the distribution of economic surplus among producers, consumers and marketers for the case of

processor oligopsony combined with retailer oligopoly (but no successive market power). Figures 5 and 6 combine to illustrate some important points regarding the efficiency and distributional impacts of market power in a vertical market chain. First, modest levels of market power have small efficiency effects. Figure 5 shows that even successive oligopoly plus oligopsony or successive oligopsony plus oligopoly generate efficiency losses relative to perfect competition of 10 percent or less so long as the market power is modest--2 and  $\gamma$  values of 0.2 or less. However, figure 6 shows that the distributional effects of market power are large even for modest departures from competition. Perfectly competitive marketers earn no profits in this model, but  $\gamma^r = 2^f = 0.2$  or more enables the marketing sector's surplus to exceed the surplus earned by the producing sector, and  $\gamma^r = 2^f = 0.4$  or more enables marketers' surplus to exceed consumers'. For the extreme case of  $\gamma^r = 2^f = 1.0$ , marketers would capture fully two thirds of the available economic surplus.

The aforementioned results on the efficiency impacts of market power are consistent with prior work, dating as far back as the original work by Harberger (1954). However, figure 5 also illustrates that markets with large departures from competition that are repeated across multiple vertical stages can have large efficiency losses. For example, the case of successive oligopoly plus oligopsony where  $\gamma^r = \gamma^w = 2^f = 0.5$  (i.e., Cournot duopolies and duopsony) reduces the total economic surplus in the market by about 25 percent.

Now consider trade liberalization in terms of eliminating the per-unit tariff  $T = 0.2$  (a 20 percent tariff at the competitive equilibrium). Figure 7 depicts the absolute change in farm price from removing the tariff for alternative competition scenarios. Given that  $\epsilon_c^r = 2 > \eta_c^r = 1$ , producers bear only one third of the incidence of the tariff in competitive equilibrium. Thus, abolishing the tariff raises the farm price by  $\Delta P^f = 0.067$  in the competitive equilibrium.  $\Delta P^f$  is a decreasing function of the degree of downstream market power because an imperfectly competitive marketing sector

always captures a share of the benefits of an exogenous shock of this type.

The important question is the extent to which downstream market power vitiates the benefits to the developing economy of trade liberalization. Figure 7 shows that the price increase generated from trade liberalization is dissipated considerably by significant departures from competition, especially when they occur in multiple stages of the downstream market. For example, in the case of successive oligopoly power plus processor oligopsony, modest market power manifest by  $\gamma^r = \gamma^w = 2^f = 0.2$  reduces the farm price increase from tariff removal by 27 percent, while the more extreme scenario of  $\gamma^r = \gamma^w = 2^f = 0.5$  reduces the price increase by fully half.

The effect of market power on the increase in producer welfare caused by trade liberalization is more pronounced than the effect on price because producer surplus is determined both by the change in farm price and the change in output, and market power diminishes both. Figure 8 depicts the change in producer welfare from trade liberalization for alternative competitive scenarios. Consider again the case of successive oligopoly plus processor oligopsony power. The modest market power represented by  $\gamma^r = \gamma^w = 2^f = 0.2$  reduces the producer surplus increase from trade liberalization by over half, while  $\gamma^r = \gamma^w = 2^f = 0.5$  reduces it by 75 percent.

Next consider the distribution of benefits from trade liberalization across producers, consumers, and marketers depicted in figures 9 and 10. Figure 9 represents the case of processor oligopsony and retailer oligopoly, while figure 10 represents successive oligopoly plus processor oligopsony. Producer and consumer welfare both decline monotonically in the degree of market power exercised. Marketers' profit rises monotonically as a function of  $\gamma^r = 2^f$  in figure 9, but marketers' profit is actually declining in  $\gamma^r = \gamma^w = 2^f$  for high values of market power in the successive-oligopoly-plus-oligopsony case. This outcome illustrates an important feature of market power generally and of successive market power in particular. Agents who exercise market power always



impose a negative externality on the other participants in the market. Thus, rising values of  $\gamma^r = \gamma^w = 2^f$  represent higher absolute levels of market power exercised by marketers, but the negative externality imposed on processors' profits when retailers increase their market power (and vice versa) dominates the higher profits earned by the retailer, causing overall marketing sector profits to fall for high levels of market power exercised at successive stages.<sup>21</sup>

Both figures 9 and 10 demonstrate that the distributional effects of market power are quite dramatic. Even rather modest levels of market power enable the marketing sector to capture the largest share of the benefits from trade liberalization, and for very high levels of market power, the marketing sector captures the lion's share of the benefits. Clearly, the presence of downstream market power is an important issue when considering the impacts of trade liberalization.

A great many extensions and generalizations of this simulation framework are possible, and we will mention only a few. All of the results discussed here are conditional upon the base values of  $\epsilon_c^f = \eta_c^r = 1$ , and  $f = 0.5$ . The specific results will change as these base values change, although the qualitative conclusions do not change. Moreover, the effects of changing these variables are readily determined. More inelastic farm supply will exacerbate the anticompetitive impacts of processor oligopsony power, and a more inelastic retail demand will exacerbate the impacts of retailer oligopoly power. A smaller farm share will diminish the importance of oligopsony power for any value of  $f$ .

We have modeled the case of a constant per-unit tariff, but many tariffs are *ad valorem*. The impacts of removing an *ad valorem* tariff are also readily simulated, although the *ad valorem* tariff adds some complications to the modeling relative to a per-unit tariff. In particular, because the *ad valorem* tariff affects the slope of the downstream supply functions derived from the farm supply

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<sup>21</sup> This result provides an incentive for vertical coordination in the marketing chain to internalize these external effects. We discuss this issue briefly in the next section.

function, the simple proportional relationship between price elasticity at the farm level and at retail ( $\varepsilon^r = \varepsilon^f / f$ ), that holds for the per-unit tariff, does not hold for the *ad valorem* tariff. Indeed, an *ad valorem* tariff makes the downstream supply relationships less elastic, *ceteris paribus*, and, thus, an *ad valorem* tariff can exacerbate the distortion from oligopsony power in the retailer-processor interaction.<sup>22</sup> Removing the tariff will actually reduce the distortion from a given degree of retailer oligopsony power, which will provide an additional welfare benefit from trade liberalization.

Finally, figure 11 asks the question of whether a developing economy can increase economic surplus by integrating downstream into the processing of its agricultural product, despite possibly facing tariff escalation. This question may be answered in the affirmative when the integration enables the developing economy to avoid facing processor oligopsony power in the importing country. The vertical axis in figure 11 represents the additional per-unit tariff,  $\tau$ , imposed on processed product imports relative to the tariff imposed on the raw product ( $T = 0.2$ ) under a tariff escalation scenario. The horizontal axis measures market power. In all cases the developing country integration removes the producing sector's exposure to processor oligopsony power, but any market power exercised by the importing country's retailing sector remains. Three alternative scenarios for retail sector market power are depicted: (i) the retailing sector exercises both oligopsony and oligopoly power that is equivalent in magnitude to the oligopsony power exercised by the importing country's processing sector, (ii) the retailing sector exercises only oligopoly power that is equivalent to the processing sector's oligopsony power, and (iii) the retailing sector exercises oligopoly power that is fixed at  $\tau = 0.2$ .

The lines in figure 11 are iso-welfare lines, i.e., they represent  $(\tau, T)$  combinations that hold the producing country welfare constant in terms of the choice of integrating into the processing

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<sup>22</sup> Alston, Sexton, and Zhang (1997) study the effects of a proportional shift *downward* in farm supply caused by public-sector research when the downstream market may be imperfectly competitive.

sector and facing tariff escalation or selling to importing country processors and facing oligopsony power. Thus all  $(\theta, T, 2)$  combinations below an iso-welfare line represent situations where the developing economy enhances economic welfare by integrating into the processing sector, given the extent of market power exercised by the importing country's retailers. Clearly, depending upon the particular market power configuration, the developing country may do better by integrating the processing function despite tariff escalation of 50 percent ( $\theta = 0.1$ ) or even 100 percent ( $\theta = 0.2$ ).<sup>23</sup>

## 5. Additional Issues for Developing Country Access to Vertical Chains

In this section we consider some of the additional issues involved when developing country exporters are faced with the problem of market access in the context of a vertically related market. Market access at the raw commodity stage as is presumed by most of the models focusing on trade liberalization does not give much guidance for developing countries who wish to access markets closer to the consumer stage. We focus on two issues: first, the nature of vertical contractual relationships, and second, the issue of governance in global commodity chains and how this may affect the prospects for developing countries in increasing market access through up-grading their food and agricultural exports.

### (i) *Vertical Contractual Relationships*

Typically, models of the food marketing system assume that processors and retailers operate at arms' length, and in particular, that food retailers take upstream prices as given, and that neither manufacturers nor retailers attempt to influence contractual terms. This approach, however,

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<sup>23</sup> One useful extension of this result is to recognize that, instead of  $\theta$ , the vertical axis in figure 11 could represent  $c^w$ . In other words, for a constant tariff at the raw product and processed product stages ( $\theta = 0$ ), figure 11 can depict the absolute per-unit cost penalty the developing country could incur relative to the developed-economy's processing sector and still benefit from integrating the processing sector.

ignores the use of a wide variety of what are known as vertical restraints, including practices such as discounts, ‘full-line’ forcing, exclusive distribution, exclusive territories and ‘slotting allowances’ (McCorriston, 2002). These vertical restraints that characterize the links between retailers and manufacturers are common practice and, as shown by McCorriston and Sheldon (1997), both the US and UK competition authorities have investigated a wide range of such practices. For example, the UK Competition Commission recently identified 30 different contractual practices between manufacturers and retailers, 27 of which they concluded had the potential to be against the public interest (Competition Commission, 2000).

The modern theory of vertical restraints assumes a manufacturer is seeking a contract that will maximize its profits, given that a retailer undertakes some set of actions to maximize profits given the compensation scheme offered by the manufacturer. The contractual problem is to overcome the existence of vertical externalities between the two stages of the marketing chain, specifically the problem of double marginalization where without a contract between manufacturer and retailer, each marks up price over marginal cost. It is well-known that if the manufacturer (retailer) integrated vertically with the retailer (manufacturer), the manufacturer (retailer) mark-up would disappear and vertical profits would be maximized. Also, in the literature on vertical restraints, it is a basic proposition that a contract such as a two-part tariff or resale price maintenance will resolve this externality without the need for vertical integration (Katz, 1989).

A key characteristic of much of the theoretical literature is that use of vertical restraints or vertical integration will generate a welfare improvement, as the retail price will be lower.<sup>24</sup> However, it is also possible that vertical restraints may reduce competition at either the

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<sup>24</sup> The benefits of vertical coordination between the processing and retailing sectors are readily determined in the simulation model of the preceding section. Under vertical coordination, the conditions of trade between the processing and retailing sectors are the same as if the trade were competitive.

manufacturing or the retailing level, and, hence, may not be socially desirable if collusion is facilitated at either one or both levels (Bonnano and Vickers, 1988; Rey and Stiglitz, 1988; Shaffer, 1991).

The vertical restraint that has probably raised the most concern in recent years in both the UK and the United States has been slotting allowances, which are payments by upstream suppliers to retailers to guarantee access to shelf space in the supermarket. The principal issue here is that shelf space is scarce and that access to shelf space requires the payment of a slotting allowance. In the UK, the Competition Commission (*op. cit.*) reported that 40 percent of suppliers had to pay slotting allowances, while in the US, Bloom, Gundlach and Cannon (2000) suggested that slotting allowances accounted for around 15 percent of all promotional expenditure for new product introductions. Slotting allowances can be rationalized as lump-sum payments that ration scarce retail shelf-space. However, existing theory suggests that such payments can be either anti- or pro-competitive. For example, Shaffer (*op. cit.*) has shown that slotting allowances are a “facilitating” practice, allowing retailers to raise prices. In contrast, Sullivan (1997), Chu (1992), and Lariviere and Padmanabhan (1997) have used risk sharing and signaling/screening stories respectively to show that slotting allowances provide an incentive to retailers to stock new products, with no impact on retail prices.

Whatever the actual competitive impact of business practices such as slotting allowances, the nature of vertical contractual arrangements in the food marketing chain are important aspects of market structure and behavior that need to be taken into account when evaluating the effects of reductions in tariffs on farm commodity imports. Obviously they have an impact on competition among food manufacturers and retailers based in the developed countries, but they may also

impact the market access of firms in the developing countries that are attempting to become more involved in activities beyond production of raw commodities.

(ii) *Governance in Vertical Markets*

In Sections 3 and 4, we characterized the vertical linkages in the food marketing chain, highlighting the role of competition in the downstream stages. As such, market access issues refer not only to the level of tariffs that may be ameliorated by trade liberalization and preferential access agreements but also in terms of the ability of exporters to access the retail stage. This will typically involve some degree of ‘up-grading’, either by marketing the product directly or by further processing. There is a strand in the development literature that deals with these issues, known as ‘global commodity chain’ or ‘value chain’ analysis (Kaplinsky, 2000; UNCTAD, 2000). This framework recognizes that market access for developing country exporters is difficult and that successful market access will involve contact with firms throughout the vertically-linked chain regarding a broad range of issues including product quality, safety, delivery, packaging and traceability.

Although such ‘value chain analysis’ exists outside of formal economic theory, international economists have recently begun to recognize the importance of such issues. For example, Keessing and Lall (1992) have noted the importance of relations within a vertically related chain, suggesting that trade theory pays little attention to the information requirements, information flows, and marketing efforts involved in exporting. More recently, these issues have been addressed in the international economics literature in the analysis of ‘networks’ (see Rauch, 2001). The central focus of such research is that, even if formal barriers to trade are reduced, informational and other search costs exist that serve to hinder international trade. These informational barriers can be overcome by the existence or creation of networks, the ‘vertical’

aspects of these informational and search barriers corresponding to the ‘global commodity chain’ framework that has emerged in the development literature.

Gereffi (1999) defines a ‘commodity chain’ as the ‘whole range of activities involved in the design, production and marketing of a product’ (p.38), and distinguishes between producer-driven and buyer-driven commodity chains. Producer-driven commodity chains are those in which suppliers, who are often multinational in scope, play a dominant role in coordinating production linkages and establishing forward and backward linkages. While the examples of producer-driven commodity chains usually refer to such industries as motor vehicles and semiconductors, an example from the food sector may include a branded processed good whereby a food manufacturer coordinates production among farms (or may even own the farms too) and marketing via the retailing sector.

Buyer-driven commodity chains refer to those industries in which large retailers play a dominant role in the global commodity chain.<sup>25</sup> The main characteristic of this buyer-driven chain is the retailers’ knowledge of consumer demand and the ability to control access to shelf-space. The principal difference between these two types of chains really refers to governance structure. In a producer-driven commodity chain, manufacturers play a dominant role at the point of production, while with a buyer-driven chain control is exercised by retailers at the point of marketing and coordinating relations with suppliers upstream. Clearly, given the data provided in Section 1, the increasing dominance of food retailers in developed countries and their power vis-à-vis suppliers would correspond to an example of a buyer-driven marketing chain in the food sector.

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<sup>25</sup> Gereffi (1999) focuses on the buyer-driven nature of the apparel marketing chain, where buyers are either the retail chains such as Wal-Mart and Kmart in the US and Marks and Spencer in the UK, firms marketing branded clothing products such as Tommy Hilfiger, or specialty clothing stores such as The Gap.

As Gereffi (*op. cit.*) notes, participation in such global commodity chains is a necessary step for up-grading and diversifying developing country exports. By implication, marketing outside these commodity chains would involve considerable search costs both in terms of finding marketing outlets and in identifying the needs of consumers, barriers that would be formidable given the increasing concentration of the retailing sector in many developed countries. In contrast, participation in such commodity chains and the establishment of appropriate networks has the potential to play an important role in providing technical assistance, product up-grading, product quality, and identifying appropriate marketing opportunities and, more broadly, access to the retail stage of the vertically-related food chain.

Those involved in the development and the application of the global commodity chain framework have recently provided some informative case studies. For example, Dolan, Humphrey and Harris-Pascal (1999) discuss the case of fresh vegetable exports from Africa. They note that this market has changed from being largely characterized by arm's length transactions to one where the retailers dominate the sector. For example, in the case of the UK, the 6 leading retailers account for 76 per cent of total fresh fruit and vegetable sales. There are certain advantages for the retailing firms exerting their influence over upstream suppliers including traceability and quality control as well as ensuring timely supplies. In terms of attaining access to the retailing stage of the chain, developing country exporters have responded by developing large-scale sorting and packaging facilities for post-harvesting activities. As noted by Kaplinsky, this has led to concentration of production in Kenya and Zimbabwe with large farms dominating the export sector and small farms supplying only a small proportion of total exports. Clearly, the insights offered by the global commodity chain framework in this case refer to governance issues and what determines access to the retail stage, as well as the implications



for coordinating supply in the exporting countries. Moreover, it provides some insight into the breakdown of the total rent available in the vertical chain and how it is distributed between the various stages, a relatively small proportion of the total rent being captured by the developing country suppliers with the largest mark-up being available at the retail stage.

Kaplan and Kaplinsky (1999) focus on the canned deciduous fruit sector. They note that competition is intense between branded and own-brand products, the latter often being sold as a loss-leader by retailers. Consequently, up-grading by developing country exporters is likely to be difficult due to intense competition for shelf-space within the retailing sector. Kaplan and Kaplinsky report two cases where South African producers have attempted to move up the marketing chain. One example involved South African exporters buying the right to use the Del Monte brand name and distribution system though, unfortunately, this applied only to markets outside Europe and North America where the profile of the brand was limited.<sup>26</sup> In another example, a royalty was paid to a brand name holder, but the royalty was so large that it consumed the rent from doing so.

The case of South African Breweries (SAB), however, provides an interesting contrast to that of the South African canned fruits sector. From the mid-1990s, SAB, which, prior to the end of the apartheid regime, had operated as a virtual monopoly in both South Africa and southern Africa, began a process of international expansion via acquisition in other developing country markets such as China and the former Soviet-bloc. In 2002 it also acquired the Miller Brewing Company in the US. As a result, SAB is now the world's second largest brewer after Anheuser-Busch, operating 108 breweries in 24 countries, and ranks as 20<sup>th</sup> among the world's

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<sup>26</sup> It should be noted that, under the EU's Common Agricultural Policy (CAP), high tariffs are imposed on imports of canned deciduous fruits at the same time as production subsidies are provided to deciduous fruit producers inside the EU. As a result, South African producers have lost market share in both the EU and third-country markets (Kaplan and Kaplinsky, 1999).

top 50 multinational firms based in developing countries (UNCTAD, 2002b). Importantly, SAB's acquisition of Miller Brewing provides an example of how a developing country exporter can gain access to developed country markets, as it will use Miller's distribution system to market its brand Pilsener Urquell in the United States. UNCTAD (2002a) also notes other cases where market access to the vertical chain has taken a similar path. For example, two Brazilian orange juice companies Cutrale and Citrosuco, have acquired local plants in Florida to process some of their orange juice imports. Exporters from Indonesia and Thailand have taken over major US companies and Columbian flower exporters have acquired major flower importers in the US market.

What insights, if any, does this commodity chain framework offer to economists interested in the problem of developing country access to developed country markets? At face value, the commodity chain framework seems to be principally descriptive in nature and to lack any formal theoretical basis. Nevertheless, it arguably identifies some issues that economists have ignored. For example, it recognizes the existence of a vertically linked chain and the importance of the governance structure within this vertically related set-up. It also recognizes that access to markets is not just about arm's length trading and that a change in relative prices will not necessarily solve the problem for developing country exporters. The development of both formal and informal contacts with firms in the vertical chain, are important for developing countries' ability to gain access to the retail stage of the food chain and identifying the requirements for doing so. While broadly informal in nature, this is principally the focus of recent research in economics on networks and market access and requires considerably more research particularly in relation to food markets.

## **6. Summary and Conclusions**

There are three overall points to be extracted from this paper. The first is to recognize that in fully understanding the impact of trade liberalization, it is necessary to understand the vertical linkages that characterize food markets in many developed countries. Given that the food sector is most appropriately characterized by successive oligopoly/oligopsony with developing country exporters of raw commodities entering at the first stage of the food chain, the implication of reducing tariffs is different in magnitude from that implied by models that assume perfect competition. Moreover, the distributional effects also differ relative to the perfectly competitive case and may result, somewhat paradoxically, in developing countries receiving a lower share of the total value added within the food chain as trade reform occurs. This outcome arises since, with incomplete pass-through of the tariff reduction, mark-ups in the downstream sector increase. This issue needs further attention from economists and policy-makers.

Second, consolidation has increased in the food industry in developed (and developing) countries in recent years. This may also have implications for developing country exporters in terms of market access and the prices they receive. In particular, increasing concentration at either the retailing or processing sector (or both), will reduce the share that developing countries receive within the food marketing chain.

Third, there have long been calls for developing countries to diversify the composition of their exports. In recent years, these issues have been reflected in several publications by UNCTAD urging developing countries to reduce their reliance on raw commodities and export more high-value, processed food products. As we have argued in this paper, such a strategy is likely to face obstacles when we account for the highly concentrated nature of the vertical chain that characterizes the food industry in developed countries. This is not just an issue of tariff

escalation, but an issue that must also recognize the buyer driven nature of the food chain. In this context, retailing firms determine what and how much appears on the supermarket shelves both in terms of the nature and quantity of the product, as well as meeting appropriate quality and health and safety standards. Also, due to issues of legal liability, retailers are increasingly concerned about traceability. Moreover, in recognizing the scarcity of shelf space, vertical restraints become an important issue. These issues also have potential consequences for the organization of agricultural production in developing countries, as large farmers may be more capable than smallholders of meeting the requirements of the food industry in developed countries. Resolving these issues may have implications for small farmers in developing countries, particularly given the recent tendency to reform parastatals.

Taken together, the vertically related, highly-concentrated nature of the food sector in developed countries raises many issues for developing countries attempting to increase market access and the returns from exporting agricultural and food products. These issues have, by and large, been ignored by economists and policy-makers in providing estimates about what further trade reform may bring to developing countries. To the extent that the role of the ‘value chain’ has been recognized in the broader development literature, this has often been done on a case study basis with little formal analysis. Consequently, to fully understand the implications of trade reform for raw commodity exporters and the issues for developing countries attempting to diversify their export profile, further attention needs to be paid to the issue of industry consolidation and market structure in developed country food markets.

**Table 1: Concentration Ratios in US Food Manufacturing,<sup>1</sup> 1997**

<b>Industry</b>	<b>CR4 (%)</b>
Animal food	32.7
Grain and oilseed milling	48.7
Sugar and confectionary product mfg.	45.3
Fruit and vegetable processing	31.5
Dairy product mfg.	25.6
Meat product mfg.	26.9
Seafood preparation and packaging	12.5
Bakeries and tortilla mfg.	32.0
Other food mfg.	40.6
Beverage mfg.	53.3
Tobacco mfg.	87.5
Average	39.7

Source: US Census Bureau, 2001.

<sup>1</sup> Share of value added accounted for by the 4 largest firms.

**Table 2: Product Concentration Ratios in US Food Manufacturing,<sup>1</sup> 1997**

<b>Product</b>	<b>CR4 (%)</b>
Dog and cat food mfg.	63.4
Malt mfg.	66.5
Wet corn milling	73.7
Soybean processing	73.4
Other oilseed processing	72.7
Breakfast cereal mfg.	86.7
Sugar cane mills	61.8
Cane sugar refining	96.4
Beet sugar mfg.	82.7
Chocolate and confectionary mfg.	86.6
Condensed/evaporated dairy mfg.	68.8
Cookie and cracker mfg.	64.6
Snack food mfg.	63.0
Brewing	90.7
Distilling	64.8
Cigarettes	98.0
Average	75.9

Source: US Census Bureau, 2001.

<sup>1</sup> Share of value added accounted for by the 4 largest firms.

**Table 3: Concentration Ratios by Product in EU Countries<sup>1</sup>**

Product	Ireland	Finland	Sweden	Denmark	Italy	France	Spain	UK	Germany	Average
Baby food	98	100	100	99	96	93*	54	78	86	91
Canned soup	100	85	75	91	50	84	--	79	41*	87
Ice cream	--	84	85	90	73*	52	84	45	72	76
Coffee	91	72	71	70	60	100	--	74	67	75
Yoghurt	69	83*	90	99*	36	67	73	50	76	70
Chocolate confectionary	95	74	--	39	93	61	79	74	--	74
Pet food	98	80	84	40	64*	73	53	77	87	79
Breakfast cereals	92	--	52	70	88	70	82	65	67	73
Tea	96	90	63	64	80	82	62	52	55	72
Snack foods	72	70*	80	78	71	50	56	73	48	68
Carbonates	85	50	62	--	60	69	79	55	60*	71
Butter	--	--	--	100	--	32*	--	65	30	65
Pasta	83	97	82	61	51	57	65	37	49	65
Frozen meals	--	--	63	--	90	62	39	39	65	62
Wrapped bread	85	44	47	59	80	70	96	58*	9	59
Biscuits	83	73	51	44	55	61	53	42	50	58
Canned fish	--	70	72	49	68	43*	33	43*	--	55
Mineral water	--	100	74	70	37	--	31	14	22	50
Fruit juice	--	70	50	65*	62	26	38	35	46	48
Canned vegetables	--	68	47	50	36	29	--	--	--	47
Average	89	79	69	69	67	63	61	56	55	68

Source: Cotterill (1999).

<sup>1</sup> 3-firm concentration ratios, except \* which are 2-firm.**Table 4: Seller Concentration in US and EU Food Retailing, 1990s**

Country	CR5 (%)
Austria	79
Belgium-Luxembourg	57
Denmark	78
Finland	96
France	67
Germany	75
Greece	59
Ireland	50
Italy	30
Netherlands	79
Portugal	52
Spain	38
Sweden	87
UK	67
EU	26
United States	35

Sources: Cotterill (1999), McCorriston (2002), and Hughes (2002).

**Table 5: Estimated Market Power and Lerner Indices <sup>a</sup>**

Study	Industry	Market Power	Lerner Index
Appelbaum (1982)	US textiles	0.05*	0.07
	US tobacco	0.40*	0.65
Lopez (1984)	Canadian food processing	0.19*	0.50
Schroeter (1988)	US beef-packing:	0.22*	
	- oligopsony		0.01
	- oligopoly		0.04
Karp and Perloff (1989)	Rice export	0.68 <sup>□</sup> d	0.11
Azzam and Pagoulatos (1990)	US meat (oligopoly)	0.22*	0.46
	US livestock (oligopsony)	0.18*	1.10
	US composite meat processing		0.74
Schroeter and Azzam (1990)	US beef <sup>b</sup>	0.05*	0.55
	US pork <sup>b</sup>	0.06*	0.47
Buschena and Perloff (1991)	Philippines coconut oil	0.58 <sup>□</sup>	0.89
Wann and Sexton (1992)	US grade pack pears <sup>b</sup>	0.08*	0.15
	US fruit cocktail <sup>b</sup>	0.48*	1.41
Deodhar and Sheldon (1995)	German bananas	0.29 <sup>□</sup>	0.26
Deodhar and Sheldon (1996)	German bananas	0.20 <sup>□</sup> d	0.18
Bhuyan and Lopez (1997)	US food industries <sup>c</sup>	0.18*	0.33
	US tobacco industries	0.18*	0.33
Wilson (1997)	UK bread manufacturing	0.31	0.84
Genoseve and Mullin (1998)	US sugar industry	0.04 <sup>□</sup>	0.05
Steen and Salvanes (1999)	French fresh salmon	0.02-0.05 <sup>□</sup> e	0.12-0.04
Bettendorf and Verboven (2000)	Dutch coffee roasting	0.02-0.17* <sup>f</sup>	0.07-0.54
Gohin and Guyomard (2000)	French food retailing:		
	- dairy products <sup>b</sup>	-0.02*	0.20
	- meat products <sup>b</sup>	-0.03*	0.17
	- other food products <sup>b</sup>	0.01*	0.12

<sup>a</sup> Acknowledgements to Jeff Perloff (UC Berkeley) for providing some of the data in this table

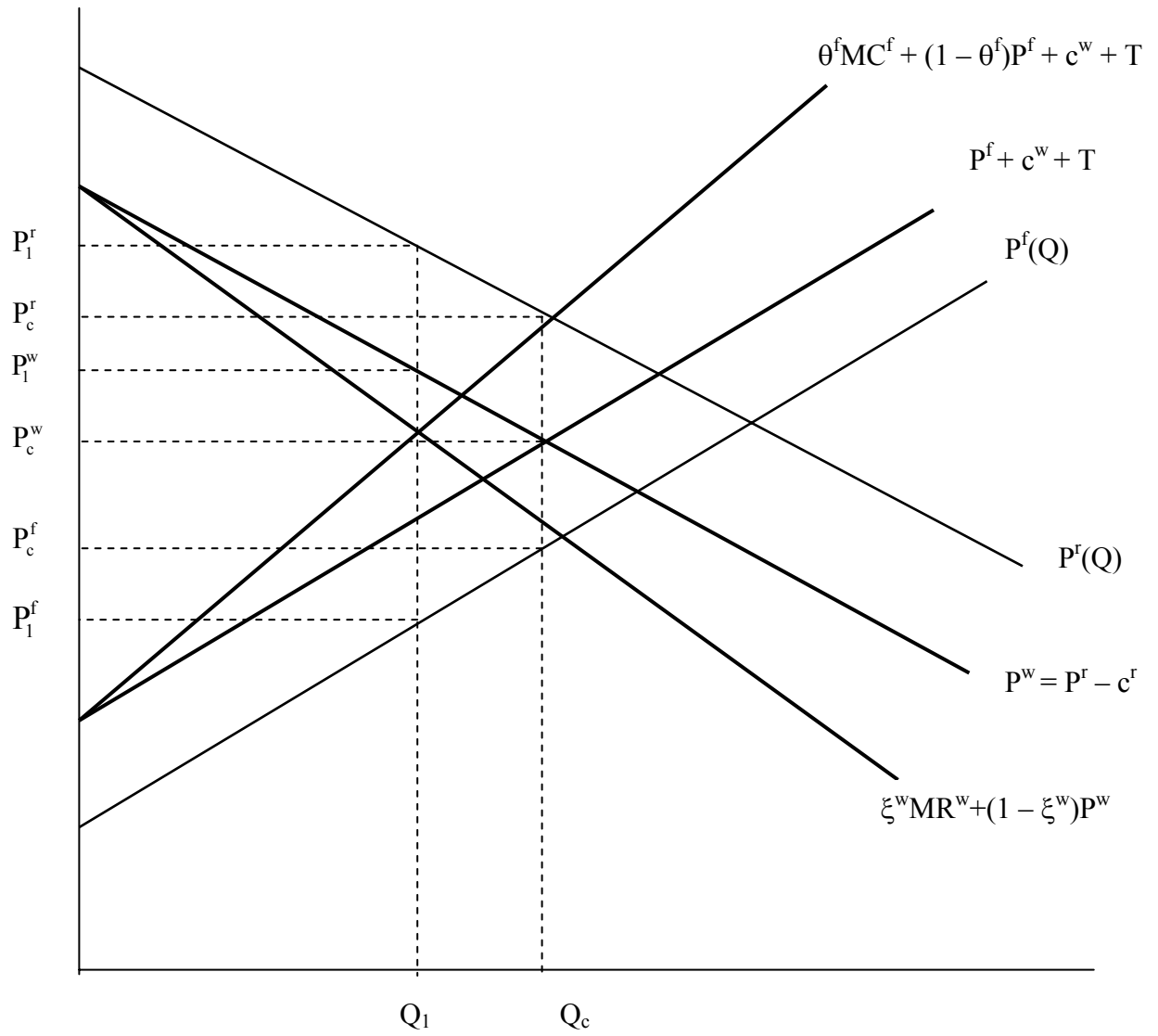
<sup>b</sup> Estimates based on joint oligopsony/oligopoly power

<sup>c</sup> Bhuyan and Lopez also calculated Lerner indices for 40 4-digit SIC food industries, ranging from 0.72 for cereal preparation to 0.08 for dried fruit and vegetables

<sup>d</sup> Estimate based on a closed loop dynamic model

<sup>e</sup> Static and dynamic estimate <sup>f</sup> Quadratic and logarithmic demand estimates; \* Conjectural elasticity; <sup>□</sup> Conjectural variation

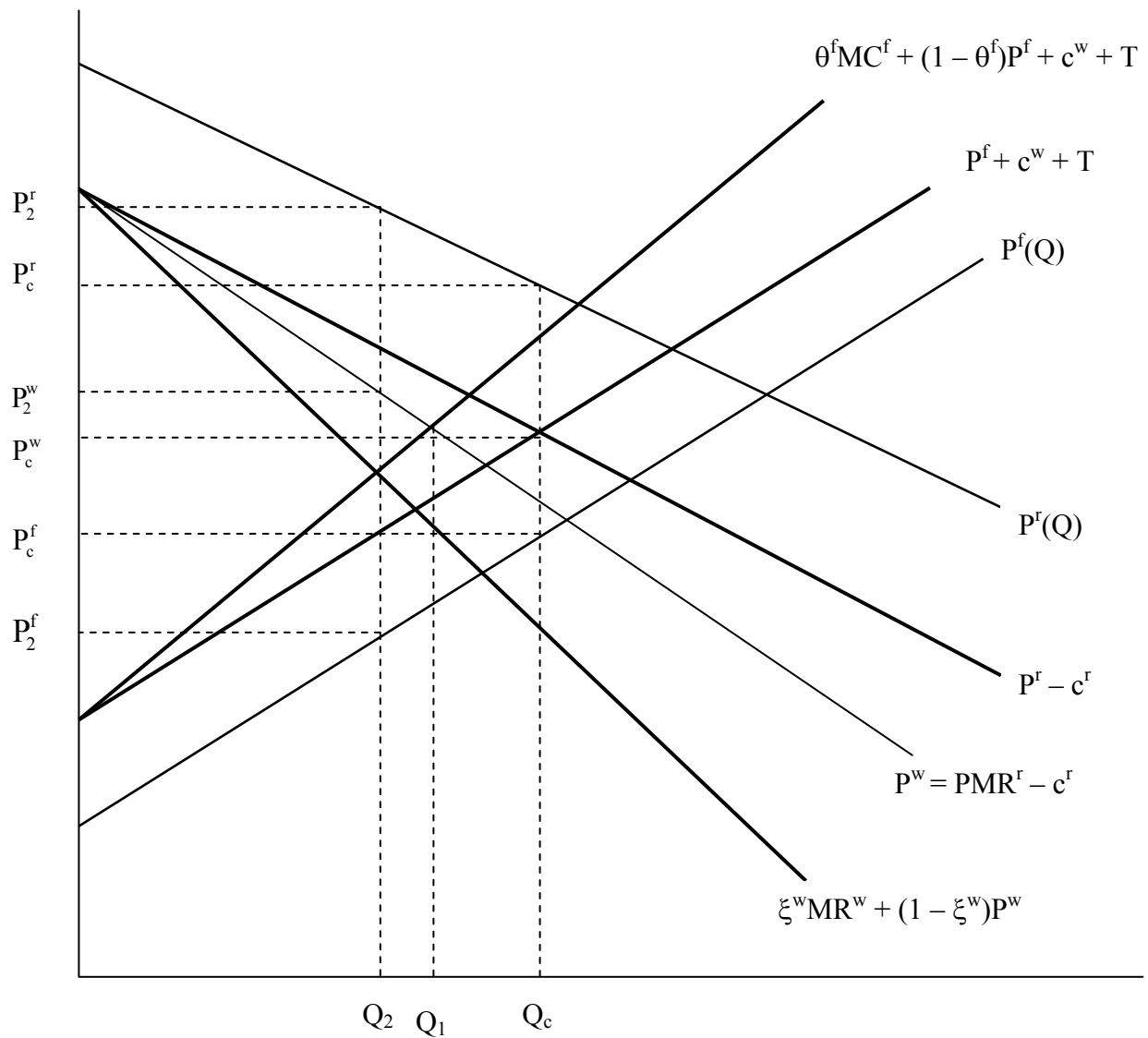
**Figure 1: Market Equilibrium under Processor Oligopoly and Oligopsony Power**



Note: Figure 1 illustrates the outcome for  $\xi^w = \theta^w = 0.5$  (see footnote 14)

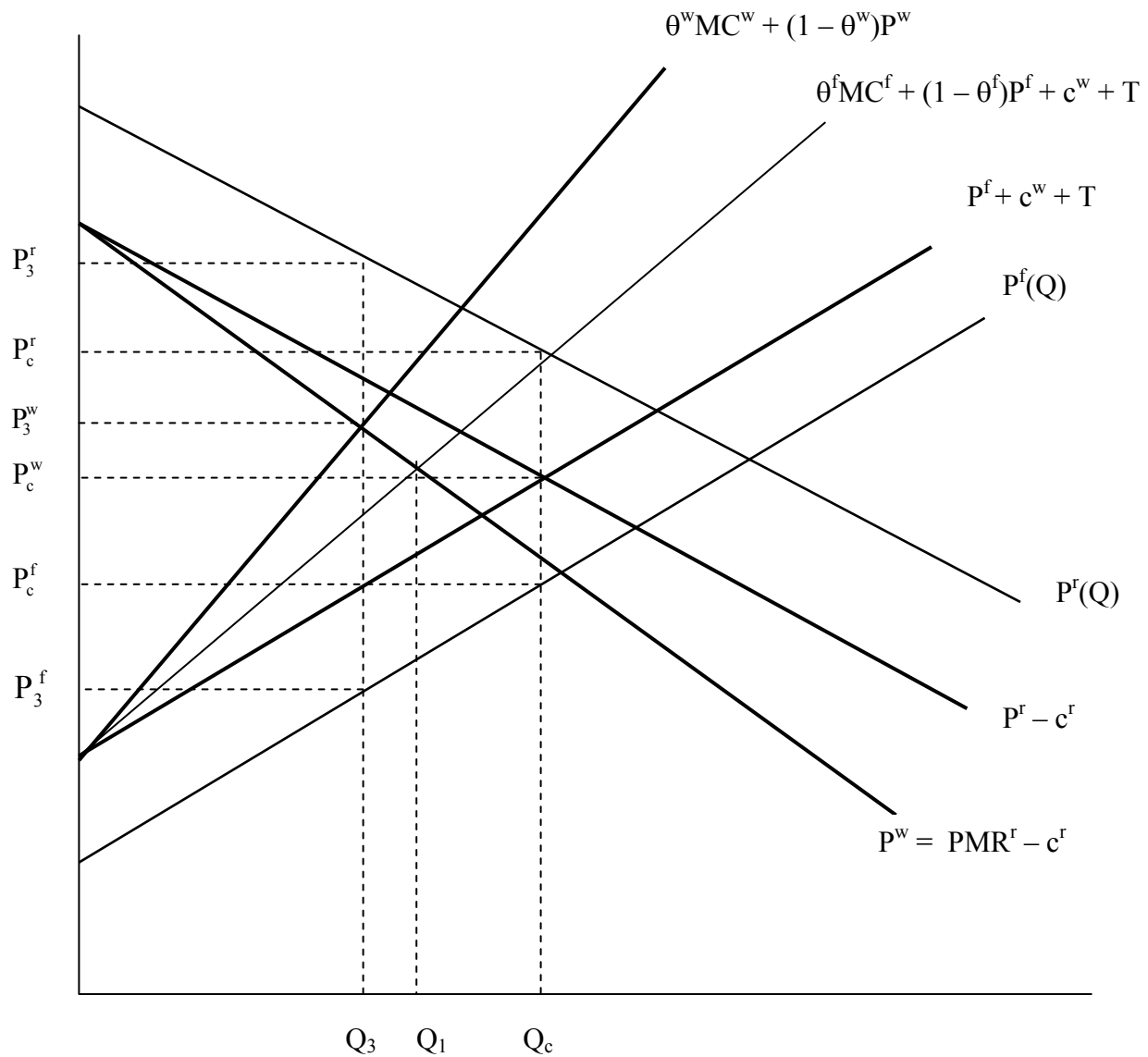


**Figure 2: Successive Oligopoly Power with Processor Oligopsony Power**



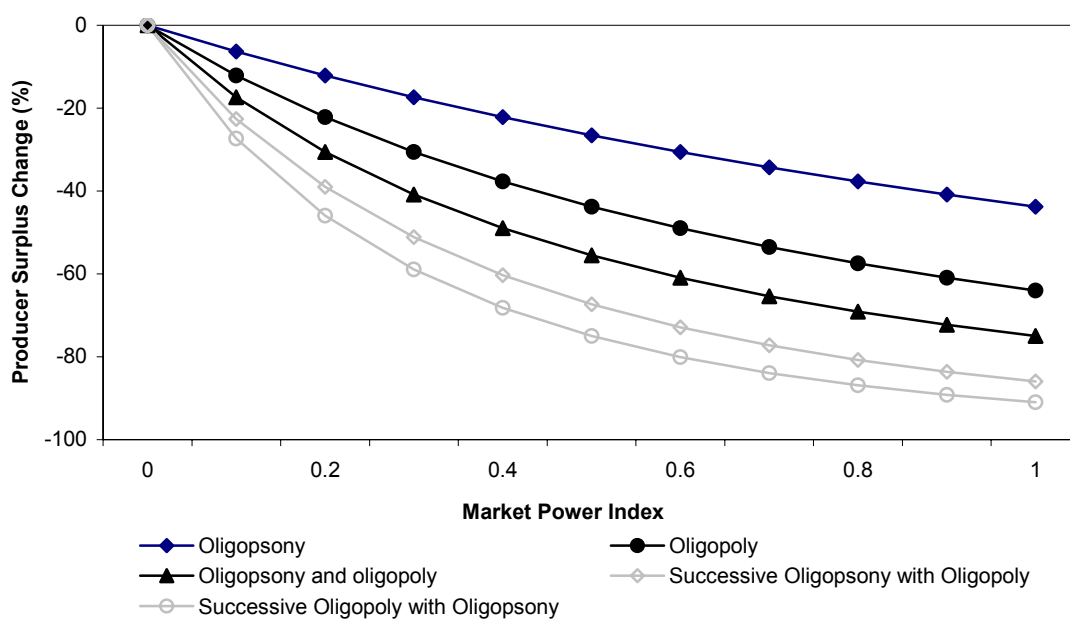
Note: Figure 2 illustrates the outcome when  $\xi^w = \xi^r = \theta^f = 0.5$  (see footnote 14)

**Figure 3: Successive Oligopsony Power with Retailer Oligopoly Power**

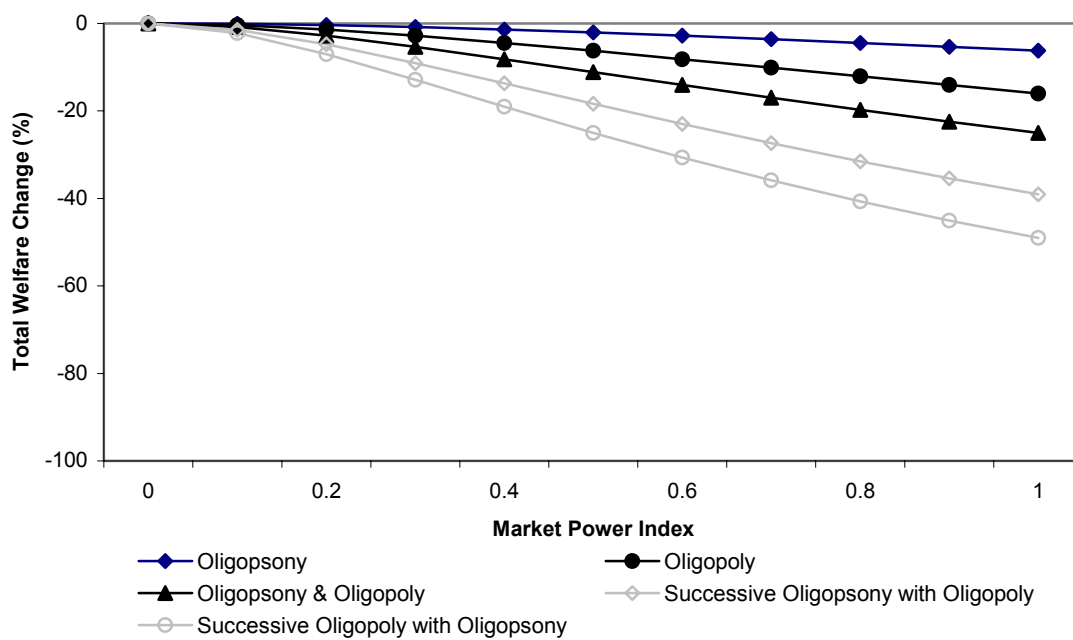


Note: Figure 3 illustrates the outcome when  $\theta^f = \theta^w = \xi^r = 0.5$  (see footnote 14)

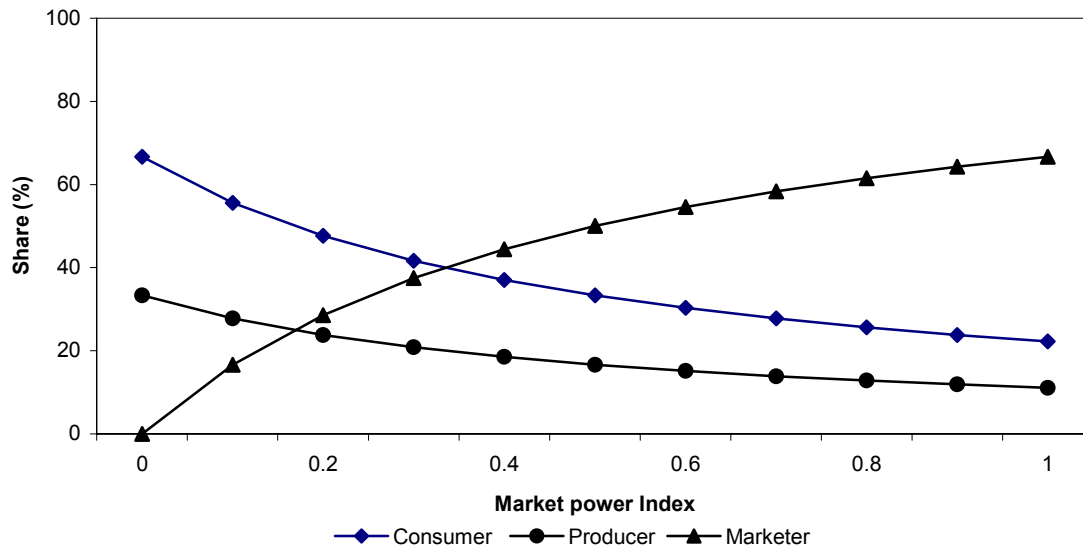
**Figure 4: The Effect of Market Power on Producer Welfare**



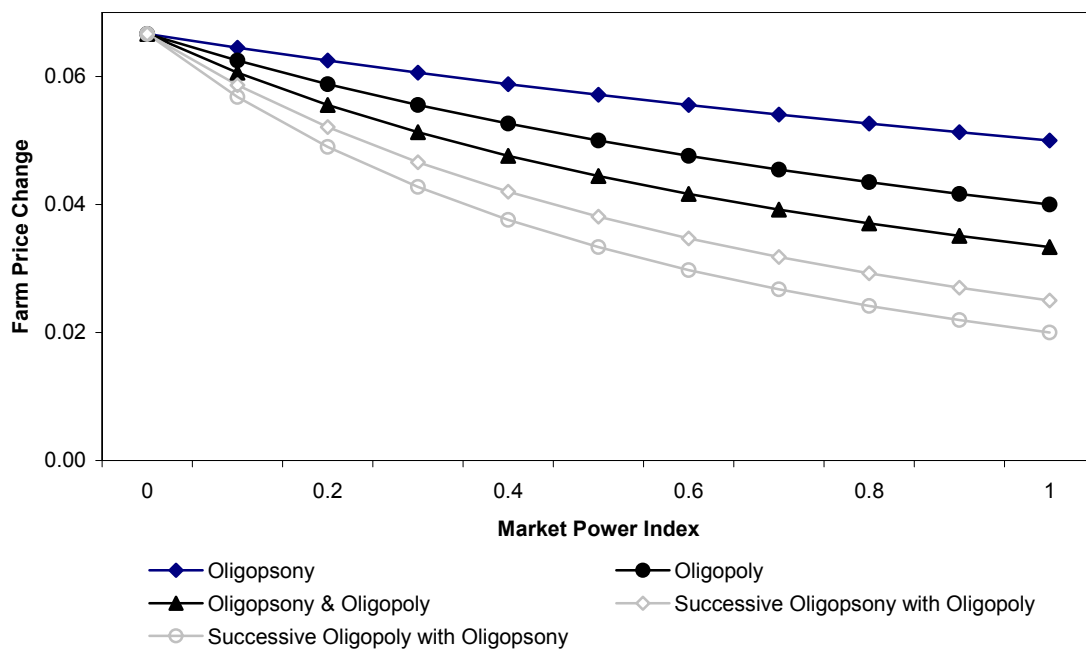
**Figure 5: The Effect of Market Power on Total Welfare**



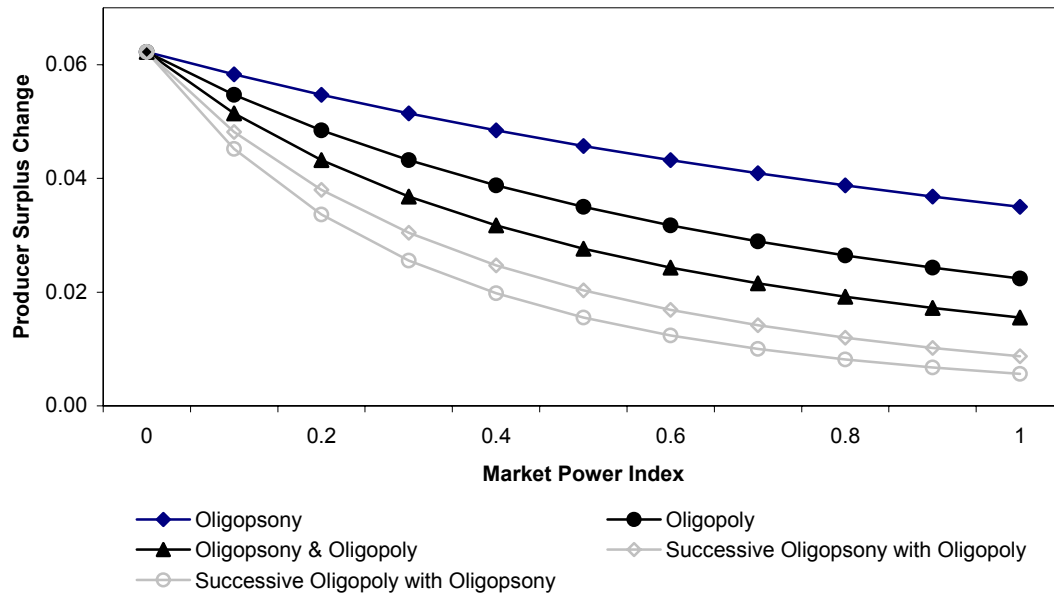
**Figure 6: The Effect of Market Power on the Distribution of Welfare: Processor Oligopsony and Retail Oligopoly**



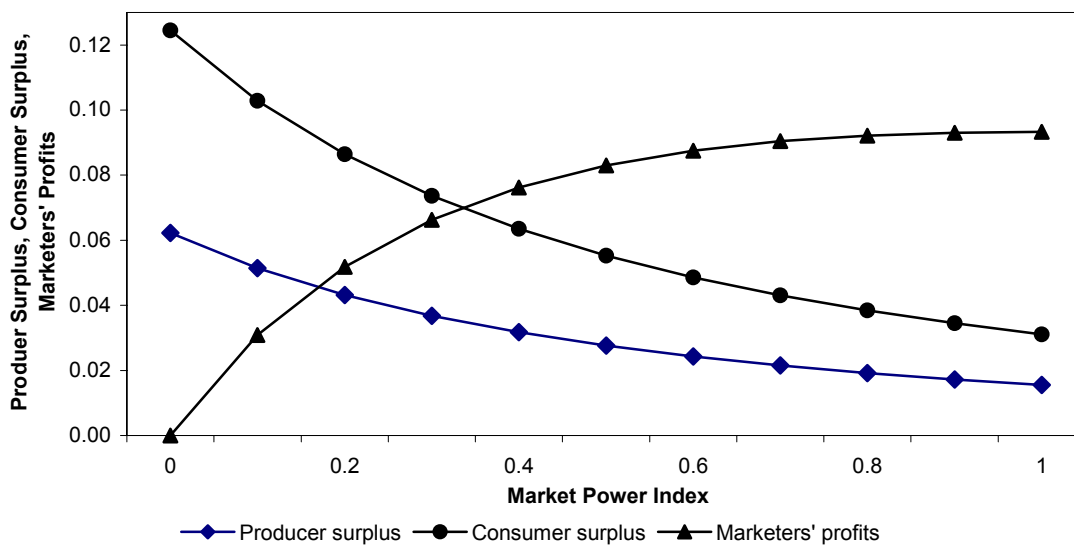
**Figure 7: Change in Farm Price from Trade Liberalization**



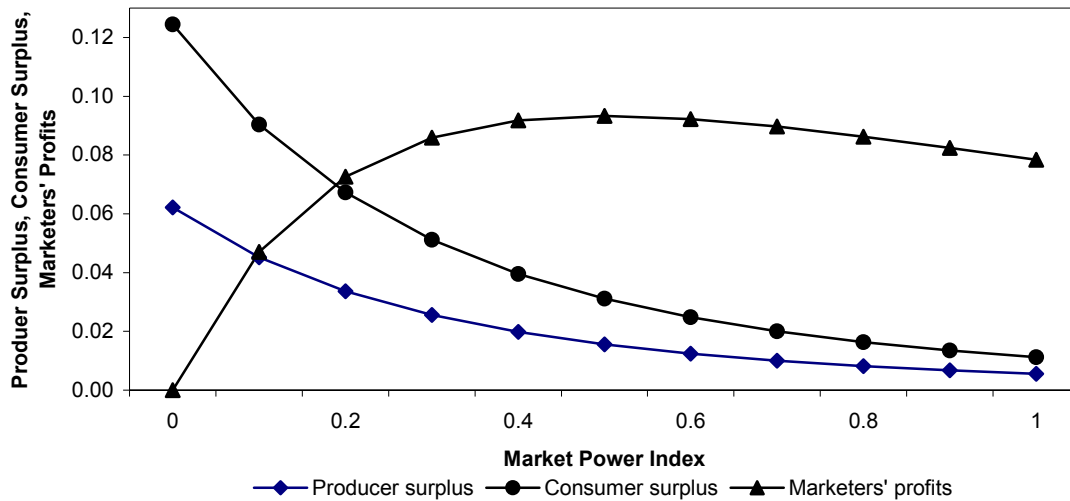
**Figure 8: Change in Producer Surplus from Trade Liberalization**



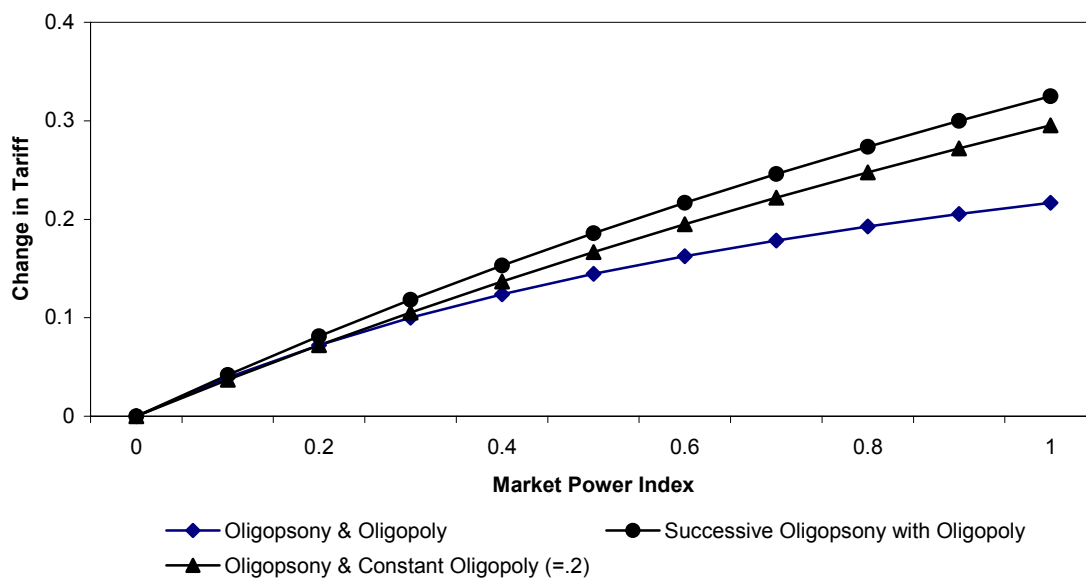
**Figure 9: Change in Producer Surplus, Consumer Surplus and Marketers' Profits from Trade Liberalization for the Case of Processor Oligopsony and Retail Oligopoly**



**Figure 10: Change in Producer Surplus, Consumer Surplus and Marketers' Profits from Trade Liberalization for the case of Successive Oligopoly with Processor Oligopsony**



**Figure 11: Welfare Enhancing Vertical Integration for a Developing Economy, Given Tariff Escalation, and Importing Country Oligopsony Power**



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