Analyzing Vertical Market Structure and Its Implications for Trade Liberalization

Richard Sexton[1], Ian Sheldon[2], Steve McCorriston[3] and Humei Wang[1]

[1]University of California, Davis, [2]Ohio State University, and [3]University of Exeter and Ohio

All correspondence should be addressed to: Ian Sheldon, Department of Agricultural, Environmental and Development Economics, The Ohio State University, 2120 Fyffe Road, Columbus, Ohio-43210. Voice-mail: 614-292-2194, e-mail: sheldon.1@osu.edu

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Abstract

A model is developed to characterize the vertically linked and concentrated nature of developed country food markets. This model is then parameterized and used to simulate the effects of varying food market structures on the benefits to developing country exporters of agricultural commodities from trade liberalization by developed countries.

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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 developed country markets. This process will involve the reduction of tariffs on agricultural commodities 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 analyzing 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 marketing system is most appropriately characterized by successive oligopoly/oligopsony with developing country exporters of raw commodities entering at the first stage, the implication of reducing tariffs is likely different in magnitude from that implied by models that assume perfect competition. Moreover, the distributional effects will 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.

In this context, the objectives of this paper are twofold: first, we develop a model that characterizes the vertically-linked nature of developed country food markets. The model is based on a market setting where a primary agricultural product is exported from a developing economy, and it is processed and sold in a developed economy. The market structure in the developed economy features independent processing and retailing sectors, both of which may exhibit market power. Second, we derive the implications of various combinations of market structures 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. From this we are able to simulate the effects of reducing a per unit import tariff on the raw agricultural commodity.

The paper is organized as follows. In section 1, we provide a brief overview of the characteristics of the food industry in the United States and the European Union (EU). In section 2, we describe 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 3, we simulate the effects of tariff reduction through this vertical market model. Some extensions are outlined in section 4, and finally in section 5 we summarize and conclude.

1. Market Structure of 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. 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). Using more disaggregated data at the four-digit SITC level, the average 4-firm concentration ratio was just below 76 percent in 1997, ranging from 62 percent in sugar cane mills to 98 percent in cigarettes.

Turning to food manufacturing in the EU, the data 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 (Cotterill, 1999). 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, *op.cit.*).

(ii) *Food Retailing*

Several important differences are apparent in the food retailing market structures in the US and EU. 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 (Cotterill; McCorriston, 2002). 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 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.

(iii) *Industry Consolidation*

An additional feature of market structure in the food industry in recent years has been consolidation through mergers and acquisitions which has contributed to increasing concentration. Moreover, international mergers and acquisitions have also been increasing significantly not only involving acquisitions in developed country markets by firms located in other developed countries, but also involving acquisitions in developing countries too. To give some examples, EU-based retailers such as Royal Ahold and Sainsbury have expanded into the US market (Cotterill), Carrefour and Royal Ahold have expanded into various developing country markets in Central and Latin America (Chavez, 2002; Farina, 2002; Gutman, 2002), and Wal-Mart have expanded into the EU (Hughes, *op. cit.*) and Central and Latin America food sectors (Chavez *op. cit.*; Farina, *op. cit.*). As a result, food retailing is becoming increasingly multinational with three food retailers Wal-Mart, Carrefour, and Royal Ahold now appearing in the world's top 100 multinational corporations (UNCTAD, 2002a).

In addition, as a consequence of this trend in mergers and acquisitions, 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 Berdegué, 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 Berdegué, *ibid*). 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, *op. cit*.). 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.

2. Agricultural Trade and Importing Country Market Power

Given this background, we now 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.[1] The market structure in the developed economy features independent processing and retailing sectors, both of which may exhibit market power.[2]

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

(1) $P^r = D(Q^r, | \mathbf{X}),$

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) $P^f = S(Q^f | \mathbf{Y}),$

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.

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

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1 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,2001).

2 This model is adapted from prior work by Huang and Sexton (1996), Alston, Sexton, and Zhang (1997), and Sexton and Zhang (2001)

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

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

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 $\mathbf{V^r}$.[3]

[3] 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.

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

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

Equation (6) can be written in elasticity form as

(6') $$P^w\left(1 - \frac{\xi^w}{\eta_1^w}\right) = P^f\left(1 + \frac{\theta^f}{\varepsilon^f}\right) + (c^w + T),$$

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, $\eta_1^w = -\frac{\partial Q^w}{\partial P^w}\frac{P^w}{Q^w}$ 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 $\theta^f \in [0,1]$ measures the processing firm's oligopsony market power in procuring the farm product and $\xi^w \in [0,1]$ 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 ξ and θ, 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^r, 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.[4]

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

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

The first order condition for maximizing equation (7) is

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

[4] 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.

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: $P^w = D^w(Q|\xi^r, c^r)$.

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

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

The first order condition for maximizing equation (9) is

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

where ξ^w denotes the degree of the processors' oligopoly power, and η_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 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

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

The first order condition for maximizing equation (11) is

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

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

A representative retailer's profit function can be expressed as

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

The first order condition for maximizing equation (13) is

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

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

3. 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') $Q^r = a - \alpha P^r$, importing country excess demand at retail,

(2') $P^f = b + \beta Q^f$, 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:

$Q_c = 1, \quad P_c^r = 1, \quad$ in which case $P_c^w = 1 - c^r, \quad P_c^f = 1 - c^r - c^w = f$, 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) $$\alpha = \eta_c^r, \quad \beta = \frac{f}{\varepsilon_c^f}, \quad a = 1 + \alpha, \quad b = f - \beta,$$

where η_c^r is the absolute value of retail price elasticity of demand and ε_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'') $P^f + T = b + \beta Q^f + T$.

(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:

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

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 Ω_1 measures the total distortion due to oligopoly and oligopsony power in the linear model, and $Q_1 < 1 = Q_c$ whenever either θ^f or ξ^w is positive. Figure 1 illustrates the model.[5] Note also that this general specification nests the competitive equilibrium, which is obtained when $\xi^w = \theta^f = 0$.

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

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

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

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

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

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[5] 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 ξ representing the weight attributed to the marginal revenue curve and $(1-\xi)$ representing the weight attributed to the demand curve. Similarly, for an industry with oligopsony power, the perceived marginal factor cost curve is $\theta MC(Q) + (1-\theta)S(Q)$, where $MC = \partial[S(Q)Q]/\partial Q$ denotes the marginal factor cost curve.

(21) $ES_1 = CS_1 + PS_1 + \Pi_1 + R_1$

Given the constant-cost characterization of the marketing sector (processing and retailing), the sector earns zero profits in competitive equilibrium: $\Pi_1 = 0$.

In the linear version of the model, the market equilibrium prices, output, and distribution of economic welfare are determined by six parameters: ξ^w (seller oligopoly power), θ^f (buyer oligopsony power), η_c^r (price elasticity of retail demand evaluated at the no-tariff competitive equilibrium), ε_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 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: ξ^r, ξ^w, θ^f, η_c^r, ε_c^f, f and T. In addition to the parameters contained in the preceding case, a second ξ 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 5. 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: ξ^r, θ^w, θ^f, η_c^r, ε_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 $\varepsilon_c^r = 2.0$.[6] Given the linear formulations for retail supply and farm

[6] 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

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, 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, θ and ξ, which both range in the unit interval. As summarized by Sheldon and Sperling (2003), most point estimates of θ and/or ξ from prior empirical studies, are quite low--0.2 or less. However, Bhuyan and Lopez (1997) obtained estimates of ξ 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 ξ 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 outlined in Sexton (*op. cit.*) probably serve on balance to understate the extent of market power.[7] 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 $\theta^f = \theta^w = \xi^r$.

(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 vertical stages,

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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.

[7] 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.

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 ($\xi^r = \xi^w = \theta^f = 0.2$) 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--θ and ξ 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 $\xi^r = \theta^f = 0.2$ or more enables the marketing sector's surplus to exceed the surplus earned by the producing sector, and $\xi^r = \theta^f = 0.4$ or more enables marketers' surplus to exceed consumers'. For the extreme case of $\xi^r = \theta^f = 1.0$, 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 $\xi^r = \xi^w = \theta^f = 0.5$ (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 $\varepsilon_c^r = 2 > \eta_c^r = 1$, 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. ΔP^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 $\xi^r = \xi^w = \theta^f = 0.2$ reduces the farm price increase from tariff removal by 27 percent, while the more extreme scenario of $\xi^r = \xi^w = \theta^f = 0.5$ 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 $\xi^r = \xi^w = \theta^f = 0.2$ reduces the producer surplus increase from trade liberalization by over half, while $\xi^r = \xi^w = \theta^f = 0.5$ 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 $\xi^r = \theta^f$ in figure 9, but marketers' profit is actually declining in $\xi^r = \xi^w = \theta^f$ 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 $\xi^r = \xi^w = \theta^f$ 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.[8]

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.

[8] This result provides an incentive for vertical coordination in the marketing chain to internalize these external effects.

4. Extensions

A great many extensions and generalizations of this simulation framework are possible, and we mention only a few here. All of the results discussed here are conditional upon the base values of $\varepsilon_c^f = \eta_c^r = 1$, 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 θ.

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 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.[9] 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, in this paper we have ignored the issue of tariff escalation.[10] 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) and Corden (1971), and UNCTAD (2002b) has recently cited tariff escalation as one of the main problems facing developing country exporters in diversifying their export profile. However, it is possible that this disadvantage could be offset by

[9] 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.
[10] In Sexton, Sheldon, McCorriston and Wang (2003), we show that depending upon the particular market power configuration, the developing country may do better by integrating the processing function despite tariff escalation.

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.[11] 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.

5. Summary and Conclusions

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. Consequently, to fully understand the implications of trade reform for raw commodity exporters, further attention needs to be paid to the issue of industry consolidation and market structure in developed country food markets.

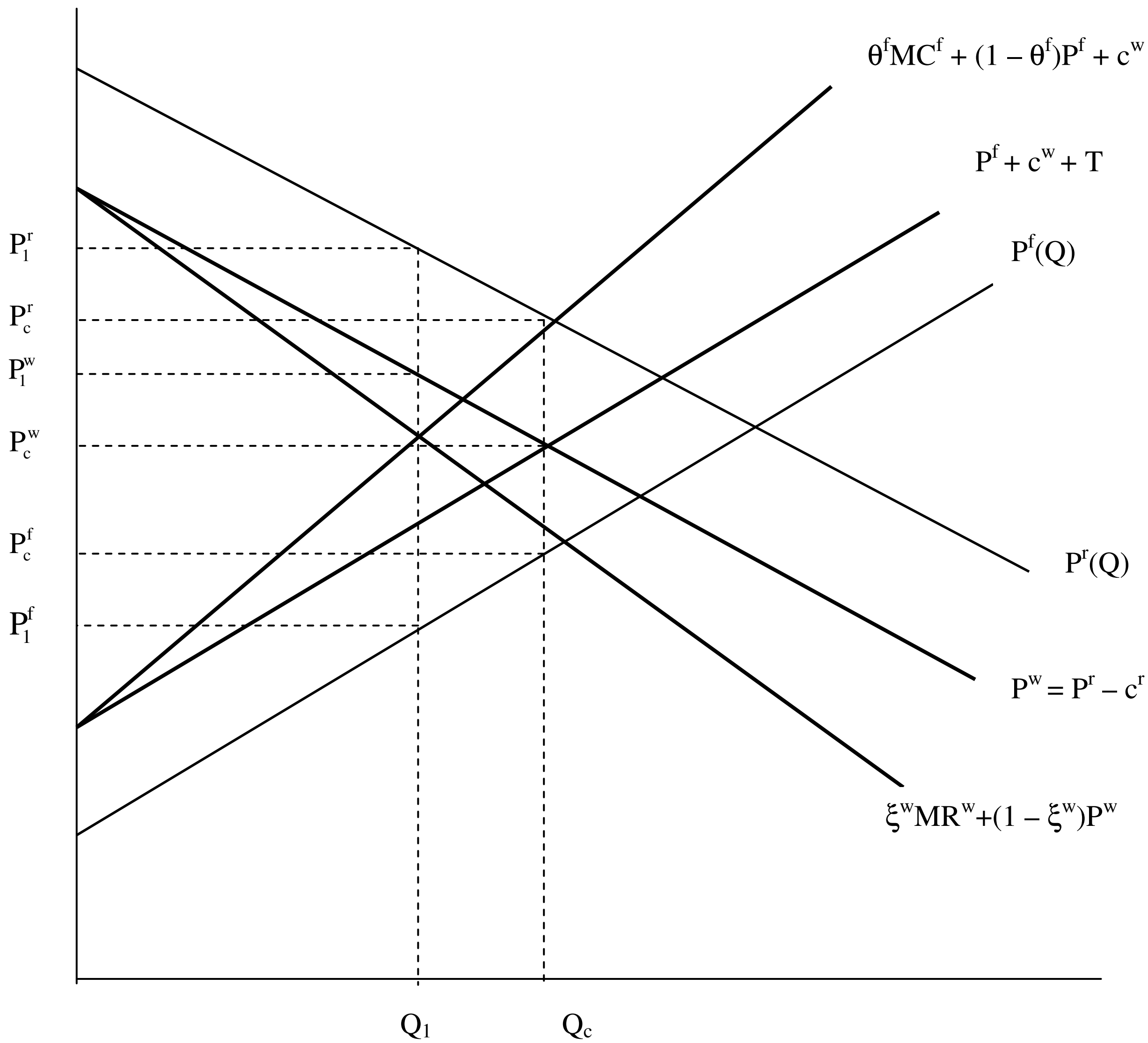
In this context, there are two key results to be drawn from this paper. First, if developing country exporters face a marketing system characterized by a structure of successive oligopoly/oligopsony, and the associated problem of double marginalization, reduction of import tariffs, while increasing raw commodity prices, will not result in exporters obtaining a larger share of the consumer´s food "dollar" in developed countries. This follows from the fact that if the retail demand function (farm excess supply function) is linear, and given oligopoly (oligopsony) mark-ups (mark-downs) of price over (below) marginal cost (marginal resource cost), firms in the food retailing and processing sectors are able to

[11] 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.

capture most of the benefits of a reduction in the tariff on the imported raw agricultural commodity. This implies that developing country exporters will benefit much less from trade liberalization by developed countries than is being forecast by development agencies such as the World Bank (2003), and non-governmental organizations such as Oxfam (2003).

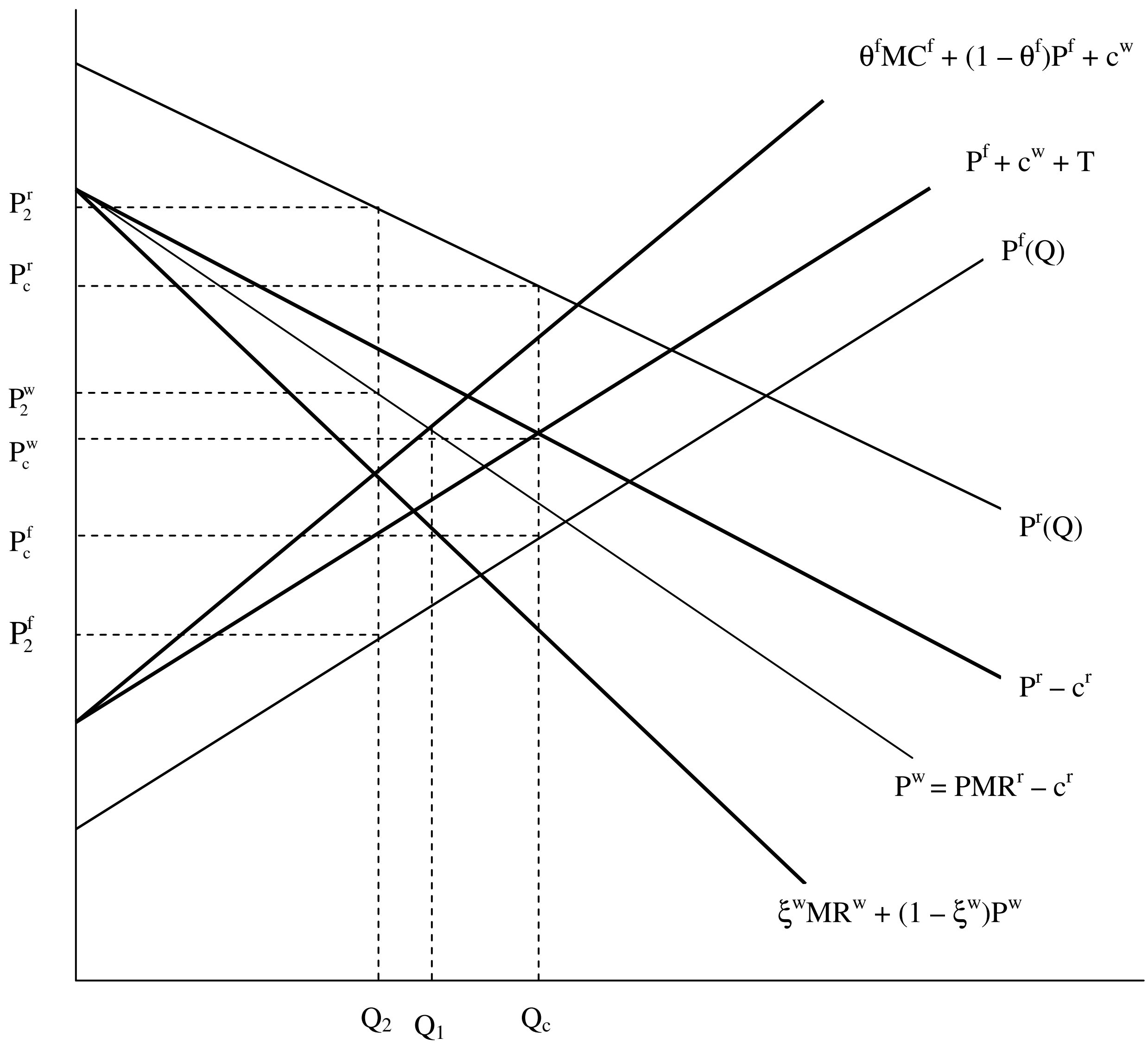
Second, as the food processing and retailing sectors become more concentrated in developed countries, and hence less competitive, this will reduce even further the share of commodity exporters in the available rents in the food marketing system. This comes about from the fact that with less competitive food retailing and processing, the relevant marginal revenue (marginal resource cost) curves become steeper, allowing the oligopoly (oligopsony) mark-ups (mark-downs) to increase. This generates the key policy implication that developing country exporters may benefit as much from vertically integrating into food processing and other value-adding activities further down the vertical marketing chain as from trade liberalization. This result provides support to development agencies such as UNCTAD (2000; 2002b) that have been advising developing country exporters to adopt a policy of diversifying into value-added activities in the food marketing system.

Figure 1: Market Equilibrium under Processor Oligopoly and Oligopsony Power



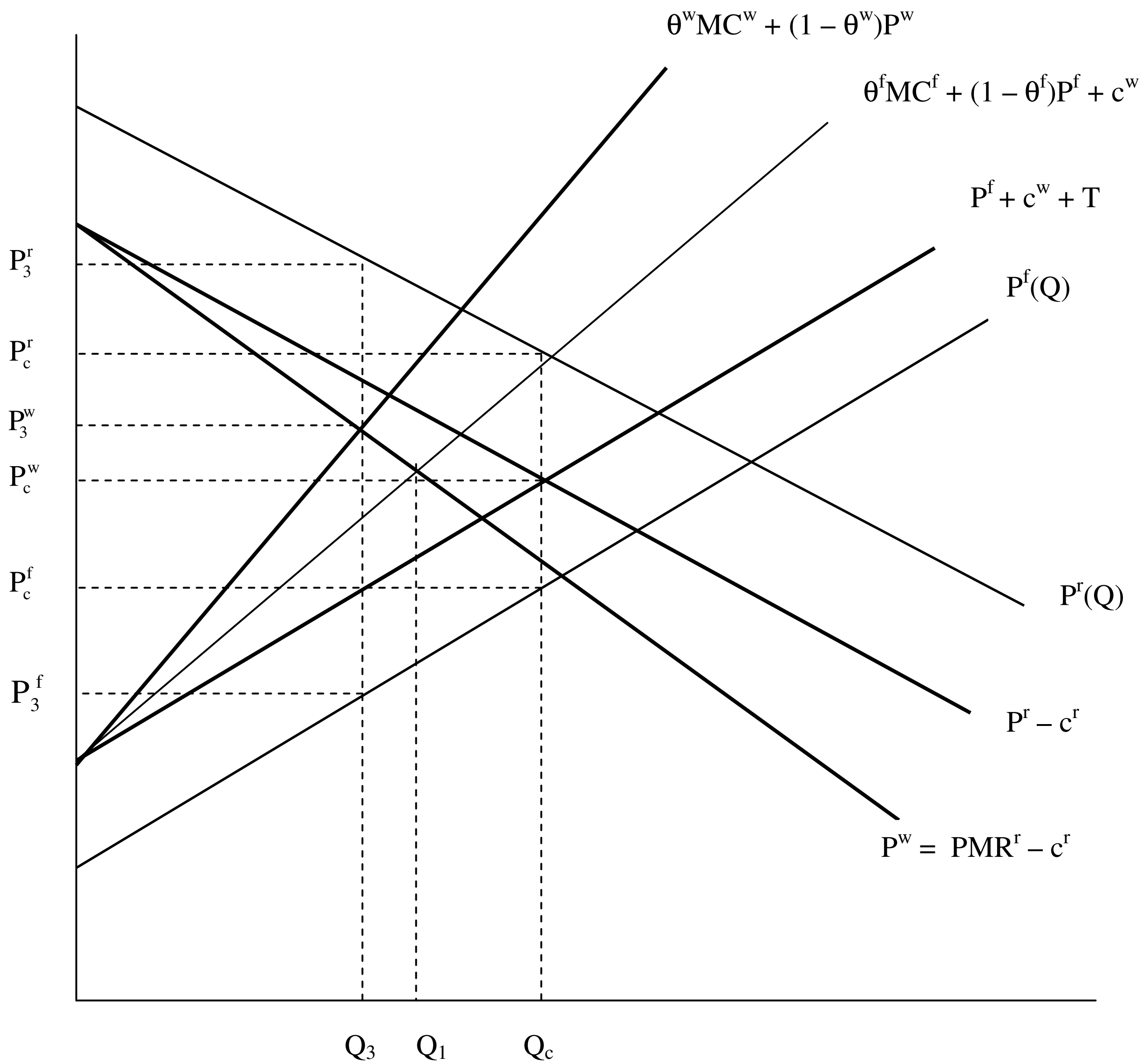
Note: Figure 1 illustrates the outcome for $\xi^w = \theta^w = 0.5$ (see footnote 4)

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 4)

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 4)

Figure 4: The Effect of Market Power on Producer Welfare

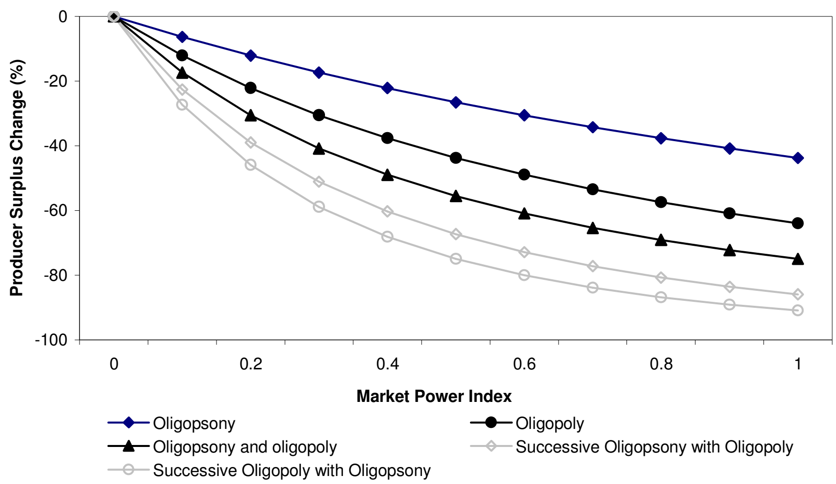


Figure 5: The Effect of Market Power on Total Welfare

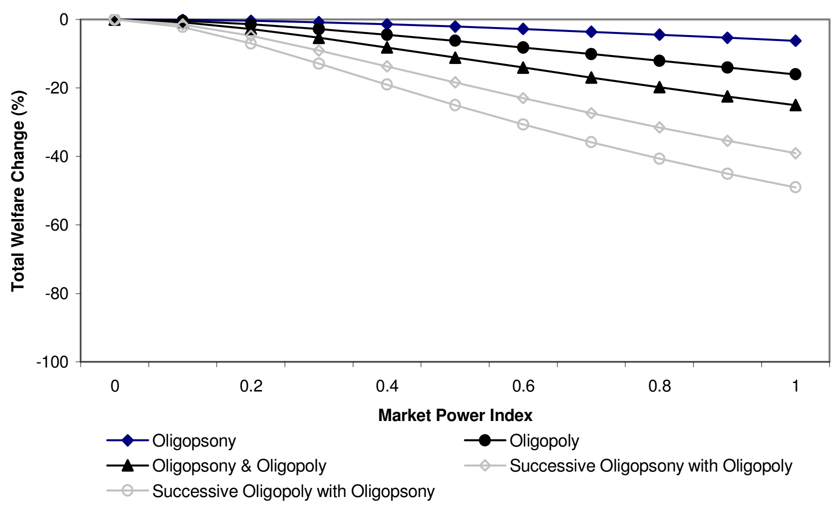


Figure 6: The Effect of Market Power on the Distribution of Welfare: Processor Oligopsony and Retail Oligopoly

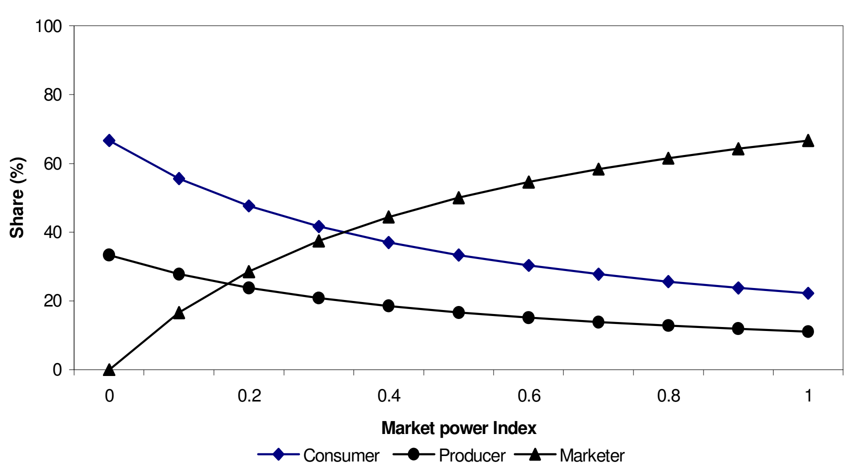


Figure 7: Change in Farm Price from Trade Liberalization

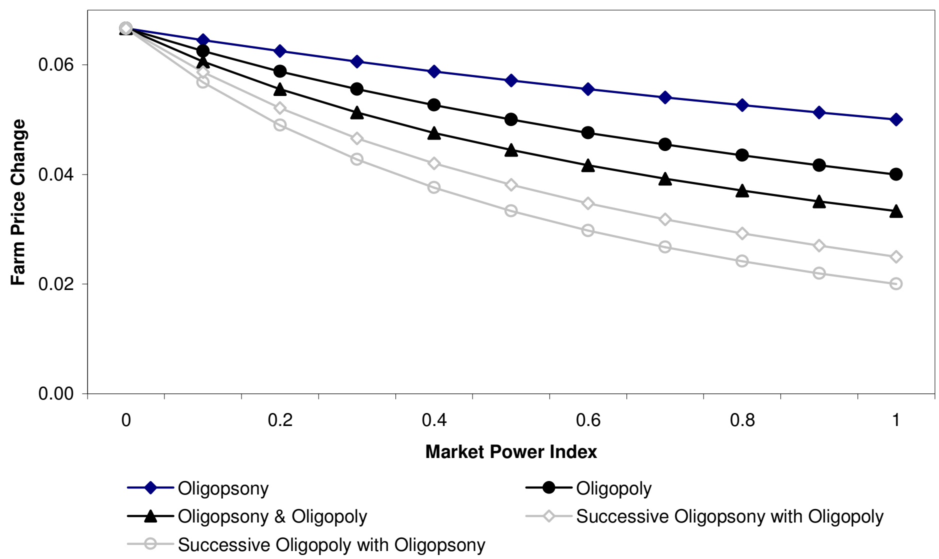


Figure 8: Change in Producer Surplus from Trade Liberalization

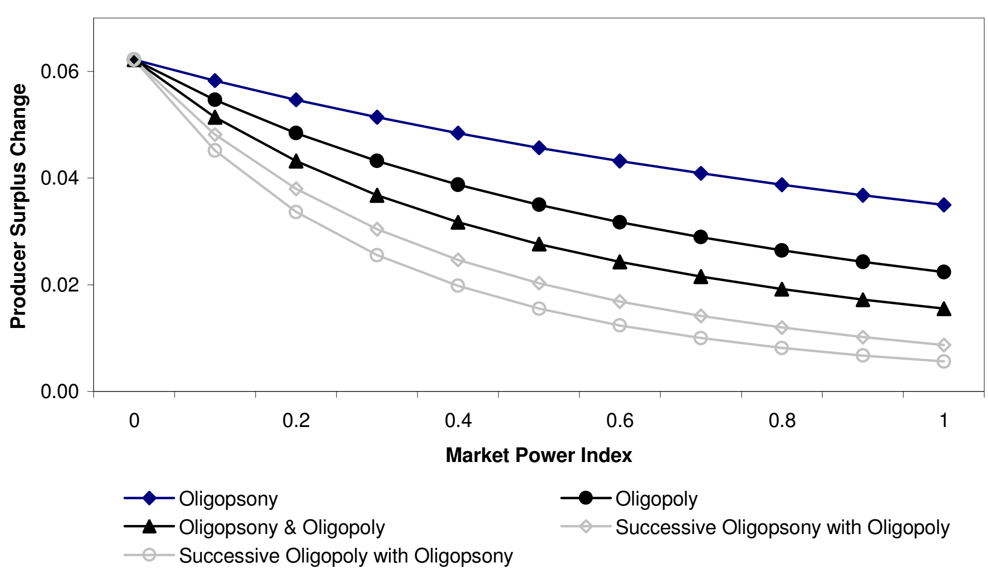


Figure 9: Change in Producer Surplus, Consumer Surplus and Marketers' Profits from Trade Liberalization for the Case of Processor Oligopsony and Retail Oligopoly

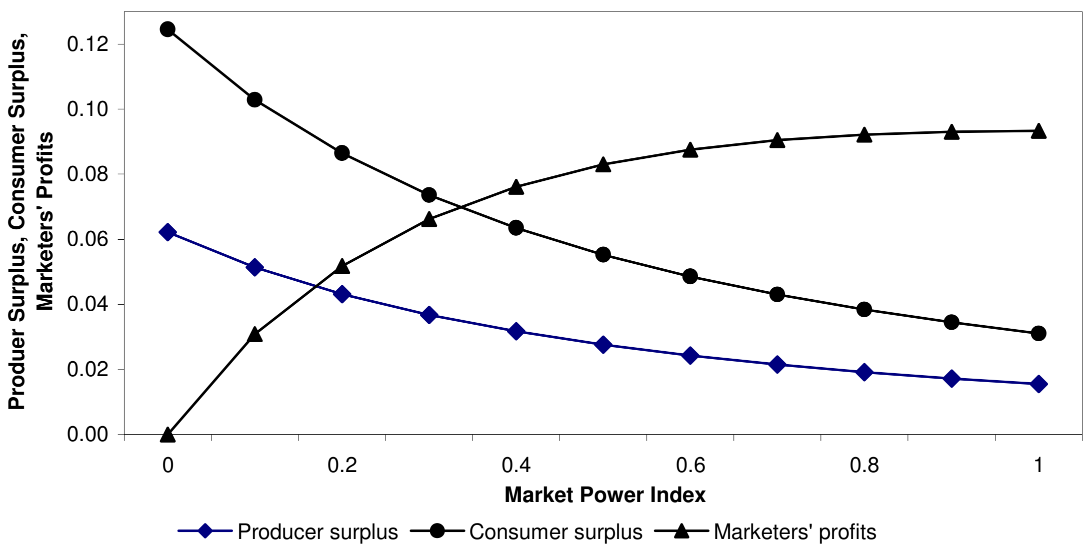
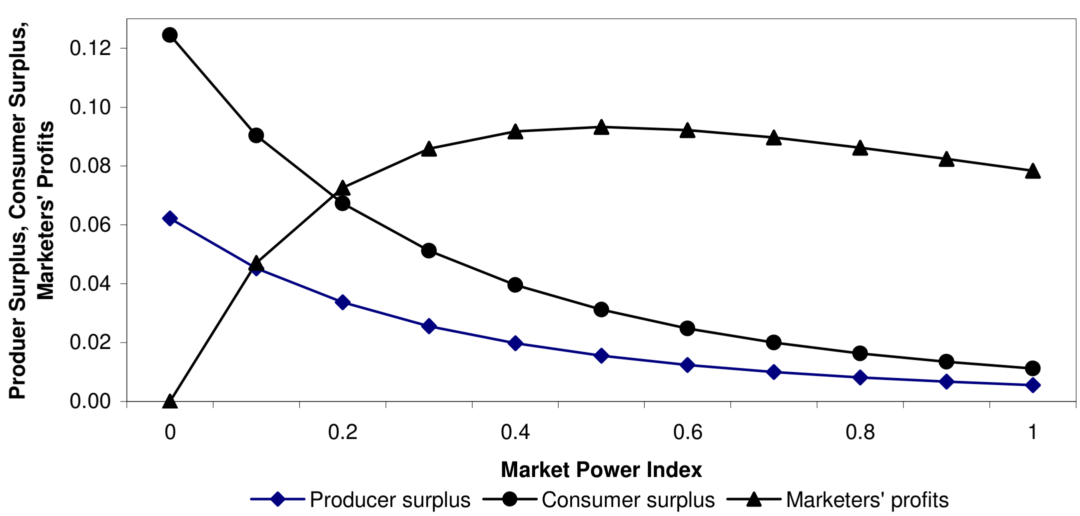


Figure 10: Change in Producer Surplus, Consumer Surplus and Marketers' Profits from Trade Liberalization for the case of Successive Oligopoly with Processor Oligopsony



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