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Mohammad Mainul Hoque
Iowa State University

John R. Schroeter
Iowa State University, johns@iastate.edu

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Exports of agricultural commodities to developed countries play a significant role in the economies of many developing countries. The elimination of import tariffs has the potential to benefit producers in the developing countries, but estimates of the extent of the gains from trade liberalization typically assume perfect competition. Significant concentration in the food processing and retailing sectors of the U.S. and the EU undermine the plausibility of this assumption in the case of agricultural trade, however. Sexton, Sheldon, McCorriston, and Wang (2007) develop a model of the effects of trade liberalization that accounts for the vertically-linked and concentrated characteristics of the developed countries' food markets. Their analysis is limited to the case of a constant per unit tariff, however. In this paper, we extend the analysis of the effects of trade liberalization in the presence of downstream market power to the case of an ad alorem tariff, and we find important qualitative differences from the results for the unit tariff case.

Keywords
oligopoly, oligopsony, trade liberalization, ad valorem tariff

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Mohammad Mainul Hoque, *Iowa State University*
John R. Schroeter, *Iowa State University*

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Abstract

Exports of agricultural commodities to developed countries play a significant role in the economies of many developing countries. The elimination of import tariffs has the potential to benefit producers in the developing countries, but estimates of the extent of the gains from trade liberalization typically assume perfect competition. Significant concentration in the food processing and retailing sectors of the U.S. and the EU undermine the plausibility of this assumption in the case of agricultural trade, however. Sexton, Sheldon, McCorriston, and Wang (2007) develop a model of the effects of trade liberalization that accounts for the vertically-linked and concentrated characteristics of the developed countries' food markets. Their analysis is limited to the case of a constant per unit tariff, however. In this paper, we extend the analysis of the effects of trade liberalization in the presence of downstream market power to the case of an *ad valorem* tariff, and we find important qualitative differences from the results for the unit tariff case.

KEYWORDS: oligopoly, oligopsony, trade liberalization, *ad valorem* tariff

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1. Introduction.

Agriculture plays a key role in developing countries' economies. According to the United Nation's Food and Agriculture Organization, agriculture's share in developing countries' GDP is a little more than ten percent, but more than half of the economically active population is engaged in this sector (FAO, 2004, Table A4). The majority of developing countries' export earnings come from a few agricultural commodities and, therefore, trade in agriculture has more significant implications for the low income countries than for the rich countries. In recognition of these facts, increasing the access of low-income, agricultural commodity exporting countries to developed countries' markets has been one of the central issues in the last several rounds of World Trade Organization negotiations.

Motivated by the belief that increased access to developed countries' markets will boost producers' earnings and accelerate economic growth, developing countries advocate the elimination of high agricultural tariffs. Agricultural imports from developing countries are used as raw materials for the food and beverage industries in the developed countries, however, and the impact of trade liberalization in agricultural commodity markets will depend on conduct in these industries.[1] An increasing pace of consolidations and rising market concentration in developed countries' food processing and retailing sectors raises the prospect of non-competitive conduct by firms in these sectors.[2] Although most agricultural trade policy analyses in the literature rely on the competitive market paradigm, Sexton *et al.* (2007) have incorporated the vertically-linked and concentrated characteristics of developed countries' food markets in their analysis of the impact of agricultural trade liberalization on developing countries' economic development.[3] The Sexton *et al.* (2007) model assumes price-taking conduct by producers in the developing country and consumers in the developed country, with the behavior of these agents summarized by linear farm supply and retail demand functions. Food processors and retailers in the developed country may engage in oligopoly/oligopsony conduct. Sexton *et al.* (2007) show that an analysis based on the assumption of competitive conduct will overstate the price

[1] For example, McMillan *et al.* (2003) and Wilcox and Abbott (2004) discuss examples from the Mozambique cashew nut sector and the Ivory Coast cocoa market, respectively, in which the gains from liberalization appear to have largely been captured by market-power-wielding processors and exporters – in these cases, in the developing countries themselves – rather than by farmers.

[2] Sexton *et al.* (2007) summarize the findings of several studies detailing the extent of concentration in food processing and retailing in the U.S. and the EU.

[3] Ahn and Lee (2010) is one recent example of agricultural trade policy analysis that accounts for market power in the food marketing channel.

and quantity effects of the removal of a tariff if firms exercise market power. They also investigate the implications of market power for the distribution of the benefits of trade liberalization. Here, their finding is that market power generally erodes the shares of the welfare gains reaped by producers and consumers, and enhances the share claimed by marketing firms.

The Sexton *et al.* (2007) analysis of trade liberalization considers the case of the removal of a constant per unit tariff. One of the extensions they suggest is the counterpart to their analysis for an *ad valorem* tariff. On its face, this case appears to have the potential to deliver qualitatively different results because an *ad valorem* tariff does not merely shift the imported commodity supply curve that processors face, it rotates it, making it less elastic and thereby increasing the pricing distortion that results from any given degree of processor oligopsony power. Conversely, when such a tariff is removed, the scope for the exercise of oligopsony power is correspondingly reduced, further contributing to the benefits of trade liberalization.

In this paper, we present the analysis of the effects of trade liberalization with downstream market power for the *ad valorem* case. Our main result is that, for certain patterns of oligopoly/oligopsony conduct in the marketing channel, and for parameter values that are representative of real-world agricultural commodity import markets, the effects of trade liberalization for the *ad valorem* case exhibit qualitative differences from those for the unit tariff case. In particular, there are circumstances under which an analysis assuming competitive conduct could actually *understate* the price and quantity effects of removal of the tariff if there is oligopsony power exercised by processors and/or retailers. The effects of market power on the distribution of gains from trade reform can also differ substantially from those for the unit tariff case. It is possible that the gains to producers and consumers of the removal of an *ad valorem* tariff could actually be greater with oligopsony power than in a regime of competitive conduct.

The next section provides a simple illustration of the differences in the effects of trade liberalization for the *ad valorem* and constant per unit tariff cases. Section 3 develops a general model that can be used to project the impact of removal of an *ad valorem* tariff for various patterns and degrees of oligopoly and oligopsony power in the marketing channel. Section 4 undertakes some numerical calculations designed to illustrate the range of outcomes that are possible. A final section offers concluding remarks.

2. Trade liberalization with unit and *ad valorem* tariffs.

Sexton *et al.* (2007) consider a setting in which farms in a developing country produce and export a primary commodity to a developed country. The processors and retailers, which together comprise the downstream sector in the developed country, process the imported raw agricultural product and sell it to domestic consumers. Trade in the primary commodity is subject to a tariff (either unit or *ad valorem*) imposed by the developed country. Conversion of the farm product to the retail good does not allow substitution between the raw commodity and other inputs, so quantities at the farm, wholesale, and retail market stages can all be measured in retail-product-equivalent units, for example, and denoted by the same variable. Both processors and retailers operate at constant marginal cost. Producers in the developing country and consumers in the developed country are price-takers, whereas processors and retailers may exercise market power in their input and output markets.

To illustrate the differences in the effects of trade liberalization for unit and *ad valorem* tariffs, consider first the case in which retailers are price takers in their input (wholesale) and output (retail) markets, while processors may exercise oligopsony power in their input (farm) market and oligopoly power in their output (wholesale) market. Let P with superscripts of "r," "w," and "f," denote price at the retail, wholesale, and farm levels, respectively. Likewise, let Q^r, Q^w, and Q^f denote aggregate quantity in these respective markets; although equilibrium will be characterized by $Q^r = Q^w = Q^f = Q$, say. While the primary focus will be on linear demand and supply curves,[4] for now, denote (inverse) retail demand and farm supply functions in general functional form as $P^r = D_r\left(Q^r\right)$ and $P^f = S_f\left(Q^f\right)$, where $D_r'(\cdot) < 0$ and $S_f'(\cdot) > 0$.

With price-taking behavior in the retail sector, profit-maximizing retail firms will purchase the wholesale product up to the point at which the wholesale price is equal to the retail price net of marginal retailing cost, giving rise to the wholesale demand function:

$$P^w = D_w\left(Q^w\right) = D_r\left(Q^r\right) - c^r, \tag{1}$$

where c^r denotes marginal retailing cost. For the case of a specific tariff of T dollars per unit, the analysis follows Sexton *et al.* (2007). For the representative firm in the processing sector profit is

$$\pi_p = D_w\left(Q^w\right)\cdot q - \left(S_f\left(Q^f\right) + T\right)\cdot q - c^p q, \tag{2}$$

[4] We retain the assumption in Sexton *et al.* (2007) of linear supply and demand functions although, as they acknowledge, the choice of functional form is not innocuous in an analysis of tax incidence. Note 6 includes an additional observation about the implications of functional form.

where q denotes the representative firm's quantity and c^p is marginal processing cost. Differentiating:

$$\frac{d\pi_p}{dq} = D_w(Q^w) + q \cdot D_w'(Q^w)\frac{dQ^w}{dq} - S_f(Q^f) - q \cdot S_f'(Q^f)\frac{dQ^f}{dq} - c^p - T$$
$$= D_w(Q^w) + Q^w \cdot D_w'(Q^w) \cdot \theta^w - S_f(Q^f) - Q^f \cdot S_f'(Q^f) \cdot \phi^f - c^p - T,$$

where conjectural elasticities $\theta^w \equiv (dQ^w/dq) \cdot (q/Q^w)$ and $\phi^f \equiv (dQ^f/dq) \cdot (q/Q^f)$ are the conventional indices of market power. $\theta^w = 0$ ($\phi^f = 0$) corresponds to price-taking behavior in the output (input) market while $\theta^w = 1$ ($\phi^f = 1$) corresponds to pure monopoly (monopsony) conduct. Intermediate values of θ^w (ϕ^f) map to hypothetical oligopoly (oligopsony) solution concepts between the polar cases of competitive conduct and pure monopoly (monopsony). Setting the expression for $d\pi_p/dq$ equal to zero, using (1), and imposing $Q^r = Q^w = Q^f \equiv Q$, the result is the industry equilibrium condition for the case of oligopoly/oligopsony power in the processing sector:

$$D_r(Q) + Q \cdot D_r'(Q) \cdot \theta^w - S_f(Q) - Q \cdot S_f'(Q) \cdot \phi^f = c^p + c^r + T. \qquad (3)$$

Our interest focuses on the discrete changes in equilibrium that are brought about by the removal of the tariff under various circumstances. But insights into the direction and comparative magnitudes of these changes can be obtained by examining the derivative of the equilibrium quantity with respect to the size of the tariff. Differentiation of (3) yields:[5]

$$\frac{dQ}{dT} = \frac{1}{(1+\theta^w) \cdot D_r'(Q) + Q \cdot \theta^w \cdot D_r''(Q) - (1+\phi^f) \cdot S_f'(Q) - Q \cdot \phi^f \cdot S_f''(Q)}.$$

Confining attention to the case of linear demand and supply ($D_r''(\cdot) = S_f''(\cdot) = 0$), we have:

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[5] The derivative is calculated assuming that the nature of oligopoly and oligopsony conduct, reflected in the values of the conduct parameters, θ^w and ϕ^f, will be unaffected by a change in the tariff.

$$\left.\frac{dQ}{dT}\right|_{\theta^w=\phi^f=0} = \frac{1}{D_r'(Q)-S_f'(Q)} < \frac{1}{\left(1+\theta^w\right)\cdot D_r'(Q)-\left(1+\phi^f\right)\cdot S_f'(Q)} = \left.\frac{dQ}{dT}\right|_{\theta^w,\,\phi^f>0} < 0$$

Naturally, reducing (or removing) a unit tariff increases equilibrium quantity ($dQ/dT<0$) in any case, but the absolute magnitude of the quantity impact is always smaller when processors exercise market power than when they behave competitively.[6] Thus, with linear supply and demand curves, an analysis based on the assumption of competitive conduct will overstate the effects of trade liberalization if food processing firms actually exercise market power. Sexton *et al.* (2007) show that this qualitative finding applies not only to the case of processor oligopoly/oligopsony, but also to the case of single stage market power in the retail sector, as well as to cases involving non-competitive conduct in successive stages of the marketing channel.

The intuition of this result can be seen in Figures 1 and 2. Figure 1 depicts a perfectly competitive equilibrium with a tariff at output Q_0, retail price $P_0^r = D_r(Q_0)$, and farm price $P_0^f = S_f(Q_0)$. From equation (3) with $\theta^w = \phi^f = 0$, the spread between retail and farm prices in this equilibrium is simply the sum of marginal marketing (processing and retailing) cost and the tariff wedge. The retail and farm prices and the tariff are observed; on the assumption of perfect competition, the portion of the price spread in excess of the tariff is attributed to marginal marketing cost. When the tariff is removed equilibrium quantity increases from Q_0 to Q_*, the point at which the farm-retail spread is equal to marginal marketing cost alone. Figure 2 involves the same

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[6] For the general functional form case the opposite result is possible. The removal of the tariff would have a greater impact on quantity in the presence of market power than with price-taking conduct if and only if

$$\theta^w\left(D_r'(Q)+Q\cdot D_r''(Q)\right)-\phi^f\left(S_f'(Q)+Q\cdot S_f''(Q)\right)>0,$$

a condition that could be met with demand sufficiently convex ($D_r''(\cdot)>0$) and/or supply sufficiently concave ($S_f''(\cdot)<0$). This is also the condition for the "over-shifting" case in which the imposition of a unit tariff would increase the farm-retail price spread by more than the amount of the tariff ($d\left(D_r(Q)-S_f(Q)\right)/dT>1$).

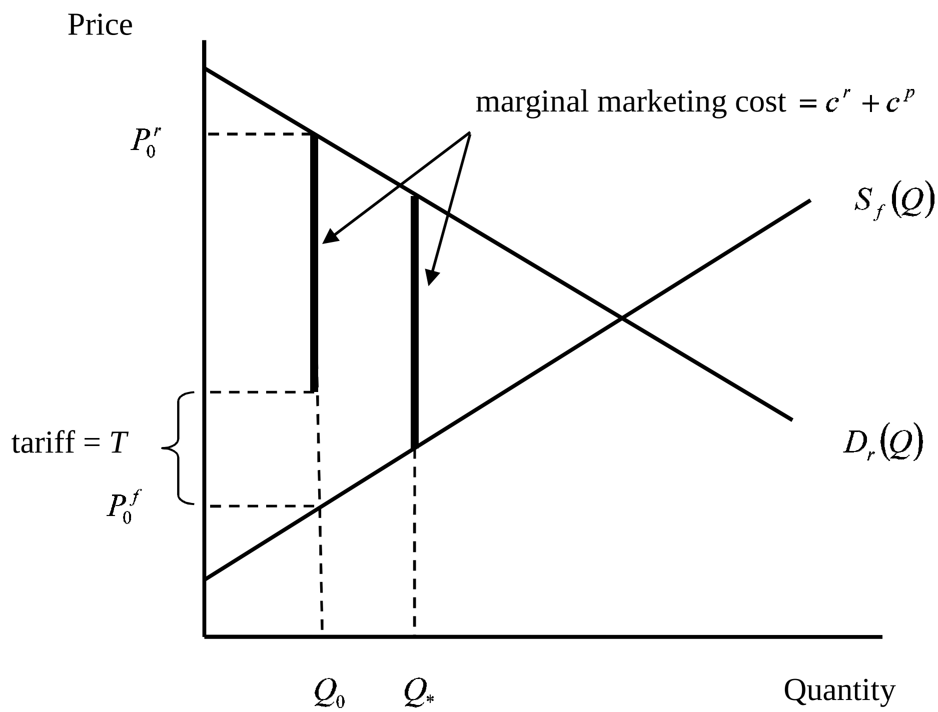

Figure 1. The effects of removal of a unit tariff with competition.

linear demand and supply curves, the same tariff wedge, and the same initial values for quantity and farm and retail prices as in Figure 1. But in Figure 2, this same *status quo* tariff equilibrium is assumed to be the result of the processing sector exercising pure monopsony power over producers and pure monopoly power over retailers. This alternative assumption about conduct leads to a different inference about marginal marketing cost: From equation (3) with $\theta^w = \phi^f = 1$, marginal marketing cost plus the tariff now determines the size, not of the gap between retail demand and farm supply, but of the gap between marginal revenue and marginal factor cost. Removing the tariff wedge shrinks this gap but, because marginal revenue is twice as steep as demand and marginal factor cost is twice as steep as supply, elimination of the tariff results in a smaller quantity adjustment in this case than in the case of competitive equilibrium. The distance between Q_0 and Q_* is smaller in Figure 2 than in Figure 1.

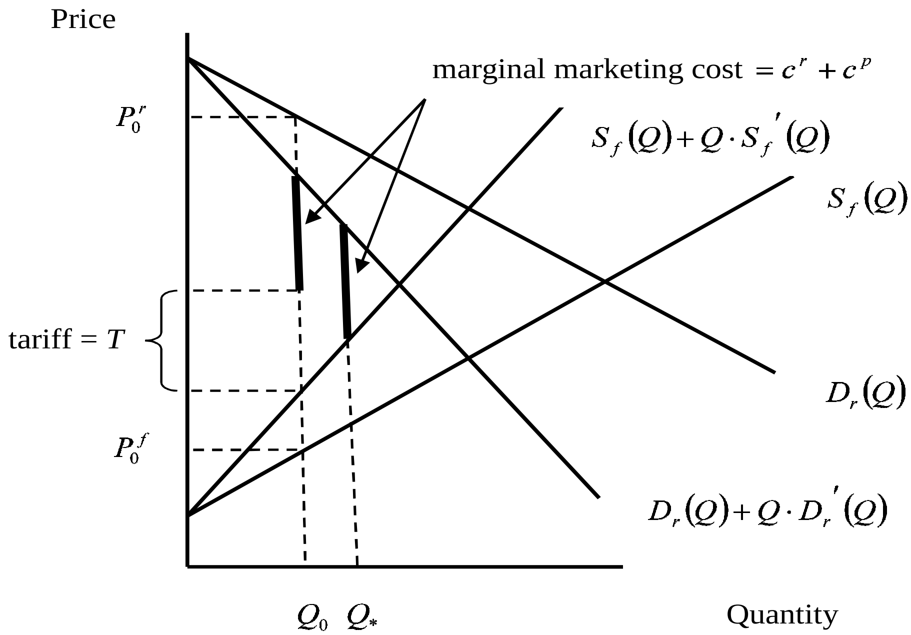

Figure 2. The effects of removal of a unit tariff with monopsony/monopoly.

With an *ad valorem* tariff and oligopsony power, a qualitatively different result can obtain, however. The counterpart to equation (2) for the *ad valorem* case is

$$\pi_p = D_w\left(Q^w\right) \cdot q - (1+t) \cdot S_f\left(Q^f\right) \cdot q - c^p q,$$

where t is the tariff rate. The counterpart to equation (3)'s equilibrium condition is[7]

$$D_r(Q) + Q \cdot D_r'(Q) \cdot \theta^w - (1+t) \cdot S_f(Q) - (1+t) \cdot Q \cdot S_f'(Q) \cdot \phi^f = c^p + c^r. \quad (4)$$

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[7] The second-order sufficient condition for the representative processing firm's profit maximization problem, assuming linear demand and supply and constant conduct parameters, is

$$\frac{d^2\pi_p}{dq^2} = \frac{Q^w}{q} D_w'\left(Q^w\right) \cdot \left(1+\theta^w\right) \cdot \theta^w - \frac{Q^f}{q} S_f'\left(Q^f\right) \cdot \left(1+\phi^f\right) \cdot \phi^f < 0$$

in the case of a unit tariff. In the case of an *ad valorem* tariff, the expression for $d^2\pi_p / dq^2$ is the same except for an additional factor of $(1+t)$ in the second term. In either case, the second order sufficient condition will be satisfied at any solution to the first-order conditions with $\theta^w > 0$ or $\phi^f > 0$ as long as demand slopes down and supply slopes up.

Differentiating with respect to t and solving:

$$\frac{dQ}{dt} = \frac{S_f(Q) + Q \cdot S_f'(Q) \cdot \phi^f}{(1+\theta^w) \cdot D_r'(Q) + Q \cdot \theta^w \cdot D_r''(Q) - (1+\phi^f) \cdot (1+t) \cdot S_f'(Q) - Q \cdot (1+t) \cdot \phi^f \cdot S_f''(Q)}$$

Now even in the case of linear supply and demand, there is the potential that the response to the removal of the tariff could be greater under market power than under competition if the processing sector exercises oligopsony power in the farm market.[8] For example, in the special case of symmetric market power ($\theta^w = \phi^f > 0$),

$$\left.\frac{dQ}{dt}\right|_{\theta^w = \phi^f > 0} = \frac{S_f(Q) + Q \cdot S_f'(Q) \cdot \phi^f}{(1+\phi^f) \cdot D_r'(Q) - (1+\phi^f) \cdot (1+t) \cdot S_f'(Q)},$$

$$\left.\frac{dQ}{dt}\right|_{\theta^w = \phi^f = 0} = \frac{S_f(Q)}{D_r'(Q) - (1+t) \cdot S_f'(Q)},$$

and $\left.\frac{dQ}{dt}\right|_{\theta^w = \phi^f > 0} < \left.\frac{dQ}{dt}\right|_{\theta^w = \phi^f = 0}$ if and only if $\varepsilon^f < 1$,

where $\varepsilon^f \equiv S_f(Q) \big/ \left(S_f'(Q) \cdot Q\right) > 0$ is the elasticity of farm supply.[9]

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[8] For the case of oligopoly power only ($\theta^w > 0, \phi^f = 0$), we have the same qualitative result as for the unit tariff case:

$$\left.\frac{dQ}{dt}\right|_{\theta^w = \phi^f = 0} = \frac{S_f(Q)}{D_r'(Q) - (1+t) \cdot S_f'(Q)} < \frac{S_f(Q)}{(1+\theta^w) \cdot D_r'(Q) - (1+t) \cdot S_f'(Q)} = \left.\frac{dQ}{dt}\right|_{\theta^w > 0,\, \phi^f = 0} < 0$$

There is a greater impact of tariff removal in the competitive case.

[9] The symmetric market power case ($\theta^w = \phi^f$) is just one illustration. For asymmetric market power at a single stage, the general condition for trade liberalization effects to be greater than in the competitive case is

Figures 3 and 4 illustrate a scenario in which removal of the tariff has a greater impact under market power than under competition for the specific case in which market power takes the form of pure monopsony conduct in the farm market and pure monopoly conduct in the wholesale market ($\theta^w = \phi^f = 1$).[10] As before, the *status quo* tariff equilibrium quantity and retail and farm prices are denoted Q_0, P_0^r, and P_0^f. From equation (4) and the assumption that the *status quo* represents a competitive equilibrium, we conclude that Q_0 satisfies

$$D_r(Q_0) - S_f(Q_0) = t \cdot S_f(Q_0) + c^p + c^r, \qquad (5)$$

an equation that implicitly defines the level of marginal marketing cost that is consistent with the assumption of competitive conduct; $c^p + c^r = \bar{c}$, say. When the tariff is removed, quantity adjusts to reduce the farm-retail price spread to $\bar{c}$ alone. The free trade equilibrium quantity, denoted Q_* and determined by

$$D_r(Q_*) - S_f(Q_*) = \bar{c}$$

is illustrated in Figure 3.

$$\frac{1}{\varepsilon^f}\left(\frac{1}{\varepsilon^f} - 1\right)\cdot\phi^f - \frac{D_r(Q)}{(1+t)\cdot S_f(Q)}\frac{1}{\eta^r}\left(\frac{\phi^f}{\varepsilon^f} - \theta^w\right) > 0,$$

where $\eta^r \equiv D_r(Q) \Big/ \left(D_r{}'(Q)\cdot Q\right) < 0$ is the elasticity of retail demand. This is a condition that could be satisfied with elastic farm supply but would require at least that $\phi^f / \varepsilon^f - \theta^w > 0$.

[10] As noted above, this outcome requires that supply be inelastic. An upward-sloping straight-line supply curve is inelastic throughout the relevant range (non-negative supply quantities and prices if and only if its price axis intercept is negative. A negative price intercept does, unfortunately, imply positive supply quantity at zero price, an obvious implausibility. Our simplifying assumption of a linear functional form should be taken only as a local approximation, however.

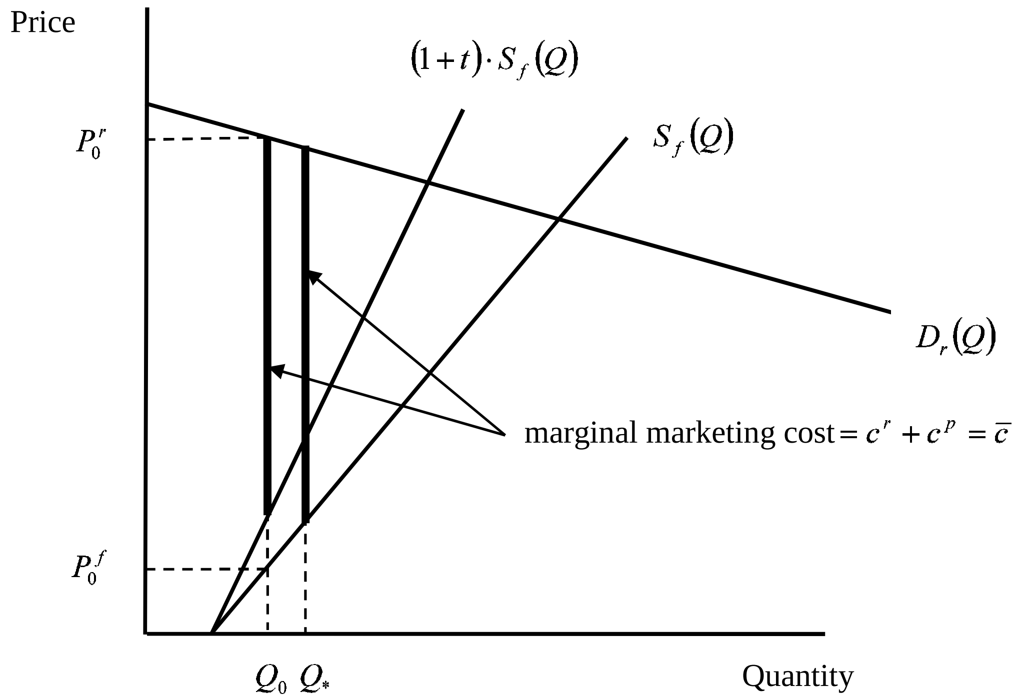

Figure 3. The effects of removal of an *ad valorem* tariff with inelastic supply and competition.

Figure 4 has the same supply and demand curves as Figure 3 and depicts exactly the same *status quo* prices and quantity, but now interprets them as the result of a pure monopsony/monopoly equilibrium. From equation (4), Q_0 is now viewed as satisfying

$$D_r(Q_0)+Q_0\cdot D_r'(Q_0)-\left[S_f(Q_0)+Q_0\cdot S_f'(Q_0)\right] = t\cdot\left[S_f(Q_0)+Q_0\cdot S_f'(Q_0)\right]+c^p+c^r. \quad (6)$$

This equation implicitly fixes the level of marginal marketing cost; $c^p + c^r = \tilde{c}$, say; that is consistent with the alternative market power story. Removal of the tariff will lead to a free trade equilibrium quantity, Q_*, determined by

$$D_r(Q_*)+Q_*\cdot D_r'(Q_*)-\left[S_f(Q_*)+Q_*\cdot S_f'(Q_*)\right]=\tilde{c}\ .$$

In terms of the geometry of the graphs, the market's adjustment to the free trade equilibrium in the monopsony/monopoly case differs from that in the competitive case in two respects. First, in the monopsony/monopoly case, the "gap" that is "closed" when the tariff is removed and quantity increases, is the difference between marginal revenue and marginal factor cost (the left-hand-side of equation (6)) whereas, in the competitive case, it is the farm-retail price spread (the left-hand-side of equation (5)). Since the marginal factor cost curve is steeper than the supply curve and the marginal revenue curve is steeper than the demand curve, it takes a smaller quantity adjustment to close a gap of any given size in the monopsony/monopoly case than in the competitive case. The second difference is that removal of the tariff in the monopsony/monopoly case eliminates not only the tariff itself ($t \cdot S_f(Q_0)$), but also the additional monopsony pricing distortion that is the result of the tariff ($t \cdot Q_0 \cdot S_f'(Q_0)$).[11] Thus, compared to the competitive case, in the monopsony/monopoly case the removal of the tariff leaves a bigger "gap" to be "closed" as quantity responds. These two factors work in opposite directions, so the quantity effects of trade reform could be larger or smaller in the monopsony/monopoly case than in the competitive case. But Figures 3 and 4 are drawn to reflect inelastic supply leading to the result that trade liberalization has a greater impact in the case of symmetric market power: The distance between Q_0 and Q_* is greater in Figure 4 than in Figure 3.

Before we proceed to a more general treatment of the effects of trade liberalization with an *ad valorem* tariff, we offer a brief summary. As Sexton *et al.* (2007) have shown, with linear supply and demand, the impact of the removal of a unit tariff is always greatest when the downstream marketing sectors exhibit competitive conduct. The presence of oligopoly or oligopsony in the marketing channel dampens the price and quantity effects of trade reform. Thus, an analysis based on the assumption of competitive conduct would overstate the impact of trade liberalization if downstream firms actually exercised market power.

[11] An *ad valorem* tariff makes the tax-adjusted supply curve less elastic so that there is greater scope for the exercise of oligopsony power, and a greater pricing distortion, at any given quantity and for any given degree of oligopsony power.

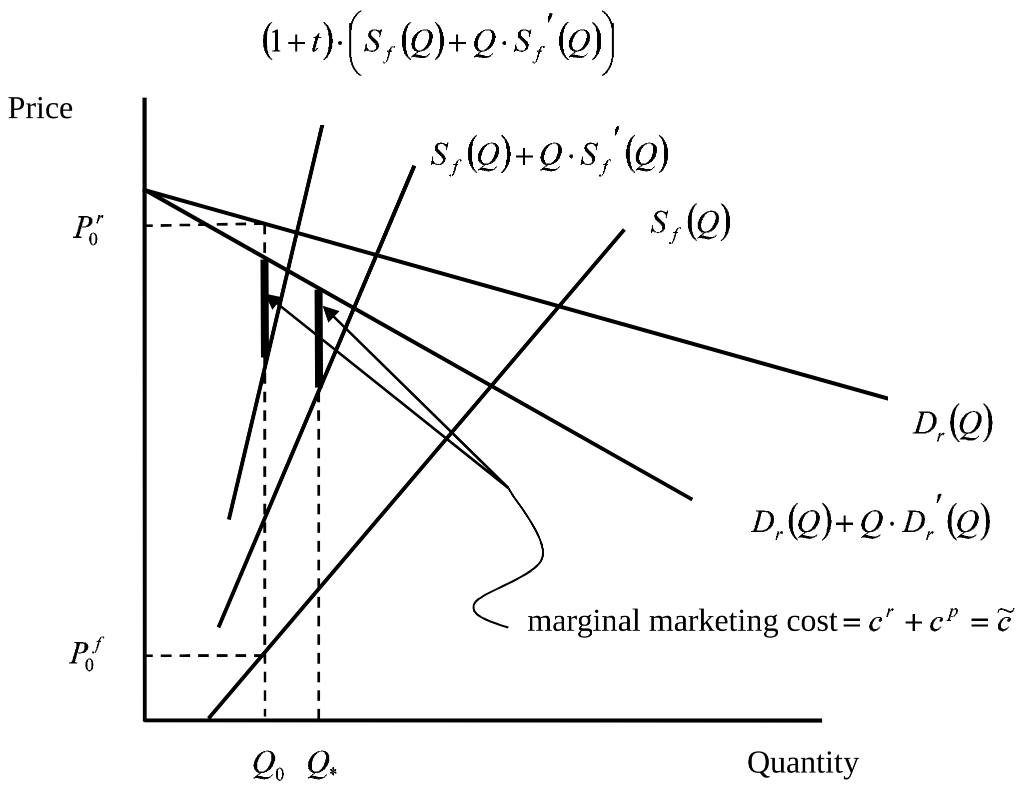

Figure 4. The effects of removal of an *ad valorem* tariff with inelastic supply and monopsony/monopoly.

The case of an *ad valorem* tariff is different in one important respect. Removal of an *ad valorem* tariff renders the supply of the primary commodity more elastic in the farm market, thus reducing the scope for the exercise of oligopsony power and its attendant output restriction. While the presence of oligopoly power, by itself, still dampens the effects of removal of the tariff, there is a possibility, depending on parameter values, that the exercise of some oligopsony power could lead to trade reform effects that are greater than those under competition. To predict the effects of trade reform for various combinations and degrees of input and output market power, and for various parameter values, we need to develop a general model of the vertically-linked marketing sectors. That task is undertaken in the next section.

3. The general model.

The previous section demonstrated that an analysis, based on the assumption of competitive conduct, of the effects of the removal of an *ad valorem* tariff on an agricultural commodity can either overstate or understate the true effects if downstream marketing firms exercise market power. How imperfectly competitive conduct influences the effects of trade liberalization depends on parameters and on the particular pattern of market power exertion in the vertically-linked marketing channel. In this section, we develop a simple model that can be used to project the effects of removal of an *ad valorem* tariff for representative parameter values and for various assumptions about market conduct.

We retain the main assumptions of the previous section. There is a fixed-proportions relationship among quantities at the farm, wholesale, and retail levels, allowing all three to be measured in common units. Processors and retailers operate at constant marginal cost. Producers in the developing country and retail consumers in the developed country are price-takers. The supply of the raw agricultural commodity in the developing country, $P^f = S_f\left(Q^f\right)$, and the demand for the retail product in the developed country, $P^r = D_r\left(Q^r\right)$, are assumed linear. As in Sexton *et al.* (2007), we consider three scenarios for the exertion of market power by processors and/or retailers. "Single stage oligopoly and oligopsony" describes the case in which one stage, either processors or retailers, exercises market power in both its input and output markets while the other stage behaves competitively. In "successive oligopsony with retailer oligopoly," retailers exert oligopoly power in their output (retail) market and oligopsony power in their input (wholesale) market, while processors are price takers in the wholesale market but exert oligopsony power over producers in the farm market. In "successive oligopoly with processor oligopsony," processors exert oligopsony power over producers in the farm market and oligopoly power over retailers in the wholesale market. Retailers are price takers in the wholesale market but exert oligopoly power over consumers in the retail market.[12] Like Sexton *et al.* (2007), we do not treat the case of bilateral oligopoly in the wholesale market.

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[12] Other patterns of market power exertion are special cases of these three. For example, the case in which both retailers and processors exert oligopoly power (only) obtains by setting ϕ^f, the index of processor oligopsony power, equal to zero in the "successive oligopoly with processor oligopsony" case.

The previous section works out the case for single stage market power exercised by processors, leading to equilibrium condition (4). The case of single stage market power in the hands of retailers (retailers have oligopoly/oligopsony power and processors are price takers) works out in a very similar fashion and leads to an equilibrium condition essentially equivalent to equation (4) and written here as equation (7):[13]

$$D_r(Q)+Q\cdot D_r'(Q)\cdot\theta^r-(1+t)\cdot S_f(Q)-(1+t)\cdot Q\cdot S_f'(Q)\cdot\phi^w=c^p+c^r, \quad (7)$$

where θ^r is a conduct parameter indexing retailers' degree of oligopoly power in the retail market and ϕ^w is a conduct parameter indexing retailers' degree of oligopsony power in the wholesale market. The obvious similarity of equations (4) and (7) makes it clear that, for given degrees of buyer and seller market power, the equilibrium values of Q, P^r, and P^f are independent of whether market power is exercised by retailers or processors.[14]

In the successive oligopsony with retailer oligopoly case, processors exercise oligopsony power over producers but are price takers in their output (wholesale) market, while retailers have market power in both their input (wholesale) and output (retail) markets. The first step is to derive processors' supply function. Profit for the representative firm in the processing sector is

$$\pi_p=P^w\cdot q-(1+t)\cdot S_f\left(Q^f\right)\cdot q-c^p q.$$

Differentiating:

$$\begin{aligned}\frac{d\pi_p}{dq}&=P^w-(1+t)\cdot S_f\left(Q^f\right)-(1+t)\cdot q\cdot S_f'\left(Q^f\right)\frac{dQ^f}{dq}-c^p\\&=P^w-(1+t)\cdot S_f\left(Q^f\right)-Q^f\cdot(1+t)\cdot S_f'\left(Q^f\right)\cdot\phi^f-c^p,\end{aligned}$$

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[13] Price-taking behavior by processors generates a wholesale market supply function: $P^w=S_w\left(Q^w\right)\equiv(1+t)\cdot S_f\left(Q^f\right)+c^p$. Incorporating this into the profit function of a representative retailing firm and proceeding as in the case of processor market power leads to equation (7).

[14] The one difference between the equilibria in these two cases is price in the wholesale market. While equilibrium retail and farm prices, P^r and P^f, are the same in both cases, in the processor market power case, wholesale price, P^w, is P^r-c^r. In the retailer market power case: $P^w=(1+t)\cdot P^f+c^p$.

where ϕ^f, as before, is $(dQ^f/dq)\cdot(q/Q^f)$. Setting $d\pi_p/dq$ equal to zero and substituting $Q^f = Q^w$ yields the wholesale supply function:

$$P^w = S_w(Q^w) \equiv (1+t)\cdot S_f(Q^w) + Q^w \cdot (1+t)\cdot S_f'(Q^w)\cdot \phi^f + c^p \qquad (8)$$

Profit for the representative firm in the retailing sector is

$$\pi_r = D_r(Q^r)\cdot q - S_w(Q^w)\cdot q - c^r q.$$

The first-order condition for profit maximization can be written as

$$D_r(Q^r) + Q^r \cdot D_r'(Q^r)\cdot \theta^r - S_w(Q^w) - Q^w \cdot S_w'(Q^w)\cdot \phi^w - c^r = 0, \qquad (9)$$

where θ^r again indexes retailers' oligopoly market power and $\phi_w = (dQ^w/dq)\cdot(q/Q^w)$ indexes retailers' oligopsony market power. From (8), using the assumption that farm supply is linear:

$$S_w'(Q^w) = (1+t)\cdot(1+\phi^f)\cdot S_f'(Q^w).$$

Substituting for $S_w'(Q^w)$ and $S_w(Q^w)$ in (9) and invoking $Q^w = Q^r = Q$, we have the equilibrium condition for the successive oligopsony with retailer oligopoly case:

$$\begin{aligned} &D_r(Q) + Q\cdot D_r'(Q)\cdot\theta^r - (1+t)\cdot S_f(Q) \\ &\qquad - (1+t)\cdot Q\cdot S_f'(Q)\cdot\left(\phi^f + (1+\phi^f)\phi^w\right) = c^p + c^r \end{aligned} \qquad (10)$$

In the successive oligopoly with processor oligopsony case, retailers exercise oligopoly power over consumers but are price takers in their input (wholesale) market, while processors have market power in both their input (farm) and output (wholesale) markets. In this case, the analysis begins with a derivation of retailers' demand for the wholesale product:

$$P^w = D_w(Q^w) \equiv D_r(Q^w) + Q^w \cdot D_r'(Q^w)\cdot\theta^r - c^r,$$

and proceeds to a first order condition characterizing profit maximization for the representative firm in the processing sector. Omitting details, the result is

$$D_r(Q)+Q\cdot D_r'(Q)\cdot\left(\theta^r+\left(1+\theta^r\right)\cdot\theta^w\right) \\ -\left(1+t\right)\cdot S_f(Q)-\left(1+t\right)\cdot Q\cdot S_f'(Q)\cdot\phi^f=c^p+c^r \tag{11}$$

The equilibrium conditions for the cases of single-stage market power at the processor level (4), and at the retailer level (7), and for successive oligopsony (10), and successive oligopoly (11) can all be nested in a single equation:

$$D_r(Q)+Q\cdot D_r'(Q)\cdot\left(\theta^r+\left(1+\theta^r\right)\cdot\theta^w\right)-\left(1+t\right)\cdot S_f(Q) \\ -\left(1+t\right)\cdot Q\cdot S_f'(Q)\cdot\left(\phi^f+\left(1+\phi^f\right)\cdot\phi^w\right)=c^p+c^r. \tag{12}$$

The values of the four conduct parameters; θ^r, θ^w, ϕ^w, and ϕ^f; are all contained in the $[0,1]$ interval, although at least one of θ^w and ϕ^w must be zero. With $\theta^r=\phi^w=0$, (12) reduces to (4), the single-stage/processor case. $\theta^w=\phi^f=0$ in (12) yields (7), the single-stage/retailer case. Setting θ^w to zero in (12) gives (10), the equilibrium condition for successive oligopsony with retailer oligopoly. Finally, with $\phi^w=0$, (12) becomes (11), the condition for successive oligopoly with processor oligopsony.

4. Some numerical illustrations.

Again, our focus is a marketing channel that uses imports of an agricultural commodity, subject to an *ad valorem* tariff, to produce a retail food product for sale to domestic consumers. From the perspective of the analyst, certain stylized characteristics of the vertically-linked farm, wholesale, and retail markets comprising the channel can be directly observed or fairly readily estimated. These features include the farm supply and retail demand elasticities, and the farmers' share of retail price that characterize the *status quo* tariff equilibria of actual markets. What is less directly estimable, and generally unknown to the analyst, is the nature of the solution concept underlying the observed equilibria.[15] Competitive conduct is one possibility, but the alternative market power scenarios presented in the previous section are also possibilities.[16] The goal of the analysis of the effects of trade liberalization is to predict how the free-trade equilibrium will compare to the *status quo* tariff equilibrium for various market power scenarios. To use the model to achieve this goal, we must first calibrate it to insure that the model's tariff equilibrium reflects features that are characteristic of real world markets.

In their analysis of the effects of removal of a unit tariff, Sexton *et al.* (2007) calibrated their model to reflect representative values for supply and demand elasticities, and for the farmers' and the tariff's share of the retail price. But their calibration method imposed these representative values at a hypothetical free-trade competitive equilibrium, rather than at the actual *status quo* equilibrium, which involves a tariff and is assumed to incorporate market power. This leads, in some cases, to sizeable differences between these representative values and their model's actual *status quo* tariff equilibrium values of the parameters.[17] Thus, their comparisons of the impact of trade reform for different assumptions about the degree of *status quo* market power confound the effects of changing conduct with the effects of changing demand and supply elasticities and the effects of changing farm/retail price ratios. To avoid this problem in our analysis of the effects of removal of an *ad valorem* tariff, we calibrate our model to exhibit representative elasticities and the farmers' share of retail price at the *status quo* tariff equilibrium instead of at the free-trade competitive equilibrium.

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[15] Empirical methods are available for the measurement of market power, given sufficient data. Bhuyan and Lopez (1997) apply the "New Empirical Industrial Organization" approach to a systematic assessment of oligopoly power in four-digit SIC food and tobacco industries.

[16] Different market power scenarios imply different decompositions of the observed spread between the retail price and the tariff inclusive farm price into oligopoly/oligopsony pricing distortions, on the one hand, and marginal marketing cost, on the other. So the problem of inferring market conduct is really just the mirror image of the problem of measuring marginal cost.

[17] For example, Sexton *et al.* (2007) imposed supply and demand elasticities of 0.6 and a farmers' share of the retail price of 0.2 at the free-trade competitive equilibrium. But, in their "successive oligopsony" case, with uniform values of 0.2 for the conduct parameters, the actual demand and supply elasticities at the tariff equilibrium are 1.20 and 0.45, respectively, and the actual farmers' share is 0.074. For successive oligopsony with conduct parameter values of 0.4, the corresponding values are 1.65, 0.34, and 0.041, respectively. The relative magnitude of the tariff that is being eliminated also varies across their market power scenarios. Their simulations use a unit tariff fixed at the value of 0.2 which, in terms of their normalization, represents 20% of the retail price at the hypothetical free-trade competitive equilibrium. But it represents, for example, 13.7% and 12.0% of the retail prices in the *status quo* tariff equilibria for successive oligopsony with conduct parameters of 0.2 and 0.4, respectively.

To begin, we normalize units so that the initial tariff equilibrium quantity corresponds to $Q_0 = 100$, and the initial tariff equilibrium producers' price (net of the tariff) corresponds to $P_0^f = 1$. Sexton *et al.* (2007) cite representative examples of imported agricultural commodities for which the farmers' share of retail price is in the range of 5% to 10%. We calibrate the model to a *status quo* tariff equilibrium retail price of $P_0^r = 15$, implying a farmers' share of 6.67%. We assume retail demand and farm supply elasticities of 0.6 ($-\eta^r = \varepsilon^f = 0.6$), as do Sexton *et al.* (2007).[18] Finally, we consider the effects of elimination of an *ad valorem* tariff that amounts to 20% of the farm price, implying $t = 0.2$.[19]

With these normalizations, the (constant) inverse demand and supply slopes are given by $D_r' = P_0^r / Q_0 / \eta^r = -0.25$ and $S_f' = P_0^f / Q_0 / \varepsilon^f = 0.0167$. The inverse demand and supply functions themselves are given by:

$$P^r = D_r(Q) = (Q - Q_0) \cdot D_r' + P_0^r = 40 - 0.25 \cdot Q \text{ and} \tag{13}$$

$$P^f = S_f(Q) = (Q - Q_0) \cdot S_f' + P_0^f = -0.667 + 0.0167 \cdot Q. \tag{14}$$

A given set of values for the conduct parameters; θ^r, θ^w, ϕ^w, and ϕ^f; implies a given pattern and degree of market power exertion.[20] For any such set of values, evaluating (12) at the *status quo* tariff equilibrium

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[18] Sexton and Zhang (2001) note that, in food marketing channels, both retail demand and farm supply are often relatively inelastic. For example, Bhuyan and Lopez (1997) and Abbott *et al.* (2005) found evidence of elasticities of demand for agricultural products such as roasted coffee and chocolate very close to 0.5. Estimates of the elasticity of supply of cocoa by Abbott *et al.* (2005) lie in the range of 0.3 to 0.5, comparing quite closely with the point estimate of 0.45 by Gilbert and Varangis (2003).

[19] This choice is made, in part, for consistency with Sexton *et al.*, but is supported by empirical evidence as well. For example, Aksoy and Beghin (2005) report average *ad valorem* tariff and tariff-equivalent rates imposed by the U.S. on agricultural imports of 10.6% and 35.2%, respectively. The corresponding figures for the EU are 21.6% and 58%, which comport well with the latest statistics of the WTO. These show that current average *ad valorem* Most-Favored-Nation tariff rates applied on agricultural imports by the U.S., the EU, and Japan are, respectively 5.3%, 16%, and 23.6%. (WTO, World Tariff Profiles 2009 – Summary) Thus, the assumption of a 20% *ad valorem* tariff rate could be described as moderate.

[20] For example, $\theta^w = 0$ and $\theta^r = \phi^w = \phi^f = 0.1$ corresponds to what we have called "successive oligopsony with retailer oligopoly" with a modest degree of market power, reflected in conduct parameter values of 0.1, at each stage. We carry out simulations for market power parameters generally in the range of 0.0 to 0.4. Conduct parameters of this magnitude appear to be in line with the empirical evidence for food processing industries. Bhuyan and Lopez (1997), Wilson

($t = 0.2$, $Q_0 = 100$, $D_r(Q_0) = 15$, $S_f(Q_0) = 1$, $D_r'(Q_0) = -0.25$, and $S_f'(Q_0) = 0.0167$) enables inference of the value for marginal processing cost that is consistent with that particular market power scenario; $c_0^p + c_0^r$, say. Then using (12) again, with $c^p + c^r = c_0^p + c_0^r$, the value of t reset to zero, and (13) and (14) substituted for $D_r(Q)$ and $S_f(Q)$ gives an equation that can be solved for the free-trade equilibrium quantity, Q_*:

$$Q_* = \frac{c_0^p + c_0^r + Q_0 \cdot \left(D_r' - S_f'\right) - P_0^r + P_0^f}{\left(1+\theta^r\right)\cdot\left(1+\theta^w\right)\cdot D_r' - \left(1+\phi^f\right)\cdot\left(1+\phi^w\right)\cdot S_f'} .$$

The free-trade equilibrium values of retail and farm price, P_*^r and P_*^f, are found by substituting Q_* into (13) and (14). The welfare effects of trade liberalization; the changes in farm producer surplus (ΔPS), retail consumer surplus (ΔCS), and profit in the marketing channel ($\Delta\Pi$); are readily obtained as:

$$\Delta PS = Q_0 \cdot \left(P_*^f - P_0^f\right) + \left(Q_* - Q_0\right)\cdot\left(P_*^f - P_0^f\right)/2 ,$$

$$\Delta CS = Q_0 \cdot \left(P_0^r - P_*^r\right) + \left(Q_* - Q_0\right)\cdot\left(P_0^r - P_*^r\right)/2 , \text{ and}$$

$$\Delta\Pi = \left(P_*^r - P_*^f - \left(c_0^p + c_0^r\right)\right)\cdot Q_* - \left(P_0^r - (1+t)\cdot P_0^f - \left(c_0^p + c_0^r\right)\right)\cdot Q_0 .$$

First, let us briefly summarize the impact of trade liberalization on quantity and price in the case of linear supply and demand and a unit tariff. Sexton *et al.* (2007) show that the removal of the tariff leads to the greatest impacts when conduct is competitive: The introduction of market power always reduces the effect of trade liberalization. For a given pattern of market power exertion (for example, successive oligopoly with processor oligopsony), the effects on price and quantity always decrease as the degree of market power increases. Moreover, holding fixed the values of the market power indices, adding an additional "layer" of market power always leads to a smaller impact of trade reform. For example, the price and quantity effects are smaller in the case

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(1997), and Schroeter (1988) estimate market power in U.S. food and tobacco industries, the UK bread manufacturing industry, and the U.S. beef packing industry, respectively. For the most part, their estimates of conduct parameters lie in the range of 0.18 to 0.30. Bhuyan and Lopez (1997) did find evidence of conduct parameters approaching 0.5 in the four-digit U.S. food and beverage industries of cereal preparation, flour and grain milling, and soybean oil mills.

of successive oligopsony with retailer oligopoly than they are for the case of single stage market power (oligopoly and oligopsony) at the retail level.[21]

With linear supply and demand but an *ad valorem* tariff, however, it is possible that the effects of trade liberalization could be greater than those that would obtain with competitive conduct if oligopsony power is exercised in at least one stage. This is because the removal of an *ad valorem* tariff makes supply more elastic and thus reduces the oligopsony pricing distortion for any given degree of market power. Figure 5 plots the farm price change due to the removal of the *ad valorem* tariff as a function of market power, for each of seven patterns of market power exertion. For purposes of illustration, the effects on the farm price are calculated for the case in which there is a common value for the market power indices that are non-zero in a particular market power scenario.[22] The bottom three lines in Figure 5's graph correspond to (respectively, from lowest to highest) the market power scenarios of processor and retailer oligopoly *only*, single stage (processor or retailer) oligopoly *only*, and successive oligopoly with processor oligopsony. For these three scenarios, the impact of tariff removal is smaller with market power than under competition, and always decreases as market power increases; a result qualitatively similar to that found by Sexton *et al.* (2007) for the unit tariff case. For the case of both oligopoly and oligopsony at a single stage (either processor or retailer), corresponding to the fourth line from the bottom in Figure 5, the impact of the removal of an *ad valorem* tariff increases as the degree of market power increases. In other words, for this case, an analysis of the impact of removal of an *ad valorem* tariff, based on the erroneous assumption of price taking conduct, would *understate* the true impact assuming that firms actually exercise market power. In comparisons of the effects of trade reform for pairs of market power scenarios, adding oligopsony power at an additional stage, or removing oligopoly power from a stage, increases the impact of tariff removal for any given degree of market power. The greatest impact occurs in the case in which processors exercise oligopsony power in the farm market and retailers exercise oligopsony power in the wholesale market, while both behave competitively in their output markets. In this scenario, and with market power indices of 0.3 ($\theta^r = \theta^w = 0; \phi^f = \phi^w = 0.3$), the effect of tariff removal on the farm price is an increase of 2.58%, more than twice the increase that would result under competitive conduct.

[21] These relationships are illustrated, for the case of the farm price, in Figure 6 in Sexton *et al.* (2007).

[22] For example, in the case of successive oligopsony with retailer oligopoly, the common value of θ^r, ϕ^w, and ϕ^f is plotted on the horizontal axis of Figure 5. For the "successive oligopoly with processor oligopsony" case and the "processor and retailer oligopoly only" case, the graphs terminate at market power index values of 0.23 and 0.24 respectively. In these cases, higher index values imply pricing distortions that would consume more than the entire spread between the retail and tariff-inclusive farm prices and are thus inconsistent with positive marginal cost.

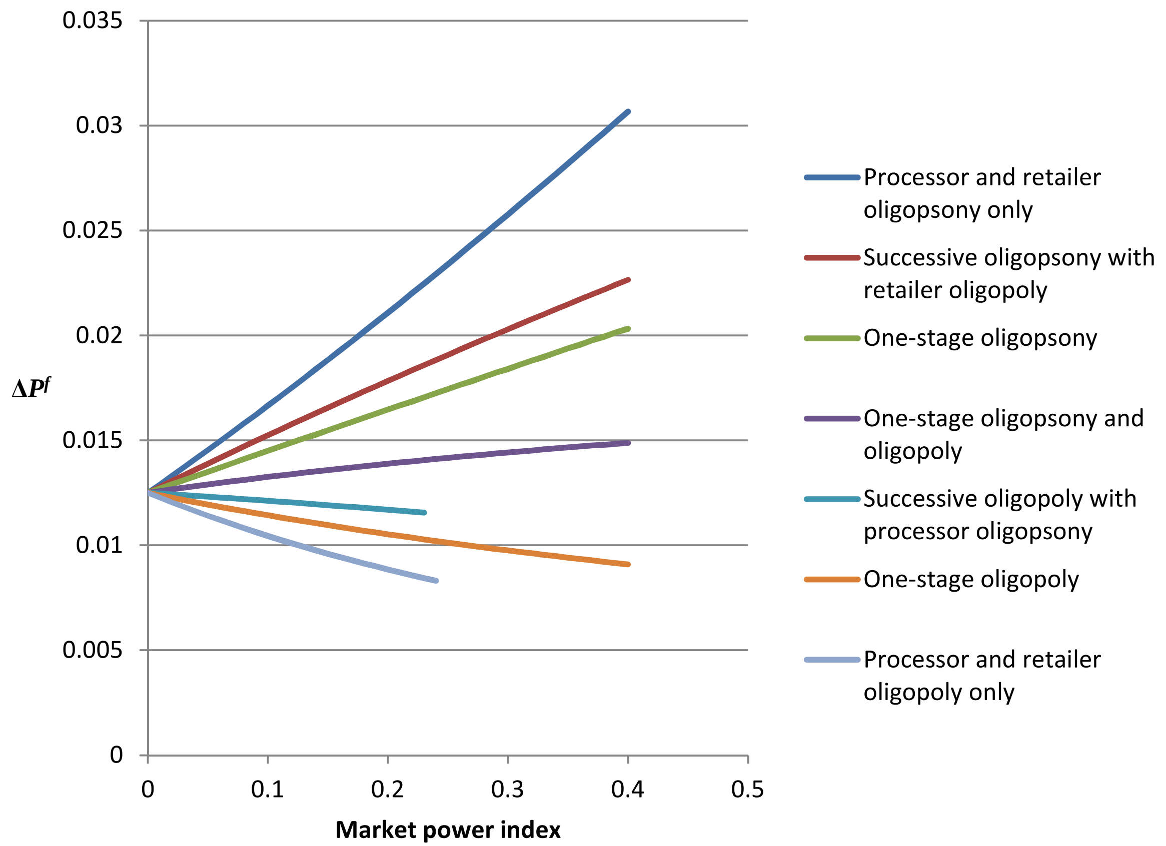

Figure 5. Changes in farm price as a result of trade liberalization. (Tariff equilibrium farm price normalized to one: $P_0^f = 1$.)

How market power affects the distribution of benefits from trade liberalization also depends crucially on the nature of the tariff: unit or *ad valorem*. Figure 6 plots, as a function of the degree of market power, the changes in retail consumer surplus, farm producer surplus, and marketers' profit that result from removal of an *ad valorem* tariff in the case of oligopoly (only) at a single stage. This graph is quite reminiscent of similar graphs in Sexton *et al.* (2007) showing the distribution of trade reform benefits for the case of a unit tariff.[23] With competitive conduct, consumers and producers capture all of the benefits of trade reform, as marketers' profit is zero both with and without the tariff. As the oligopoly power index increases, the changes in both retail consumer surplus and farm producer surplus decline as marketers capture an increasing share of the welfare gains. Marketers' profit is simply the oligopoly pricing distortion times the number of units marketed. In the linear supply and demand case, with an *ad valorem* tariff as with a unit tariff, both of these factors increase when the tariff is removed.

With an *ad valorem* tariff and oligopsony power exercised in the marketing channel, the relationship between market power and the distribution of the welfare gains can be quite different, however. Figure 7 plots, as a function of the market power index, the changes in welfare measures for the case of oligopsony at a single stage. The changes in retail consumer surplus and farm producer surplus both increase as market power increases. For the parameter values inherent in our calibration of the model, trade reform leads to bigger quantity and price impacts with market power than with competition, and both consumers and producers benefit from this. The change in marketers profit becomes increasingly negative as the market power index increases.[24] The elimination of an *ad valorem* tariff reduces marketers' markup of price over unit costs because it makes input supply more elastic and thus reduces the oligopsony price distortion. This reduction in profit margin is partially offset by the fact that trade reform leads to greater unit sales. But for our representative parameter values, the net effect of trade reform is a decrease in marketers' profit for this case of oligopsony at a single stage.

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[23] Figures 8 and 9 in Sexton *et al.* (2007) are the counterpart graphs.

[24] With market power, marketers' profit is positive both before and after trade reform. Trade reform reduces marketers' profit, however, and by amounts that increase as the degree of market power increases.

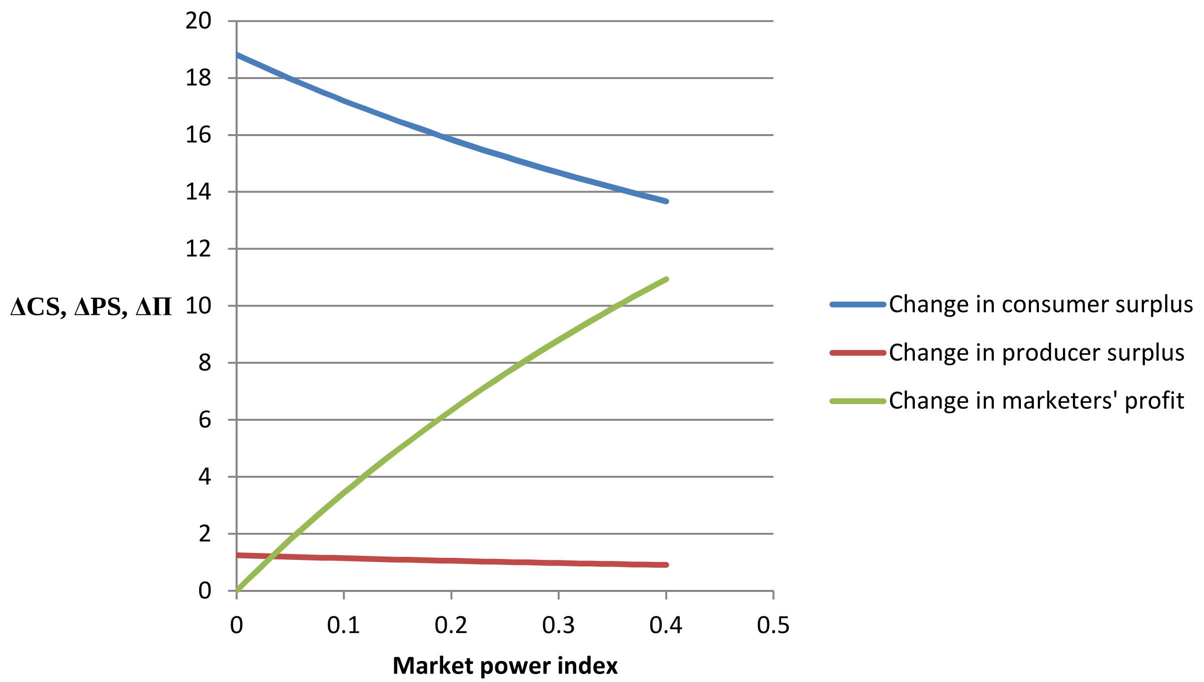

Figure 6. Changes in welfare measures as a result of trade liberalization: One-stage oligopoly case. (Tariff equilibrium farm revenue normalized to 100.)

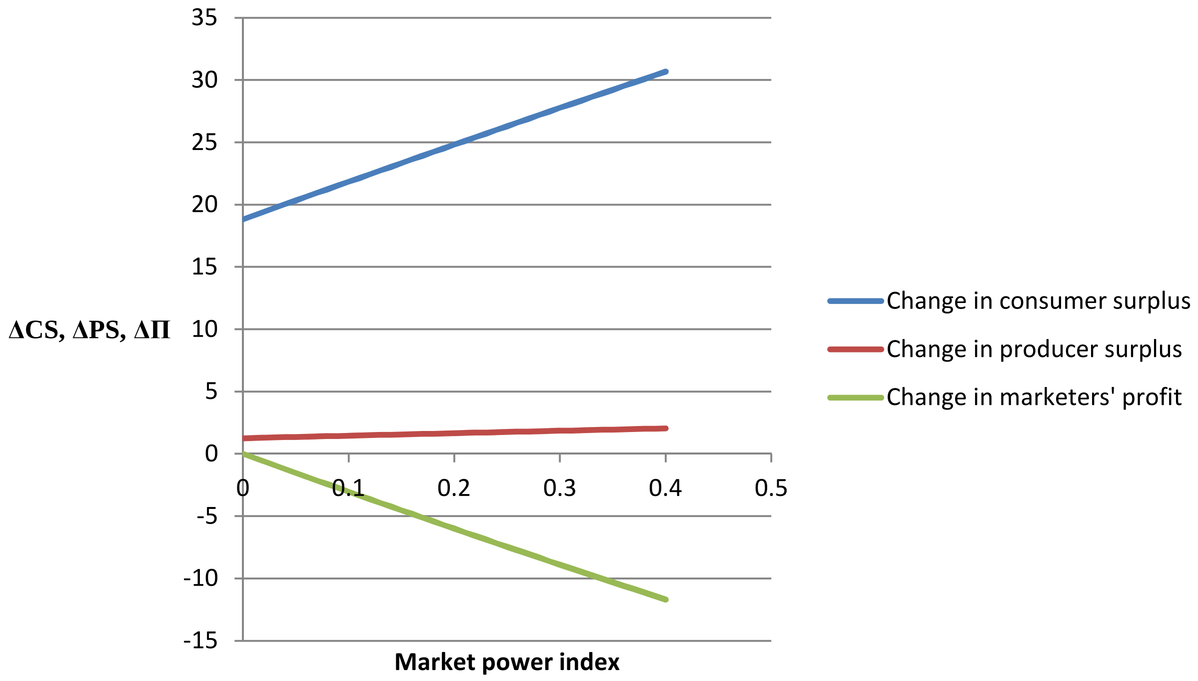

Figure 7. Changes in welfare measures as a result of trade liberalization: One-stage oligopsony case. (Tariff equilibrium farm revenue normalized to 100.)

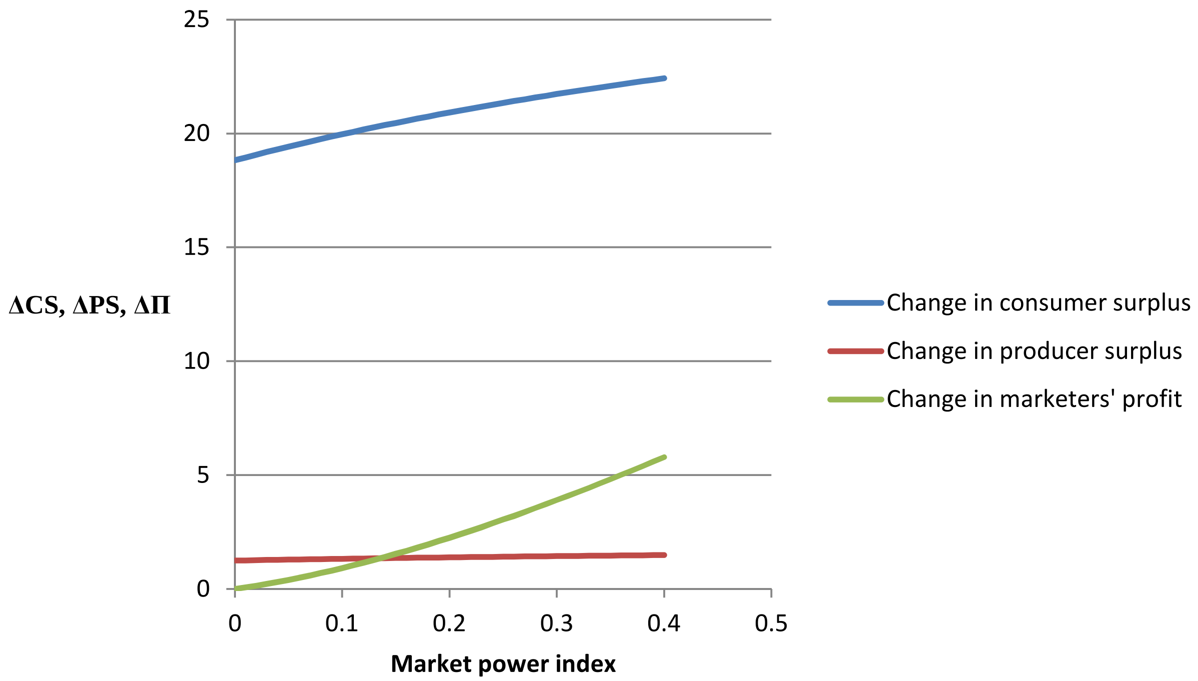

Figure 8. Changes in welfare measures as a result of trade liberalization: One-stage oligopoly and oligopsony case. (Tariff equilibrium farm revenue normalized to 100.)

Still other patterns for the distribution of trade liberalization benefits are possible. Figure 8 plots, as a function of the market power index, the benefits of removing an *ad valorem* tariff with both oligopoly and oligopsony power exercised at a single stage. Here, as in Figure 5, we show results for the symmetric case in which there is a common value for the input and output market power indices. Retail consumers, farm producers, and marketers all benefit from removal of the tariff, and the benefits increase as market power increases, although only slightly in the case of producers in the developing country. Finally, Figure 9 shows the distribution of benefits for the case of successive oligopsony with retailer oligopoly.[25] Consumers and producers benefit from trade reform to an increasing extent as market power increases. The change in marketers' profit is generally negative, first decreasing, then increasing as the degree of market power increases. In this scenario, the elimination of the tariff affects marketers' profit through its impact on three factors: output, and the oligopoly and oligopsony pricing distortions. The oligopsony distortion, represented by $(1+t)\cdot Q\cdot S_f'(Q)\cdot(\phi^f+(1+\phi^f)\phi^w)$ in equation (10), gets smaller as t goes to zero. Output and the oligopoly pricing distortion, $Q\cdot D_r'(Q)\cdot\theta^r$, increase. For low levels of the market power index, the effect of a smaller oligopsony distortion dominates and marketers' profit falls with trade liberalization. As the market power index increases to around 0.4, the effects of the three factors approximately offset, leaving no change in marketers' profit as the tariff is eliminated.

5. Summary.

For many developing countries, the majority of their export earnings are attributable to agricultural commodities sold to developed countries and subject to tariffs. The removal of these tariffs will increase the volume of trade and the prices received by developing country producers, but because these commodities are used as inputs in the food processing and retailing industries of the developed countries, firm conduct within those industries will have an influence on the magnitudes of the effects of trade liberalization. In this paper we extend the analysis of trade liberalization with downstream market power to the case of an *ad valorem* tariff and we find significant differences in results compared to those for the constant per unit tariff case. These differences stem from the fact that an *ad valorem* tariff, unlike a unit tariff, makes supply less elastic and therefore increases the scope for the exercise of oligopsony power by marketing firms.

[25] Results again are for the symmetric case in which ϕ^f, ϕ^w, and θ^r share a common value that is plotted on the horizontal axis of Figure 9.

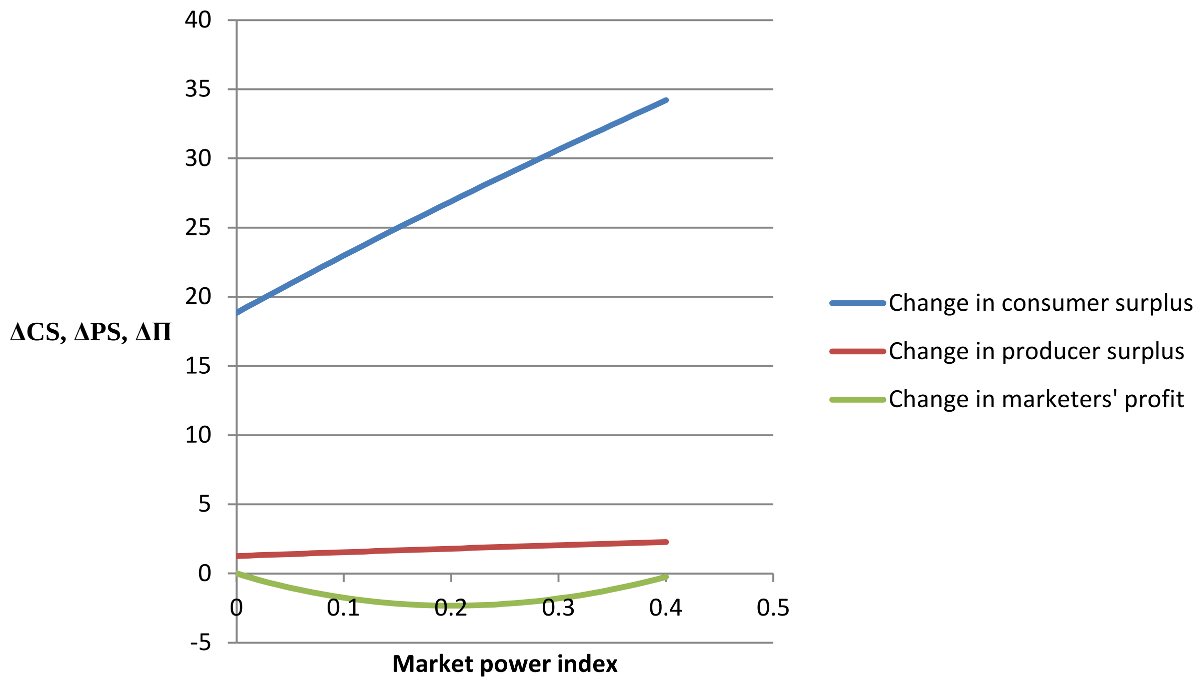

Figure 9. Changes in welfare measures as a result of trade liberalization: Successive oligopsony with retailer oligopoly case. (Tariff equilibrium farm revenue normalized to 100.)

With a unit tariff, market power exercised by downstream firms always dampens the price and quantity effects of trade liberalization. With an *ad valorem* tariff, if downstream firms exercise oligopsony power, it is possible, given plausible values for certain key parameters, that the impact of removal of the tariff could be greater than in the case of competitive conduct. The pattern of distribution of the benefits of trade liberalization also differ between the unit and *ad valorem* tariff cases. With a unit tariff, increasing market power always enables processors and retailers to appropriate a larger share of the gains from trade reform at the expense of farm producers and retail consumers. With an *ad valorem* tariff, a variety of different patterns are possible for the distribution of benefits. In particular, there are scenarios in which producers and consumers gain more from trade reform than they would if firms in the marketing channel behaved competitively.

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