Market Structure, Industrial Concentration, and Price Transmission*

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In this paper, the impact of developed country tariff reductions on developing country agricultural commodity exports is used as a setting for examining the potential effects of downstream imperfect competition on price transmission. The theoretical and numerical results show that under specific assumptions about downstream technology and demand, the incidence of commodity tariff reductions can favor the downstream marketing sector at the expense of both developing country agricultural commodity exporters as well as developed country consumers.

Introduction

In a recent survey, Meyer and von Cramon-Taubadel (2004) note that many empirical studies argue that downstream imperfect competition is a key explanation for asymmetric transmission of agricultural commodity price changes through the marketing system, e.g., Miller and Hayenga (2001). They also note that, in most cases, this claim is made with little theoretical underpinning, although they do cite papers by McCorriston, Morgan and Rayner (1998, 2001) that have addressed the issue of incomplete pass-through of commodity price changes when markets are imperfect. In this paper, a stylized model of a vertical marketing system, where one or more stages are imperfectly competitive, is introduced both in diagrammatic form, and in a more formal theoretical setting. Importantly, the model is developed in the context of the possible future reduction of tariffs on raw agricultural commodities imported by the developed countries from less developed countries. From this, it is possible to address the oft heard

[1] Parts of this paper draw extensively on earlier papers by Sheldon and McCorriston (2003); McCorriston, Sexton and Sheldon (2004, 2005); and Sexton, Sheldon, McCorriston and Wang (2003, 2004, 2006).

perception expressed by NGOs such as Oxfam that low and falling commodity prices are not fully reflected in commensurate reductions in prices paid by consumers in developed countries (Oxfam, 2001).

In order to motivate why downstream market structure may matter in terms of thinking about commodity price transmission due to trade policy reform, this paper begins by outlining two examples concerning developing country exporters. The first of these examples concerns the Mozambique cashew nut sector. In the early 1990s, Mozambique removed taxes on the export of raw cashews in response to advice from the World Bank. The World Bank (1995) forecast that, depending on prices received, cashew nut farmers' incomes would increase between US$ 17.4 and 27.9 million in the first two years of the reform. However, McMillan, Rodrik and Welch (2002) reported that the actual gains to cashew nut farmers were only US$ 5.3 million. At the same time, urban unemployment increased as labor released from cashew nut processing failed to move into other activities. This case became a "cause célèbre" for the anti-globalization movement, and a focus for attacking World Bank policies (McMillan *et al*., p.1).

What the World Bank ignored in its estimates was that the impact of reform in the Mozambique cashew nut sector was in large part influenced by the characteristics of the downstream sector which cashew nut farmers supplied. As McMillan *et al*. note, traders downstream from farmers are competitive in selling cashews, but have buying (monopsony) power in the purchase of cashews. As a result, even though export prices for raw cashew nuts did increase, as predicted by theory, export traders captured a relatively large share of the benefits from removal of the export tax, reducing the income gains to farmers.[2]

[2] Another example is Ivory Coast cocoa market liberalization (Wilcox and Abbott, 2004). Prior to liberalization, para-statal marketing boards controlled all levels of marketing of cocoa beans and also taxed cocoa bean exports. Liberalization has resulted in backward integration by multinational cocoa processor-exporters who now capture a portion of the rents previously collected as export taxes.

The second example concerns the perception that low and falling commodity market prices are not fully reflected in commensurate reductions in prices paid by developed country consumers. For example, African countries such as Burundi, Ethiopia, Rwanda and Uganda are highly dependent on exports of coffee, yet all have faced a significant decline in real prices over the past few years.[3] In key export markets such as Europe and the United States, global coffee buyers, roasters and retailers, who in total account for almost 60 percent of the share of final sales value of coffee, have benefited from lower coffee bean prices. For example, Nestlé, the second largest coffee roaster in Europe, reported a 20 percent increase in its profits in 2001, while Starbucks posted a 41 percent increase in profits (Oxfam).[4]

The point about these two examples is that they highlight how in the typical analysis of international commodity markets, little attention is paid to the fact that commodity exports from developing countries form inputs into the processing and retailing sectors in both developing and developed countries. If these industries were generally competitive, this distinction would matter little for commodity markets which could be reasonably treated in isolation from the downstream sectors which they enter into. But the observation that these sectors can often be characterized as highly concentrated, and where there has been increasing consolidation in recent years, raises specific challenges for how to analyze the incidence of trade policy reform.

Specifically, a key focus of the current round of multilateral trade negotiations is on increasing developing countries' access to developed country markets (Anderson and Martin, 2005). This process will, it is anticipated, involve the reduction of tariffs on agricultural

[3] Over the period 1998 to 2001, real coffee prices fell by 50 percent. As a result, for a country such as Ethiopia, where coffee represented 67 percent of the value of exports in 1998, the decline in world coffee prices cost Ethiopia US$ 300 million in export revenues, equivalent to 50 percent of its annual export earnings (Oxfam, 2001).

[4] All three sectors are dominated by a small number of firms. For example, in 1995, ten firms accounted for 62 percent of global coffee bean trade, while in 1998, five firms accounted for 58 percent of sales of roasted coffee in the European market (Fitter and Kaplinsky, 2001).

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. However, it is important to recognize that the vertically-linked nature of the food chain between agriculture, food processing and retailing, and the increasing consolidation of the food industry in developed countries, may influence the magnitude of the benefits that developing countries receive from increased market access. Specifically, the downstream structure of the vertical chain will determine the nature of the perceived marginal revenue function that faces exporters of raw agricultural commodities. In this context therefore, reducing the level of tariffs will determine both the increased level of market access and the distribution of the welfare effects associated with trade liberalization.

The overall message of this paper is any analysis that ignores the fact that agricultural commodities represent only a small part of a vertical marketing system, where some or all parts of this system can be characterized as imperfectly competitive, misses an important part of the environment in which commodity exporters compete. By extension, understanding some of the current concerns of agricultural commodity exporters related to the impact of trade reform requires a framework that explicitly accounts for some of these key characteristics. As is shown, many of the current concerns of commodity exporters regarding the distribution of the effects of declining commodity prices, the distribution of value-share throughout the marketing chain, and the impact of tariff reductions on market access (and the commensurate welfare effects), can be addressed in a common framework that emphasizes the role of successive oligopoly and oligopsony in downstream markets.

The paper is organized as follows. In the second section, a brief overview of the characteristics of the food industry in the United States and the European Union (EU) is provided. This forms the basis for motivating the framework outlined in the third section where a stylized model is used to capture various aspects of downstream market structure in a unified framework. Some of the results of this simple model are then derived more formally in the fourth section, followed by presentation of the results of a simple numerical evaluation of trade liberalization when downstream markets are imperfectly competitive. The main point of the analysis is that downstream market power can impact the incidence of the benefits from tariff reductions on agricultural commodities. Finally, some conclusions are drawn, along with a discussion of some suggestions for further research in this area.

Market Structure of the Food Sector in Developed Countries

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, the main developed country markets for developing country exports.[5]

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). Dis-aggregated data at the four-digit SITC level indicates a large number of specific food products where the 4-firm concentration ratio was over

[5] More detailed tabulations of these data can be found in Sheldon and McCorriston (2003).

60 percent in 1997, the average being just below 76 percent.

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. As in the United States, these averages hide some high levels of seller concentration for specific products in each EU country, most notably baby foods, canned soup, pet food, and coffee. It should be noted, however, that while seller concentration at the product level is high in many individual EU country markets, there are few examples of firms that dominate sales across EU countries as a whole (Cotterill, 1999).

Food Retailing

Several important differences are apparent in the food retailing market structures in the United States 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. 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.

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 market concentration. Domestic mergers and acquisitions in the food sector doubled between 1990 and 2002 (McCorriston, Sexton and Sheldon, 2004). Moreover, international mergers and acquisitions have also been increasing significantly. For example, EU-based retailers such as Royal Ahold and Sainsbury have expanded into the US market, and Wal-Mart has expanded into the EU. 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).[6] As the recent trade policy literature has shown, domestic market structure issues and mergers are likely to be an important dimension of market access and can easily substitute for more obvious trade policy instruments such as tariffs.[7]

Although the high and rising concentration in the food sector is not a debatable point, empirical evidence on the extent of the actual exercise of manufacturer and retailer market power in developed-country food sectors is rather mixed. Surveys of the recent empirical work by Sexton (2000), Sexton and Lavoie (2001), and Sheldon and Sperling (2003) provide evidence of modest departures from perfect competition for a wide range of products in the food manufacturing/processing sector. However, given the recent increases in consolidation in food processing and retailing, these past studies may understate current levels of market power being exercised. In addition, Sexton has argued that the limitations of the extant empirical literature probably serve on balance to understate the extent of market power.

Evaluating the Incidence of Tariff Reductions

Despite the observation that the food sector would appear to be imperfectly competitive at multiple stages, departures from the competitive-markets paradigm have seldom been considered by economists conducting agricultural and/or trade-policy analysis. Most empirical studies

[6] Acquisitions are also occurring in developing countries. For example, Carrefour, Royal Ahold and Wal-Mart have all expanded into Central and Latin America (Chavez, 2002; Farina, 2002; Gutman, 2002),

[7] See, for example, the recent paper by Horn and Levinsohn (2001) on the role of merger policy in an open economy.

assume perfect competition at a single stage, e.g., the FAPRI (Devadoss *et al*., 1993) and AGLINK (OECD, 2005) policy forecasting models, and the recent estimates of the possible impact of trade liberalization under the Doha Round contained in Anderson and Martin. Even the widely-cited work on the impact of protectionism in the EU by Messerlin (2001) reports results that treat the agricultural sector as perfectly competitive, with the exception of the bananas sub-sector.[8]

Indeed, only in recent years have papers begun to consider the role of vertical market structure in thinking about optimal trade policy. Spencer and Jones (1992), Ishikawa and Lee (1997), Ishikawa and Spencer (1999), and Sheldon, Pick and McCorriston (2001) are examples of theoretical models extending the Brander and Spencer (1985) result on export subsidies to vertical markets, while McCorriston and Sheldon (1996) examine the incidence of reform of the EU banana regime in a vertical market setting of successive oligopoly.

In order to think about the incidence of trade policy reform in a vertical marketing system, where one or more stages may be characterized as imperfectly competitive, consider the following diagrammatic representation shown in figure 1. Assume that developing countries' exports of a raw agricultural commodity enter at the upstream stage of a developed country's vertically-related food marketing system that is characterized (for ease of exposition) by a technology of one-to-one fixed proportions at each stage, i.e., a unit of the raw commodity is transformed upstream into one unit of an intermediate good and in turn into one unit of the final good downstream, where the downstream sector could be either second-stage food processing or

[8] Messerlin does acknowledge that a few large traders in grains and sugar could result in imperfect competition in these sub-sectors, and that there may be imperfect competition at the food retailing level.

food retailing.[9] It is also assumed that there is no domestic supply of the agricultural commodity and there is arms' length pricing.

The demand curve for the final good sold downstream is given by *D*. Assuming neither upstream nor downstream processing (retailing) costs, if the upstream and downstream sectors were perfectly competitive, equilibrium would be where the downstream demand and agricultural commodity supply curves intersect. However, assuming the downstream sector is imperfectly competitive the marginal revenue curve that corresponds to this downstream demand curve is given by *PMR*, the perceived marginal revenue function. Specifically, the slope of *PMR* captures the nature of competition at the downstream stage. At one extreme, if the downstream stage were either a monopoly or group of firms acting as a perfect cartel, the slope of *PMR* would be twice that of the demand curve *D*. As the downstream sector becomes more competitive, the slope of *PMR* becomes shallower as it rotates towards the demand curve. In the limit, if the downstream sector were perfectly competitive, the marginal revenue curve would coincide with the market demand curve.

In this vertically-related set-up, this perceived marginal revenue function is the derived demand curve facing the upstream sector. Again, assuming this sector to be imperfectly competitive, the marginal revenue function corresponding to the intermediate processing stage is given by *PMMR*, the slope of the perceived marginal revenue function reflecting competition in both the downstream and upstream sectors. In this set-up, the derived demand curve facing the developing agricultural exporter is not the final good demand curve, but is the *PMMR* curve at the intermediate processing stage.

[9] The recent theoretical literature on trade, vertical markets and imperfect competition consistently assumes a fixed proportions technology, and for many agricultural commodities, e.g., coffee roasting (Bettendorf and Verboven, 2000) the assumption seems very reasonable.

This stylized model characterizes successive oligopoly with imperfect competition at both the intermediate and final stages of the food chain. In the context of successive oligopoly, there is the double marginalization problem with mark-ups characterizing the links between the import and upstream sector's output and then the upstream and the downstream sector's output.[10] At the first stage, the upstream sector purchases the raw agricultural commodity from the developing country exporter. Assuming that a specific tariff is applied on the agricultural commodity, the export supply curve is given by S^T. Imports are therefore Q_M^T giving a margin of $P_U^T - P_M^T$ at the upstream stage and $P_D^T - P_U^T$ at the downstream stage. Export (world) prices for the agricultural exporter are given by P_W^T.

Consider now what happens of there is industry consolidation and that the form this takes is a drop in the number of firms competing at the downstream stage. The effect of this would be to rotate down the perceived marginal revenue function at the downstream stage. Also, because of the vertically-linked nature of the market, this would have the effect of also rotating the perceived marginal revenue function in the upstream sector. Note the effect on commodity exporters: market access will be reduced further because of industry consolidation and the price the exporter will also be lower.

This characterization of the food sector in a developed country market is consistent with data about the share that developing countries obtain from the sale of the final, processed product at the retail level. For example, Kaplinsky (2000) shows that Kenyan producers of fresh vegetables

[10] This vertically-related market structure could easily be changed to one where both upstream and downstream firms behave competitively in their output markets, but exert oligopsonistic power in the purchase of the raw agricultural commodity and intermediate good respectively. In this case, the perceived marginal resource cost curves upstream and downstream would have a steeper slope than the agricultural commodity supply curve, generating oligopsonistic markdowns at each stage. The effect of successive oligopsony in terms of market access and raw commodity prices though is qualitatively similar to that of successive oligopoly at the same stages of the marketing chain.

receive around 14 percent of the final price of the product sold at retail level with the mark-up received by the UK supermarkets being around 46 percent. Exports of mange tout from Zimbabwe gives producers a 12 percent share of the final price with supermarkets in the UK receiving a 27 percent mark-up. Data for developing country coffee exporters reported by Fitter and Kaplinsky (2001) show a similar pattern. Coffee retailers and roasters in developed countries account for 51 percent of the value of final coffee sales, while coffee growers receive only 10 percent. Taken together, and given recent estimates compiled by UNCTAD (2000, 2002b), this suggests that the relatively small share of total value received by agricultural exporters in developing countries coupled with high mark-ups for the food marketing system in the developed countries is a general issue facing developing country agricultural exporters.

Consider now what happens with trade liberalization through reduction of tariffs. In figure 1, the export supply function is now S . Quantities imported by the developed country increase to Q_M and export (world) market prices rise to P_W thus increasing export revenues and producer surplus for the exporting country. However, mark-ups throughout the vertically-related food chain change also with the retail sector mark-up changing to $P_D - P_U$ and the processing margin now being given by $P_U - P_w$. Importantly, it can be shown under fairly reasonable conditions regarding the shape of the demand function, with incomplete pass-through of the tariff reduction, the margins of the downstream and upstream firms both increase as a result of the liberalization of the tariff.[11] Consumers also benefit from trade liberalization, but not by as much if the vertically-related food marketing system was characterized by perfect competition. The main point here is that the incidence of the benefits of trade liberalization with industry concentration

[11] As is well-known from the tax incidence literature, see for example Seade (1985), and Stern (1987), there is likely to be 'under-shifting' of taxes when markets are oligopolistic, and the demand function is not too convex. This point is dealt with more explicitly in the next section of the paper.

in a vertically-related industry is different both in terms of magnitude and distributional effects compared to the case of perfect competition.

Successive Oligopoly and Pass-Through of Tariff Reductions

A Formal Model

In order to provide a little more analytical rigor to the framework presented in the previous section, a model of successive oligopoly is now developed, drawing on papers in the public finance literature Stern (1987), and Colangelo and Galmarini (2001). Consider a market setting where a primary agricultural product such as coffee is exported from a developing economy, and is processed and sold in a developed economy. The market structure in the developed economy is characterized by independent processing and retailing sectors, either or both of which may exhibit market power. A specific tariff is levied on imports of the raw agricultural commodity at the border, the inverse commodity supply function being $p^a = \upsilon(X)$, where p^a is the tariff-ridden commodity price, X being the total supply of the commodity. At this point, commodity supply is assumed to be perfectly price elastic, which rules out the exercise of oligopsony power downstream.

The game structure consists of three stages: stage 1 where the government commits to the specific tariff; stage 2 where upstream firms take the tariff-ridden commodity price as given and choose output of the intermediate processed good; and stage 3 where downstream firms take the price of the intermediate processed good as given and choose output of the final good to be sold at retail. As is usual with this type of structure, the game is solved by backwards induction.

At the downstream stage *d*, output of a representative firm *i* is given as x_i, and each firm has a cost function of the form:

$$c_i^d = k^d + p^u x_i, \tag{1}$$

where k^d are downstream fixed costs, and $p^u x_i$ is the cost of purchasing the intermediate good, there being no other downstream costs. It is also assumed for convenience that, $x_j^u = x_i^d = x_i$, i.e., the technology is where one unit of the intermediate good is transformed into one unit of the final good.

The inverse demand curve downstream is given by:

$$p^d = \phi(X), \tag{2}$$

where p^d is the price of the final good, and total downstream output is $X = \sum_{i=1}^{n} x_i$, n being the number of downstream firms. Each downstream firm i conjectures that the reactions of other firms to a small change in its output satisfies:

$$\frac{\partial(X - x_i)}{\partial x_i} = \alpha^d \left(\frac{X - x_i}{x_i} \right), \tag{3}$$

i.e., if it changes its output by 1 percent, other firms respond by raising output by α percent, where $0 \le \alpha^d \le 1$. A necessary condition for profit maximization is that a downstream firm i chooses output so that its perceived marginal revenue equals its marginal cost:

$$p^d \left\{ 1 - \frac{(\alpha^d + (1-\alpha^d)s_i^d}{\eta^d} \right\} = p^u, \tag{4}$$

where s_i^d is the market share of the ith downstream firm, and η^d is the price elasticity of demand, given as a positive number. Assuming all downstream firms produce a homogeneous product with an identical technology, adding and dividing by the number of firms n, (4) can be re-written as:

$$p^d\left(1-\frac{\gamma^d}{\eta^d}\right)-p^u=0\,, \tag{5}$$

where p^u is the price of the intermediate good, and $\gamma^d=\alpha^d+[(1-\alpha^d)/n)]\,, 0\le\gamma^d\le 1$. Stern (1987) calls this generalized-Cournot equilibrium, where downstream monopoly (n=1, $\gamma^d=1$), and perfect competition (k^d=0, $\gamma^d=0$) are special cases, and for Cournot-Nash, $\gamma^d=1/n$. As a result, the aggregate downstream profit condition can be written as:

$$\pi^d=(p^d-p^u)X-k^d n\ge 0\,, \tag{6}$$

Existence of a solution to (5) requires that $\eta^d>\gamma^d$, and stability requires that $F^d>1-\dfrac{\eta^d}{\gamma^d}$, where $F=p^d\eta^{d\,\prime}/\eta^d$ is the elasticity of the price elasticity of demand.

At the upstream stage u, output of a representative firm j is given as x_j, and each firm has a cost function of the form:

$$c_j^u=k^u+p^a x_j\,, \tag{7}$$

where k^u are upstream fixed costs, and $p^a x_j$ is the cost of purchasing the raw agricultural commodity, there being no other upstream processing costs. Again it is assumed for convenience that, $x_j^a=x_j^u=x_j=x_i$, i.e., the technology is where one unit of the agricultural commodity good is transformed into one unit of the intermediate good, which is then transformed into one unit of the final good.

Using the downstream demand curve to substitute for p^d, (5) can be solved for the inverse derived demand facing the upstream sector, $p^u=\theta(X\,|,\eta^d,\gamma^d)$. A necessary condition for profit maximization is that an upstream firm j chooses output so that its perceived marginal revenue equals its marginal cost:

$$p^u \left\{1 - \frac{(\alpha^u + (1-\alpha^u)s_j^u}{\eta^u}\right\} = p^a, \quad (8)$$

where s_j^u is the market share of the jth upstream firm, and η^u is the price elasticity of derived demand. Assuming all upstream firms produce a homogeneous product with an identical technology, adding and dividing by the number of firms m, (8) can be re-written as:

$$p^u \left(1 - \frac{\gamma^u}{\eta^u}\right) - p^a = 0, \quad (9)$$

where p^a is the raw agricultural commodity price, and $\gamma^u = \alpha^u + [(1-\alpha^u)/m)]$, $0 \le \gamma^u \le 1$. Again, upstream monopoly (m=1, $\gamma^u = 1$), and perfect competition (k^u=0, $\gamma^u = 0$) are special cases, and Cournot-Nash is $\gamma^u = 1/m$. As a result, the aggregate upstream profit condition can be written as:

$$\pi^u = (p^u - p^a)X - k^u m \ge 0. \quad (10)$$

Existence of a solution to (9) requires that $\eta^u > \gamma^u$, and stability requires that $F^u > 1 - \frac{\eta^u}{\gamma^u}$, where $F^u = p^u \eta^{u\,\prime} / \eta^u$ is the elasticity of the price elasticity of derived demand.

Given this set up, and in order to focus on the basic issue of imperfect pass-through of changes in agricultural commodity prices, assume the upstream sector is competitive, (k^u=0, $\gamma^u = 0$), and that the downstream sector is imperfectly competitive, $0 \le \gamma^d \le 1$. Under the assumptions made above, this implies that $p^u = p^a$, so that any change in the tariff-ridden commodity price is passed through fully in the upstream price, $\partial p^u / \partial p^a = 1$, the interest being in how this is passed through in the final downstream price, $\partial p^d / \partial p^u$.

In order to derive comparative statics, first write the left-hand side of (5) as $f(p^u, p^d, n)$, and the left-hand side of (6) as $g(p^u, p^d, n)$. Then re-write the stability condition as $f_{p^d} = 1 - (\gamma^d / \eta^d) + (F^d \gamma^d / \eta^d) > 0$, where the latter can be interpreted as the effect on the perceived marginal revenue of a small change in the downstream price. Pass-through of a change in the upstream price, given a change in the agricultural commodity price, is given by:

$$\frac{\partial p^d}{\partial p^u} = -\frac{f_{p^u}}{f_{p^d}} = \frac{1}{\left(1 - \frac{\gamma^d}{\eta^d} + \frac{F^d}{\eta^d}\right)} \gtrless 1 \text{ as } F^d \lessgtr 1 . \tag{11}$$

This result shows that under a generalized-Cournot setting, there can be perfect or imperfect pass-through of a tariff reduction to consumers, depending on both market structure, which works through the value of γ^d, and also the elasticity of the elasticity of the inverse demand curve, F^d, the latter taking various values depending on the shape of the demand curve, including the iso-elastic case where F^d=0.

Given the diagrammatic representation in the previous section, assume the downstream demand curve is linear, Stern shows that for generalized-Cournot, (11) becomes:

$$\frac{\partial p^d}{\partial p^u} = \frac{1}{1+\gamma^d} \le 1, \tag{12}$$

i.e., a reduction in the upstream price due to a tariff reduction is passed through less than perfectly in downstream prices, the extent depending on the value of γ^d. With a large number of firms downstream, γ^d approaches zero and pass-through of the tariff reduction approaches 1.0, whereas with a downstream monopoly, pass-through is 0.5. To get more than perfect pass-through under generalized-Cournot, there would have to be sufficient convexity in the demand function, F^d<1.

Turning now to the profit effects, the effect of a reduction in the upstream price is given as:

$$\frac{\partial \pi^d}{\partial p^u} = g_{p^d}\frac{\partial p^d}{\partial p^u} + g_{p^u} = \frac{-X\gamma\left[1 - \frac{1}{\eta^d} + \frac{F^d}{\eta^d}\right]}{1 - \frac{\gamma^d}{\eta^d} + \frac{F^d\gamma^d}{\eta^d}} < 0 \text{, iff } F^d > 1 - \eta^d, \tag{13}$$

where in the case of linear demand, (13) can be written as:

$$\frac{\partial \pi^d}{\partial p^u} = \frac{-2\gamma^d X}{1+\gamma^d} < 0,$$

i.e., with less than perfect pass-through of a reduction in the upstream price, the profits of the downstream firms increase, assuming that $\gamma^d > 0$.[12]

Given this analysis, it is fairly straightforward to allow the upstream sector to also be imperfectly competitive, resulting in successive oligopoly in the marketing system, and hence the problem of double-marginalization noted earlier. Under the assumptions of the model, it can be shown that the extent to which a reduction in the tariff on the imported agricultural commodity is passed through in the upstream price, $\partial p^u / \partial p^a$, depends on both upstream market structure, working through γ^u, and also the elasticity of the elasticity of the derived demand curve, F^u. From this, it can be shown that for linear demand, there is less than perfect pass-through of a reduction in the tariff on the imported agricultural commodity, $(\partial p^d / \partial p^u . \partial p^u / \partial p^a) < 1$, under generalized-Cournot competition at both stages of the marketing system, the case shown in the previous section of the paper.

Some Numerical Results

Using a specific numerical version of the model outlined, it is possible to simulate the

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[12] It is important to note an important connection here to Seade's (1985) work. Rather than using F^d, he uses the elasticity of the slope of demand, E=-Xp''/p', where F=1+η^d- $\eta^d E$. In Seade's work, a sufficient condition for profits to fall with a decline in the upstream price is E>2, so that 1-η^d>F^d.

potential impact market power in the downstream food sector has on the outcome of trade liberalization. In this exercise, the functional forms of the agricultural commodity supply function, and the downstream demand function, are both treated as linear, with the relevant price elasticities being set at $\eta^d = \varepsilon^a = 1.0$, each evaluated at the competitive equilibrium. In addition, downstream output and price are normalized at 1 for the no-tariff competitive equilibrium, and the share of revenue going to commodity exporters is set at 0.5. Given that the indices of oligopoly market power, $\gamma^u, \gamma^d \in [0,1]$, and likewise those for oligopsony power, $\lambda^u, \lambda^d \in [0,1]$, simulations can be conducted over the entire unit interval, however to ease graphical presentation of the results, equal departures from perfect competition for each sector are assumed, e.g., successive oligopsony and downstream oligopoly are always simulated as, $\lambda^u = \lambda^d = \gamma^d$. Five cases are considered that relate to alternative characterizations of market power embedded in figure 1. They are: (i) oligopsony only (ii) oligopoly only, (iii) both oligopoly and oligopsony, (iv) successive oligopsony and retailer oligopsony, and (v) successive oligopoly and processor oligopsony.[13]

Figure 2 depicts the absolute change in the raw commodity export price from removing a 20 percent specific tariff under alternative competition scenarios. As expected, reducing tariffs raises prices exporters receive but the extent of this is contingent on the characteristics of the downstream food sector. The simulations aptly illustrate that the effect on export prices 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. Figure 2 also shows that the price increase generated from trade liberalization is

[13] Complete details of this exercise can be found in Sexton, Sheldon, McCorriston, and Wang (2003). In a more recent paper, Sexton, Sheldon, McCorriston, and Wang (2006) use data on price elasticities and market shares for specific agricultural commodity sectors such as coffee and cocoa.

dissipated considerably by significant departures from competition, especially when they occur in multiple stages of the downstream market. As is readily observed from figure 2, when there is 'successive' market power, the effect on export prices is clearly greater than the impact of market power in a single stage.

The important question is the extent to which downstream market power vitiates the benefits to the developing economy of trade liberalization. This takes account not only of the price transmission effect but also the commensurate change in market access. 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 the export price and the change in output, downstream market power diminishing both. Figure 3 depicts the change in producer welfare from trade liberalization for alternative scenarios relating to vertical market structure. Again, the impact of market power is greater when it persists through both stages of the vertical chain.

Next consider the distribution of benefits from trade liberalization across producers, consumers, and firms involved in the processing and retailing stages depicted in figures 4 and 5. If the change in producer surplus is affected by characteristics of the downstream marketing system, so too will be the distribution of welfare changes among the two sectors downstream. By way of example, Figure 4 represents the case of upstream oligopsony and downstream oligopoly, while figure 5 represents successive oligopoly plus processor oligopsony. In the case of upstream oligopsony, producer and consumer welfare both decline monotonically in the degree of market power exercised while profits in the upstream sector rise monotonically. A similar outcome arises in the case where we add successive oligopoly, though profits in the downstream sector decline as the index of market power rises beyond a certain level since the negative externality imposed on upstream firms' profits when downstream firms increase their market power (and vice versa) dominates the higher profits earned by the downstream firms, causing overall marketing sector profits to fall for high levels of market power exercised at successive stages. Both figures 4 and 5 clearly demonstrate that the distributional effects of trade reform in a set-up that allows for 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.

Summary and Conclusions

The starting point for this paper was the observation that research on trade policy issues related to imported agricultural commodities usually considers the commodity market in isolation from the downstream stages of the vertical marketing chain into which the raw commodity enters. Given that the downstream stages can be typically characterized as imperfectly competitive, this has important implications for how to think about current policy issues. Specifically, it can be shown that the effects on exporters following trade liberalization and increased market access will likely be dependent on the nature of competition in these downstream stages. As such, removing trade barriers on their own may not be sufficient to either guarantee high levels of market access to developed country markets for developing country exporters, with subsequent implications for the likely welfare effects of trade policy reform. In particular, the possibility of imperfect pass-through of reductions in tariffs on raw agricultural commodities due to imperfect competition downstream means that distribution of the benefits from trade liberalization will differ quite markedly from the competitive model.

At this point it is useful to consider how the formal model outlined above might usefully be extended. First, it might reasonably be argued that the model is restrictive in terms of its assumption of a simple fixed proportions technology.[14] For example, McCorriston *et al*. (1998) have developed a model that allows for both imperfect competition downstream, and also a variable proportions technology in the downstream sector. Interestingly, though, their analysis shows that the marginal impact on pass-through of upstream price changes of increasing the elasticity of substitution in a variable-proportions technology is significantly diminished as the downstream sector becomes less competitive.

Second, the downstream technology is assumed to be one where there are constant marginal costs, yet industries that can be characterized as imperfectly competitive may also have technologies that exhibit increasing returns. As McCorriston *et al*. (2001) show, increasing returns in the downstream sector will tend to offset the effects of imperfect competition downstream on pass-through.

Third, while successive oligopsony is incorporated into the model underlying the numerical simulation reported in the previous section, it is based upon the assumption of a linear inverse agricultural supply function, resulting in less than perfect pass-through of changes in the agricultural commodity price. However, Weldegebriel (2004) in a more extensive analysis of oligopsony shows that in the case of upstream and downstream oligopsony, pass-through is very sensitive to convexity of the agricultural commodity supply function.

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[14] Sexton has noted elsewhere that studies appealing to a variable-proportions technology typically use very aggregate data, e.g., Reed and Clark (2000), where substitution relates to allocation of an agricultural commodity among several end uses, causing him to question whether this approach is actually a very relevant way to define either product markets or technology.

This leads to an important overall caveat concerning any discussion of the role of imperfect competition in affecting agricultural commodity price transmission: it is very sensitive to what assumptions are made about the commodity supply and downstream demand functions, as well as the downstream cost function. In other words, it is one thing to show theoretically that under certain conditions, imperfect competition downstream can cause less than complete pass-through of upstream commodity price changes, it is another to infer the existence of imperfect competition downstream from econometric estimates of price transmission if nothing is known about the upstream commodity supply function and the downstream cost and demand functions.

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Figure 1: Trade Liberalization and the Vertical Marketing Chain

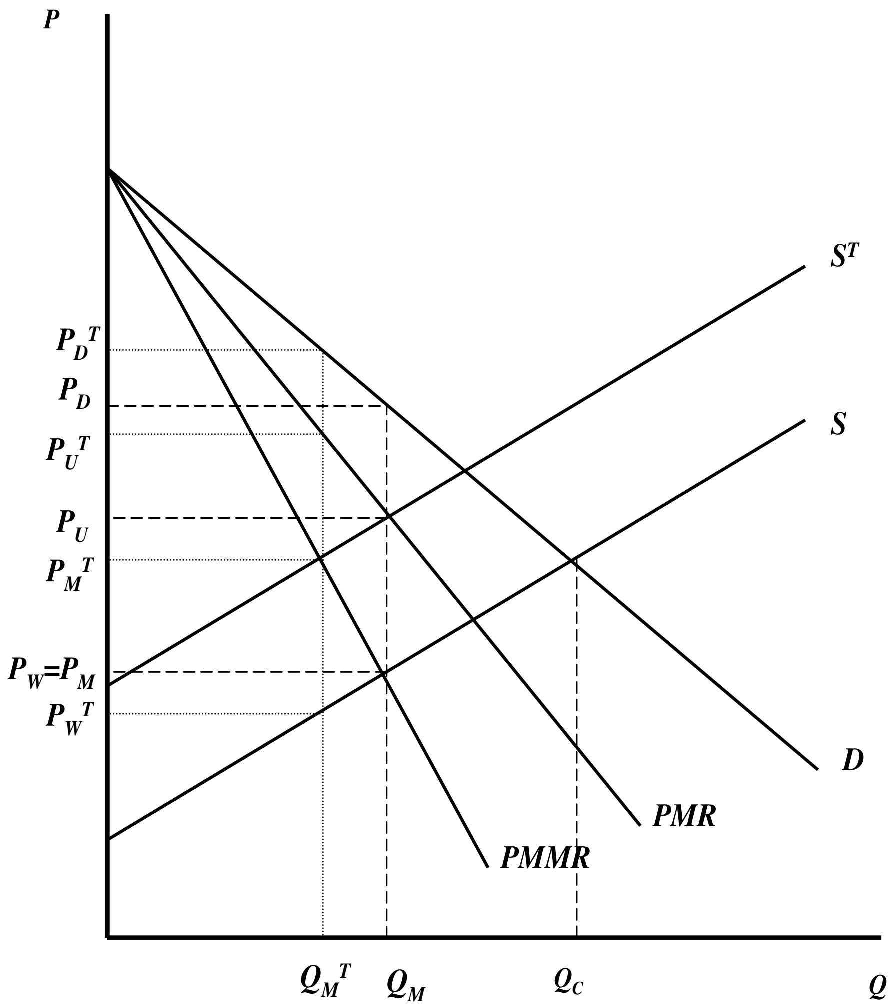

Figure 2: Change in Export Price from Trade Liberalization

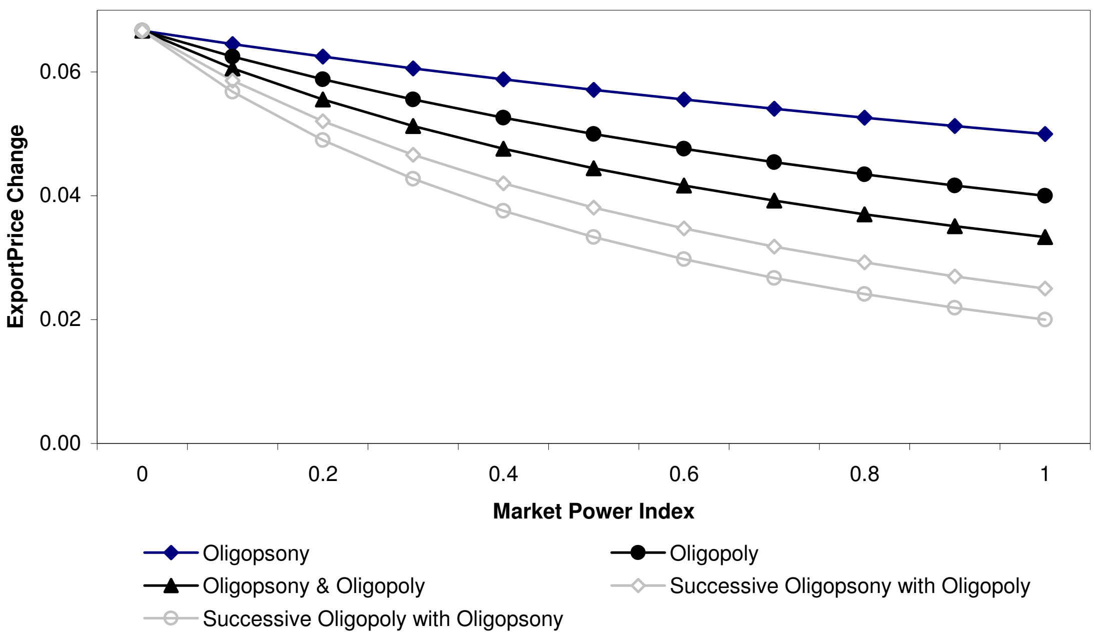

Figure 3: Change in Producer Surplus from Trade Liberalization

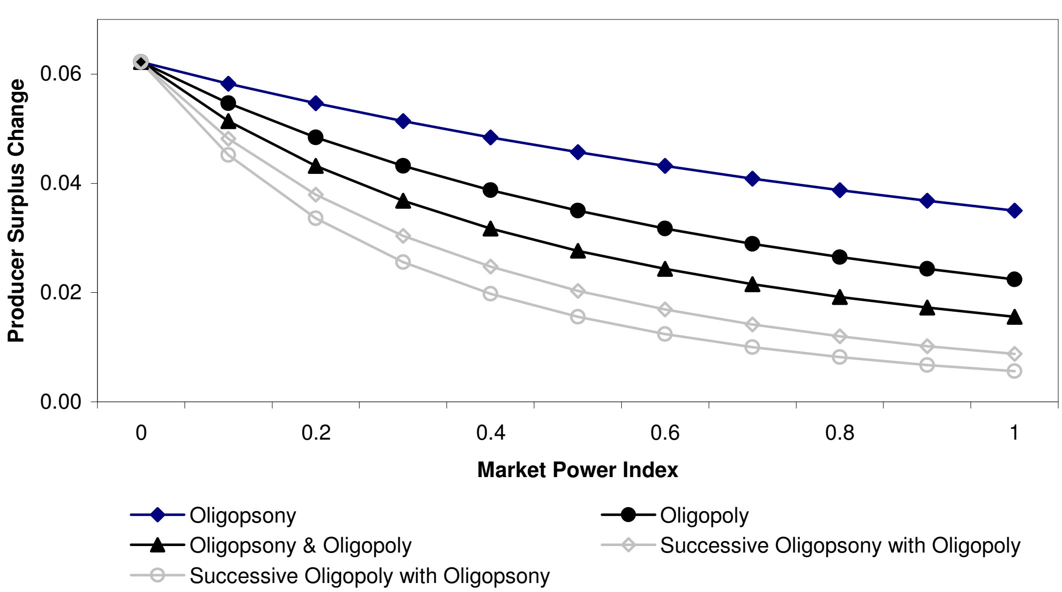

Figure 4: Change in Producer Surplus, Consumer Surplus and Marketers' Profits from Trade Liberalization for the Case of Processor Oligopsony and Retail Oligopoly

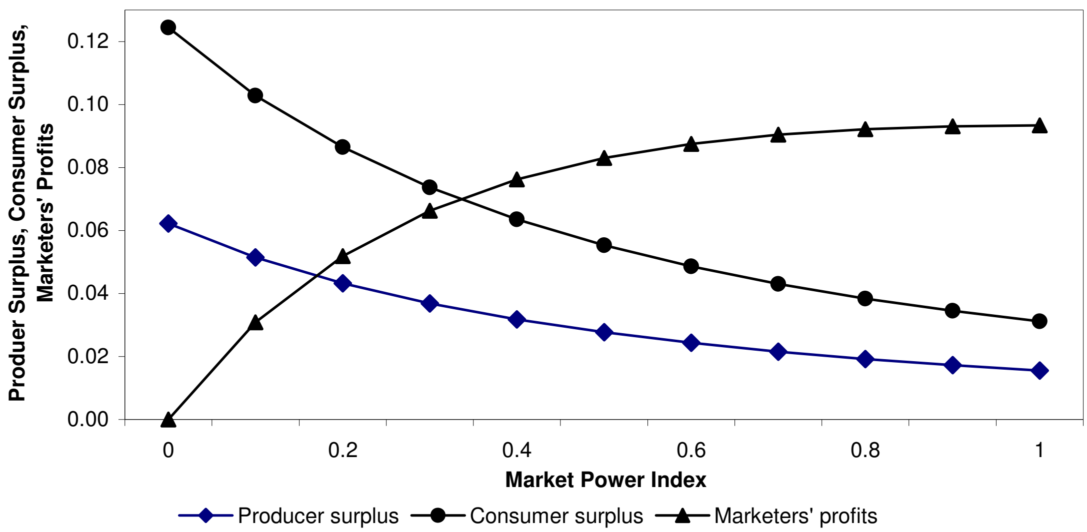

Figure 5: Change in Producer Surplus, Consumer Surplus and Marketers' Profits from Trade Liberalization for the case of Successive Oligopoly with Processor Oligopsony