Analyzing Vertical Market Structure and Its Implications for Trade Liberalization

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Introduction

- Doha Round of WTO is a “development round”, focus on increasing less developed country (LDC) access to developed country (DC) markets
- Little attention paid to food marketing system in DCs in analyzing commodity exports of LDCs:
  - Vertical/horizontal structure
  - Increasing consolidation
- Who captures benefits of tariff reduction when downstream markets are less than perfectly competitive?

Globalization and Market Access

- **Broad popular concern about increasing concentration of global food system - harms LDC exporters of commodities (Oxfam, 2001)**

  <u>Example</u>: African countries such as Ethiopia and Uganda highly dependent on coffee exports, but have faced decline in real prices

  Key export markets in EU and US where buyers/roasters/retailers account for 60% of retail sales (Oxfam, 2001)

- **Response has been advice to diversify into processing and adding value (UNCTAD, 2002)**

Globalization and Market Access

- **Will trade reform actually help smallholder farmers in LDCs benefit from globalization?**
- **Development agencies such as World Bank, and NGOs believe removal of trade distorting agricultural policies will be a "catalyst for poverty reduction" (Oxfam, 2003)**
- **In some cases, argued LDCs will not benefit from globalization, e.g., Mozambique exports of raw cashew nuts - "cause célèbre" of anti-globalization movement (McMillan, Rodrik and Welch, 2002)**

Mozambique and Cashew Nuts

- **Early-1990s, Mozambique removed export taxes on cashews on advice from World Bank**
- **Farmers' incomes forecast to increase US$ 17-28 million in first two years of reform (World Bank, 1995)**
- **Actual gains to farmers found to be only US$ 5 million (McMillan, *et al*., 2002)**
- **Estimates of benefits by World Bank ignored structure of downstream cashew nut processing sector – buyers have *monopsony* power**

Structure of Food Marketing in Developed Countries

- **Food *manufacturing* concentrated in EU (average CR3 - 67%, Cotterill, 1999), and US (average CR4 - 56%, GAO, 2009)**
- **Food *retailing* concentrated at national level in EU (average CR5 - 65%, Cotterill, 1999), and at local level in US (average CR4 - 79%, Nielsen, 2006)**
- **Increasing domestic consolidation via mergers and acquisitions (McCorriston, Sexton and Sheldon, 2004), and internationalization (UNCTAD, 2002)**
- **Structure of *successive oligopoly/oligopsony***

Trade Liberalization and Industry Consolidation in Vertical Markets

- Most studies treat agricultural/food sector as single competitive stage (Messerlin, 2001)
- If markets were competitive, ignoring vertical market structure would not matter
- With imperfect competition, incidence of benefits of trade liberalization is important (Figure 1)
- Increasing consolidation in food marketing also affects share of value added received by LDC exporters (Figure 2)

Figure 1: Trade Liberalization and Vertical Markets

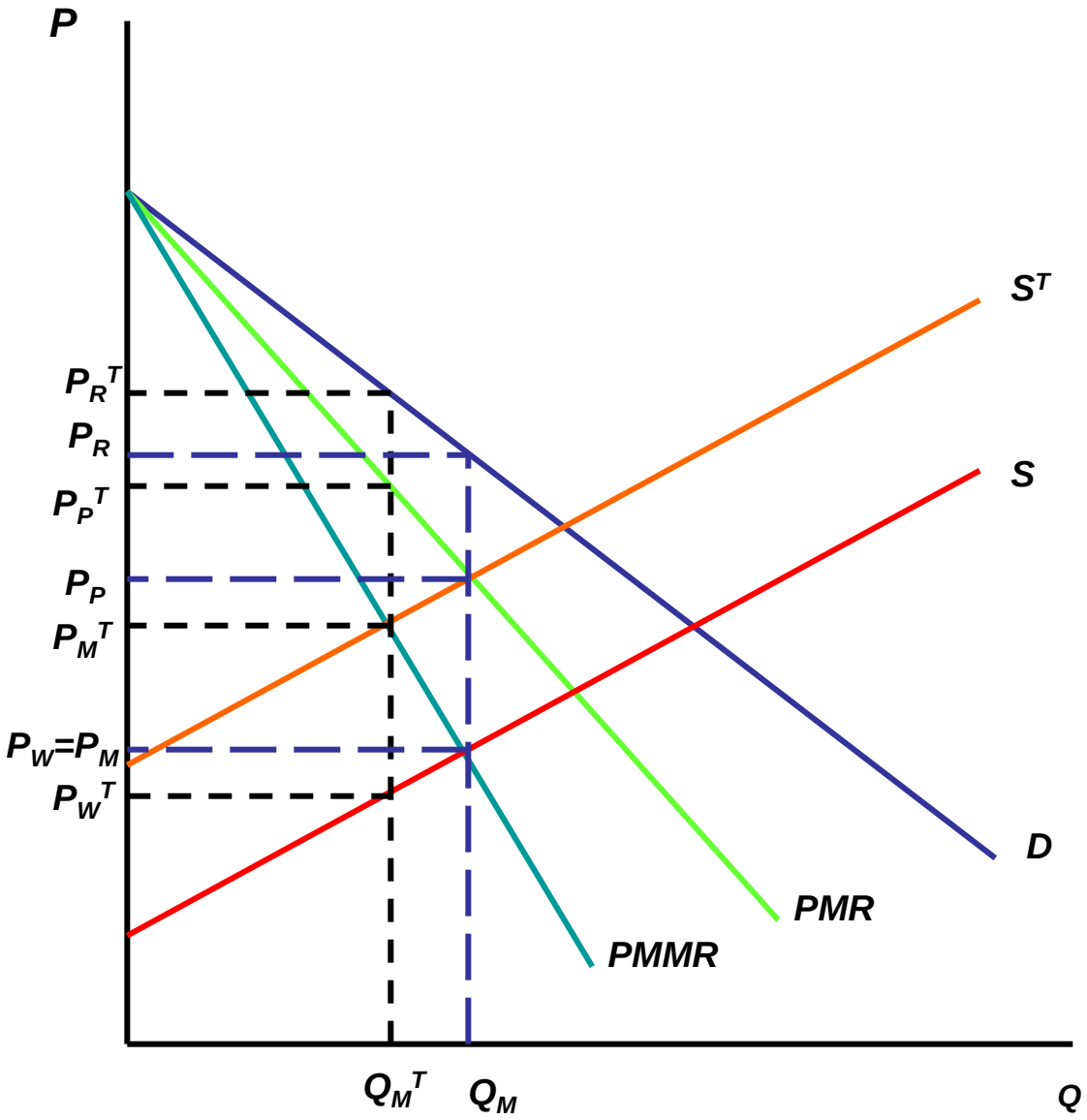
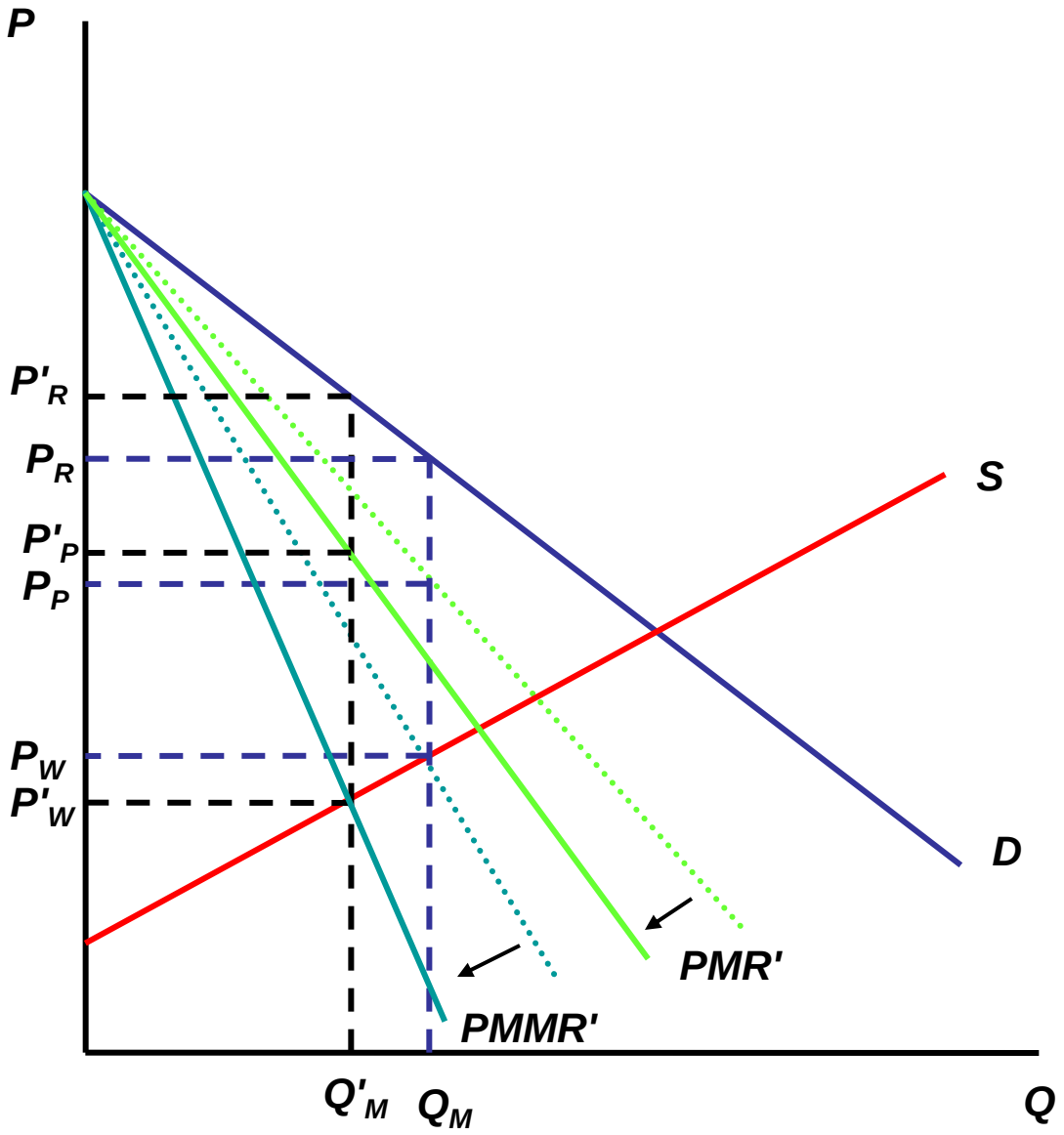


Figure 2: Increased Concentration in Vertical Markets



Trade Liberalization and Market Structure

- Vertical markets captured in policy models, e.g., Sheldon, Pick, and McCorriston (2001)
- Use vertical market model to simulate trade liberalization (Sexton and Zhang, 2001)
- Fixed proportions and constant returns technology in processing and retailing
- Linear farm supply and consumer demand
- Competition in processing/retailing captured through *conjectural elasticity* approach

Model: Inverse Supply and Demand Functions

- **Agricultural product (coffee) exported from LDC, processed and sold in DC which has processing and retailing sectors that may have market power**

(1) $P^r = D(Q^r,| X)$ – importer inverse excess demand

where Q^r is quantity and P^r is price at retail, and X are unspecified demand shifters

(2) $P^f = S(Q^f| Y)$ - exporter inverse excess supply

where P^f is farm-level price, Q^f is farm level supply and Y are unspecified supply shifters, and raw farm product subject to per-unit *import tariff* of T

Model: Technology

- Quasi-fixed proportions in processing and retailing, i.e., no substitution between farm and other inputs

  Allow substitution between other processing/retailing inputs, e.g., labor and energy; retailer costs for product separable from other products sold at retail

- Through choice of measurement units set $Q^r = Q^w = Q^f = Q$ – focus solely on impact of concentration on competition, ignoring any cost-side effects

- Assume constant returns in processing and retailing – simplifies analysis, but ignores possibility of gains from trade liberalization due to economies of scale

Model: Cost Functions

- **Assume processing and retailing firms are identical, i.e., work with *representative* processor and retailer:**

(3) $C^w = c^w(V^w)q^f + (P^f + T)q^f$ - processor cost function

q^f is volume of raw input, $c^w(V^w)$ are constant per unit processing costs, V^w is vector of prices for variable processing inputs, P^f is price of raw input

(4) $C^r = c^r(V^r)q^w + P^w q^w$ - retailer cost function

q^w is volume of wholesale input, $c^r(V^r)$ are constant per unit retailing costs, V^r is vector of prices for variable retailing inputs, P^w is wholesale price

Model: Objective

- **Derive implications of various combinations of market power in processing and/or retailing sector**

Focus on *total surplus*, and *distribution* of surplus among *consumers*, *farmers* and *marketers* (processors and retailers)

- **Assume price-taking behavior by LDC farmers, and DC consumers**

- **Simplify notation by dropping further reference to exogenous variables: X (retail demand shifters), Y (farm supply shifters), V^w (processing input prices) and V^r (retailing costs)**

Model: Oligopsony/Oligopoly Power

- Given model structure, results identical regardless of whether given degree of market power exercised by processors or by retailers

- For convenience assume processor market power/ retailer perfect competition, retail price being $P^r=P^w+c^r$

- Profits of representative processor are:

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

$q = q^w = q^f$ is level of wholesale output/volume of raw input purchases, first-order condition being:

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

Model: Processor Optimization Condition

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

$\varepsilon^f = \dfrac{\partial Q^f}{\partial P^f}\dfrac{P^f}{Q^f}$ — price elasticity of farm supply

$\eta_1^w = -\dfrac{\partial Q^w}{\partial P^w}\dfrac{P^w}{Q^w}$ — price elasticity of derived demand for processed goods

$\theta^f = \dfrac{\partial Q^f}{\partial q}\dfrac{q}{Q^f}, \quad [\theta^f \in 0,1]$ — processor *oligopsony* power

$\xi^w = \dfrac{\partial Q^w}{\partial q}\dfrac{q}{Q^w}, [\xi^w \in 0,1]$ — processor *oligopoly* power

θ^f (ξ^w) interpreted as *conjectural elasticity*, identical across all firms – (6') along with (1) and (2) yield equilibrium values of P^r, P^w, P^f, and Q

Model: Successive Oligopoly

- Processors/retailers exercise oligopoly power, and processors may exercise oligopsony power

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

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

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

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

- Three market power parameters: ξ^r, ξ^w, and θ^f, [0,1], $\eta_1^w \neq \eta_2^w$, (1), (2), (8) and (10) define equilibrium, and can be solved for P^f, P^w, P^r and Q

Model: Successive Oligopsony

- **Processors/retailers exercise oligopsony power, and retailers may exercise oligopoly power**

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

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

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

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

- **Three market parameters: ξ^r, θ^w, and θ^f, [0,1], equilibrium being defined by (1), (2), (12) and (14)**

Model: Linear Simulation

- Assume linear retail and farm supply functions:

(1′) $$Q^r = a - \alpha P^r$$

(2′) $$P^f = b + \beta Q^f$$

- Normalize at no-tariff competitive equilibrium:

$$Q_c = 1, P_c^r = 1$$

$$P_c^w = 1 - c^r, P^f = 1 - c^r - c^w = f$$

where f is farmers' revenue share, and:

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

and including a per-unit tariff T on raw input:

(2′′) $$P^f + T = b + \beta Q^f + T$$

Case 1: Oligopsony/Oligopoly Power

- Develop case of processor market power/retailer perfect competition, retail price being $P^r=P^w+c^r$, solve (1'), (2'') and (6') simultaneously for linear case:

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

where $\Omega_1 = (1+\xi^w) + (1+\theta^f)\alpha\beta = (1+\xi^w) + (1+\theta^f) f\eta_c^r / \varepsilon_c^f$

Ω_1 measuring total distortion due to processor market power, $Q_1 < 1 = Q_c$ whenever θ^f or $\xi^w > 0$

Case 1: Equilibrium

- **Firms with oligopoly power face perceived marginal revenue (PMR), and with oligopsony power also face perceived marginal factor cost (PMC)**

In Figure 3, equilibrium Q_1 where $PMR^w = PMC^w$, total surplus being:

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

$$PS_1 = \int_{b}^{P_1^f} \frac{P - b}{\beta} dP = \frac{(P_1^f - b)^2}{2\beta}$$

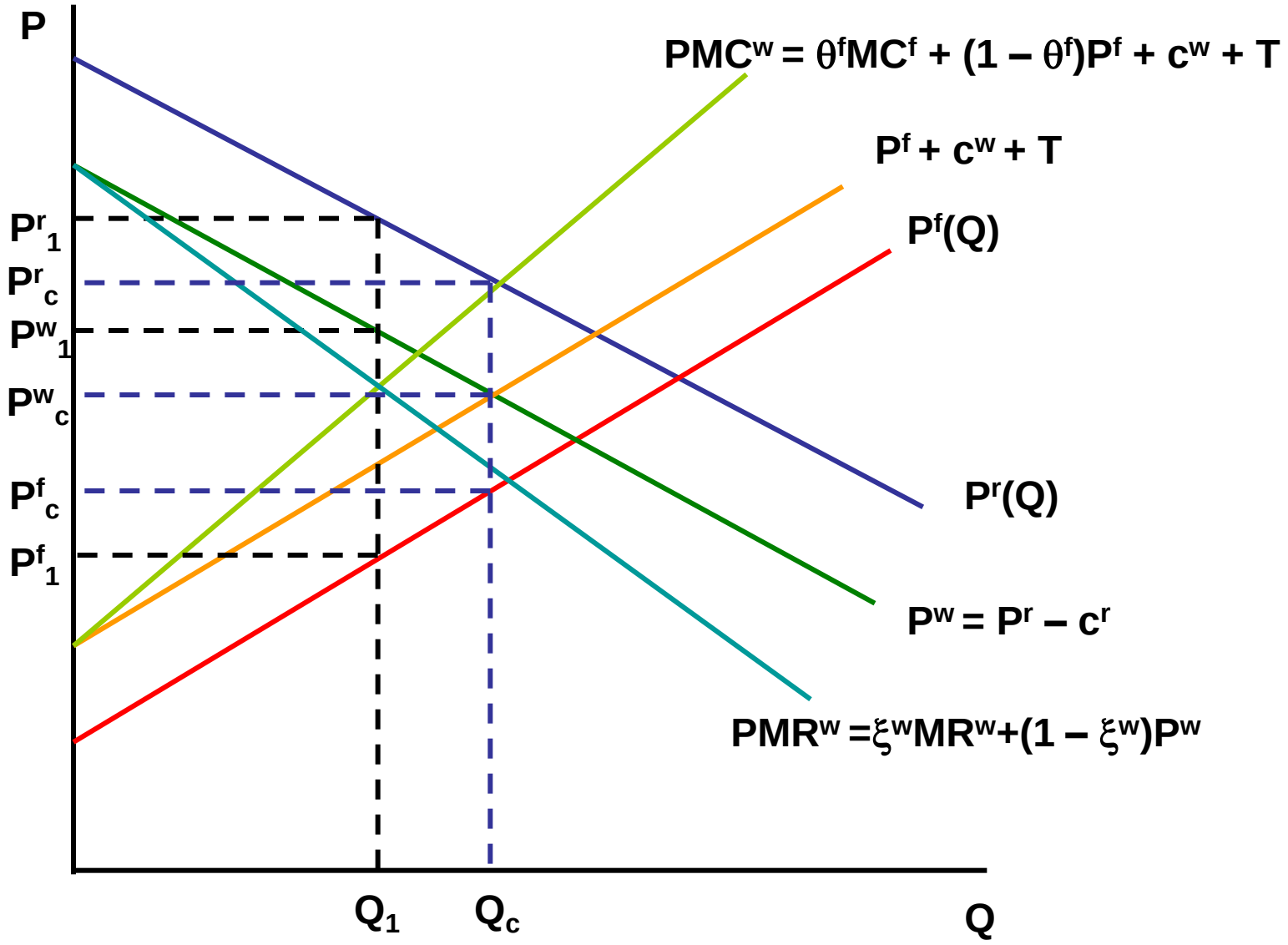
$$\pi_1 = \pi_1^w + \pi_1^r = \left[P_1^r - P_1^f - 1 + f - T \right] Q_1, \quad R_1 = TQ_1$$

$$ES_1 = CS_1 + PS_1 + P_1 + R_1$$

and if $\xi^w = \theta^f = 0$, Q_c is competitive equilibrium, and $\pi_c = 0$

Six key parameters: $\xi^w, \theta^f, \eta_c^r, \varepsilon_c^f, f, T$

Figure 3: Processor Oligopoly/Oligopsony



Case 2: Successive Oligopoly

- Develop case of processor/retailer market power, and solve (1'), (2''), (8), and (10) simultaneously for linear case:

$$(17)\qquad Q_2 = \frac{1+\alpha(\beta - T)}{\Omega_2},\ P_2^w = b + \beta Q_2 + c^w,$$

$$P_2^r = \frac{a - Q_2}{\alpha},\ P_2^f = b + \beta Q_2$$

where:

$$\Omega_2 = (1+\xi^r)(1+\xi^w) + (1+\theta^f)\alpha\beta = (1+\xi^r)(1+\xi^w) + (1+\theta^f) f\eta_c^r / \varepsilon_c^f$$

Ω_2 measuring total distortion due to successive oligopoly and processor oligopsony

Case 2: Equilibrium

- **Processor and retailer in successive oligopoly each face perceived marginal revenue (PMR^w) and (PM^r)**

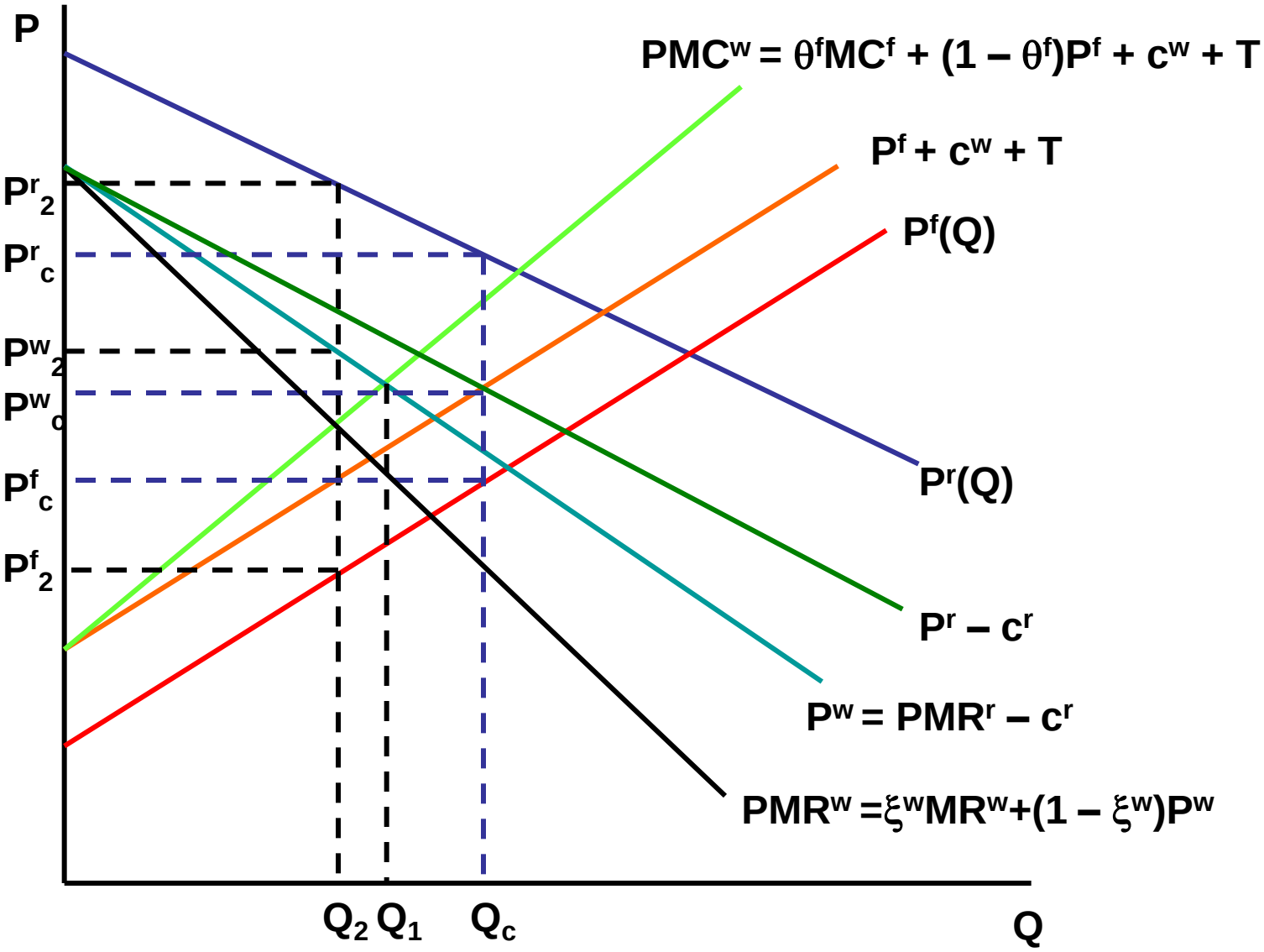
Processor with oligopsony power also faces perceived marginal factor cost (PMC^w)

In Figure 4, equilibrium Q_2 where $PMR^w = PMC^w$

Reduction in output from Q_1 to Q_2 being result of incremental distortion due to successive oligopoly

Seven key parameters: $\xi^r, \xi^w, \theta^f, \eta_c^r, \varepsilon_c^f, f, T$

Figure 4: Successive Oligopoly/Processor Oligopsony



Model Calibration

- Key market power parameters are ξ^r, ξ^w, θ^f, and θ^w – as these lie in range 0 to 1, simulate over unit interval

- Consider equal departures from competition, e.g., in case of successive oligopsony and retailer oligopoly, $\theta^f = \theta^w = \xi^r$

- Farm share of revenue under no tariff competitive equilibrium set at f = 0.5 – when f is small, diminishes impact of oligopsony

- Per-unit tariff at competitive equilibrium set at T=0.2

- Price elasticity of farm supply and retail demand evaluated at no-tariff competitive equilibrium, $\varepsilon^f_c = \eta^r_c = 1$, which, given f = 0.5, implies that $\varepsilon^w_c = 2.0$

Market Power Parameters

- Most empirical estimates indicate rather modest departures from perfect competition – point estimates falling in range 0.25 or less (Sheldon and Sperling, 2003)

- Bhuyan and Lopez (1997) found considerably higher values in some industries in their sample

- Given consolidation in sector, past studies may under-estimate degree of market power being exercised

- Sexton (2000) argues limitations of empirical literature probably understate degree of market power – analysis of too broad markets, and failure to account for upstream/downstream market power

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

Simulation Results

- **Downstream oligopoly always more damaging to farmers than oligopsony as it affects entire final product (Figure 6)**
- **Market power has small efficiency effects at modest levels of market power, but effects increase with large departures from competition (Figure 7)**
- **Large distributional effects even for modest departures from perfect competition (Figure 8)**
- **Increase in farm price/producer surplus due to trade liberalization is a decreasing function of downstream market power (Figures 9 and 10)**
- **Distributional effects of trade liberalization are dramatic (Figures 11 and 12)**

Figure 6: Effect of Market Power on Producer Welfare

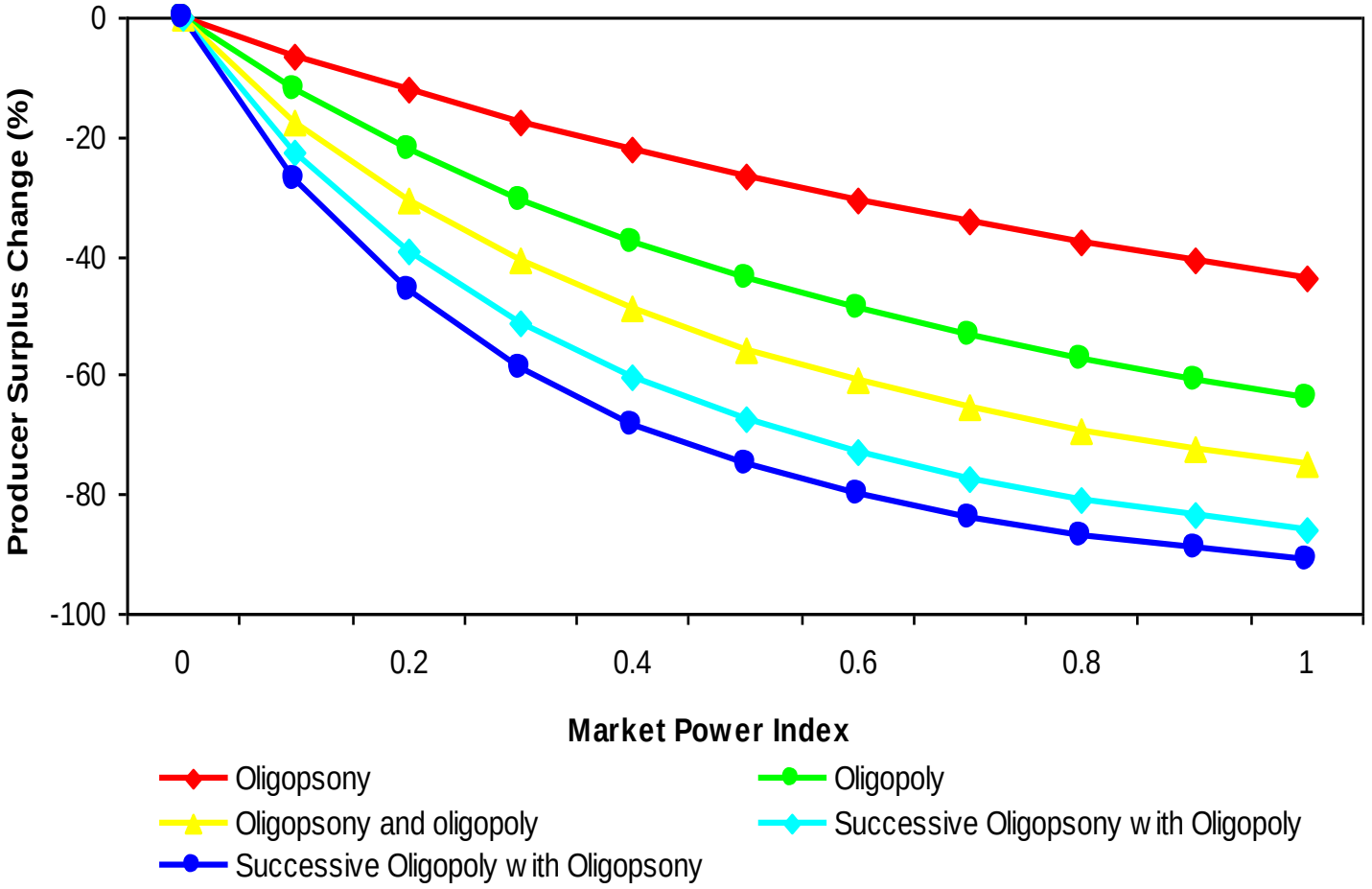


Figure 7: Effect of Market Power on Total Welfare

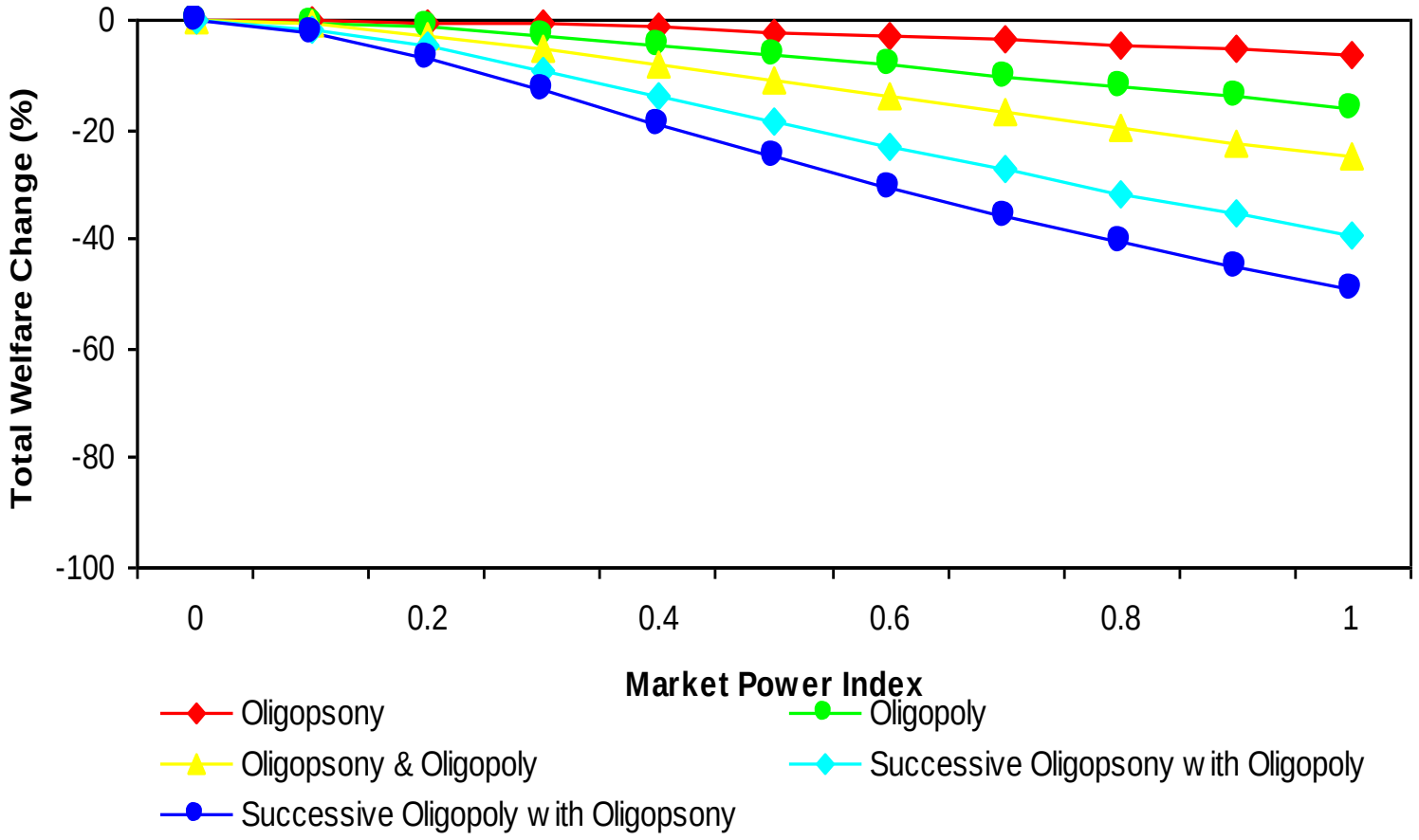


Figure 8: Effect of Market Power on Distribution of Welfare - Processor Oligopsony and Retail Oligopoly

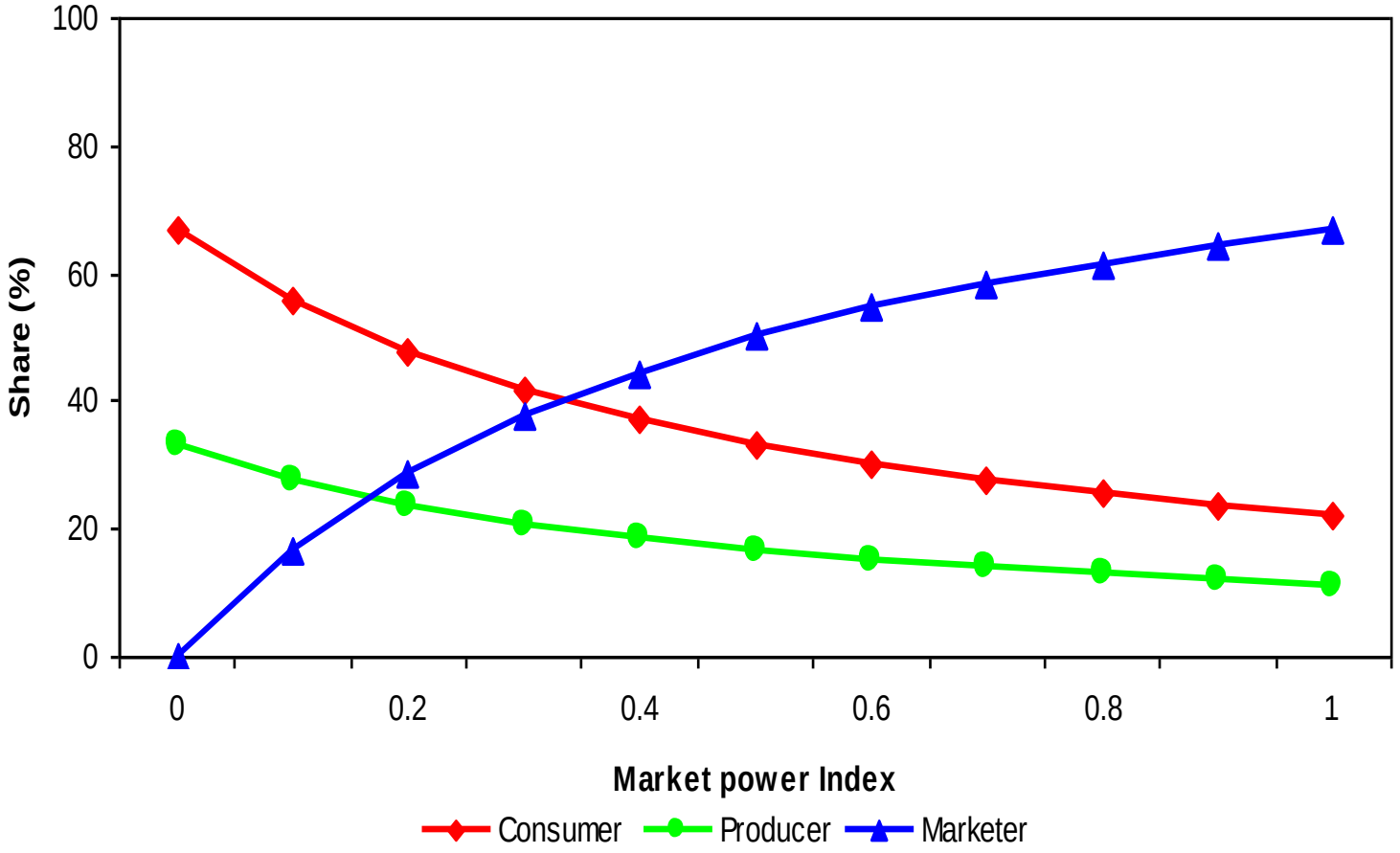


Figure 9: Change in Farm Price from Trade Liberalization

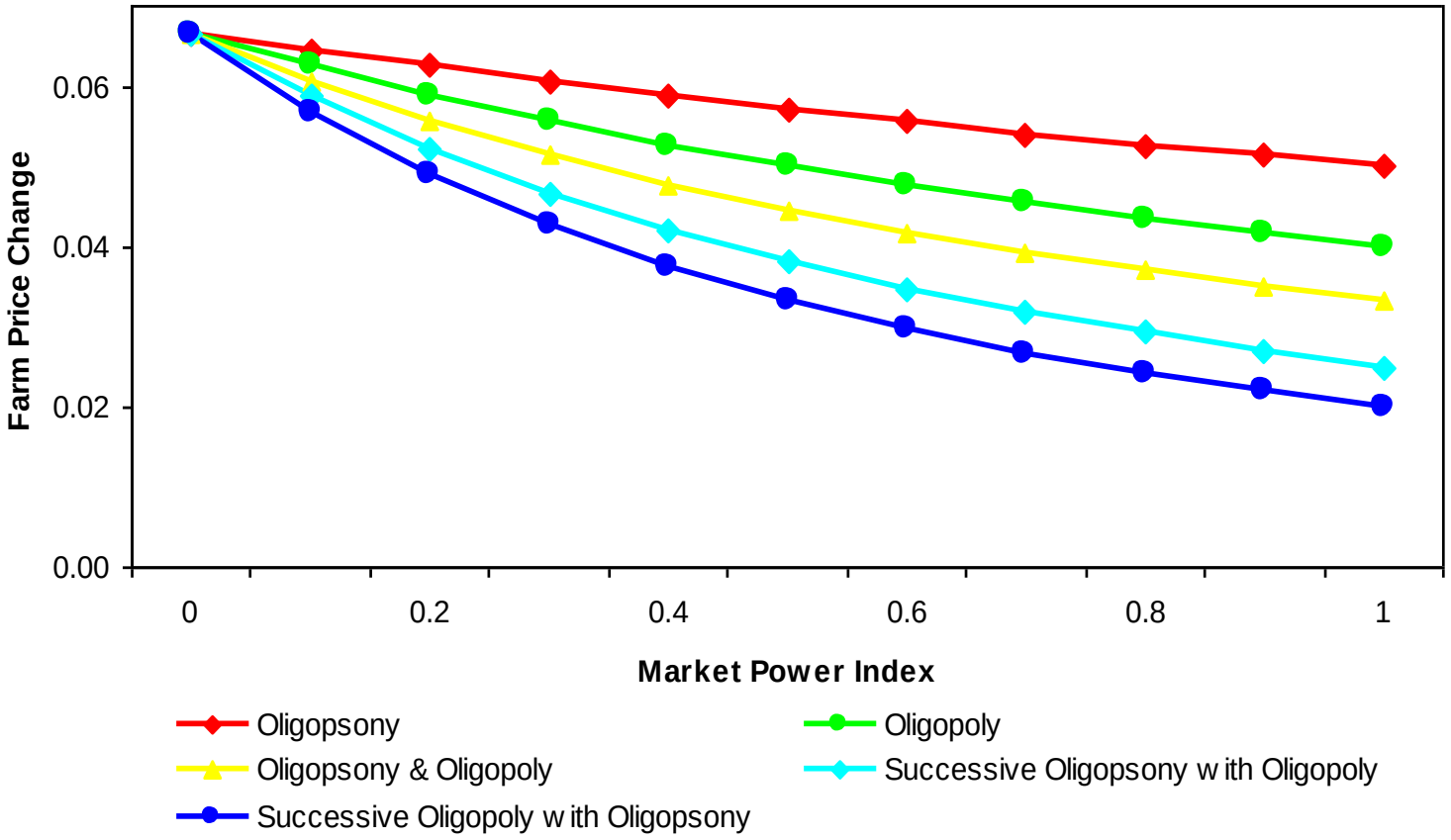


Figure 10: Change in Producer Surplus from Trade Liberalization

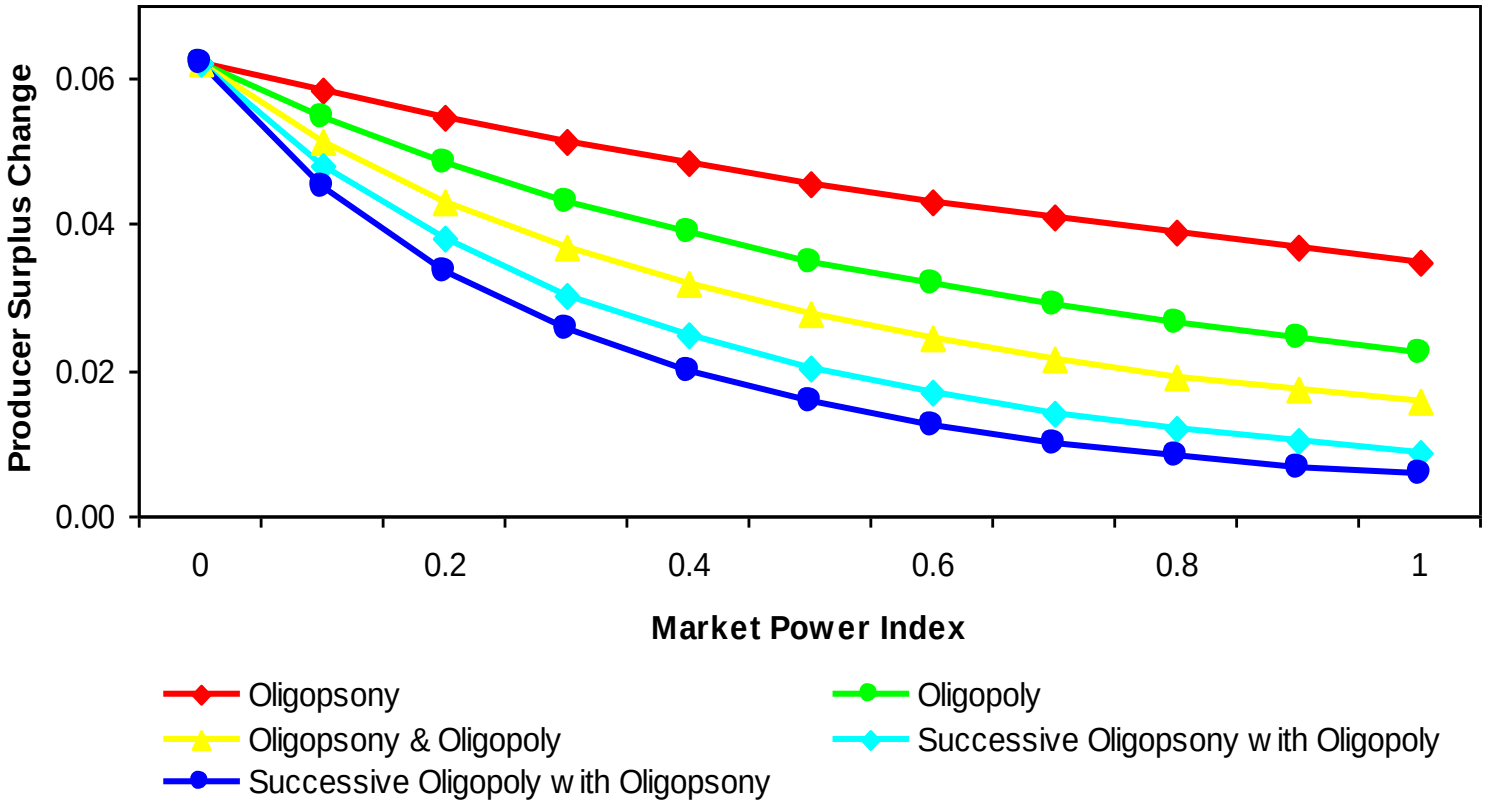


Figure 11: Change in Producer Surplus, Consumer Surplus and Marketers' Profits from Trade Liberalization for Case of Processor Oligopsony and Retail Oligopoly

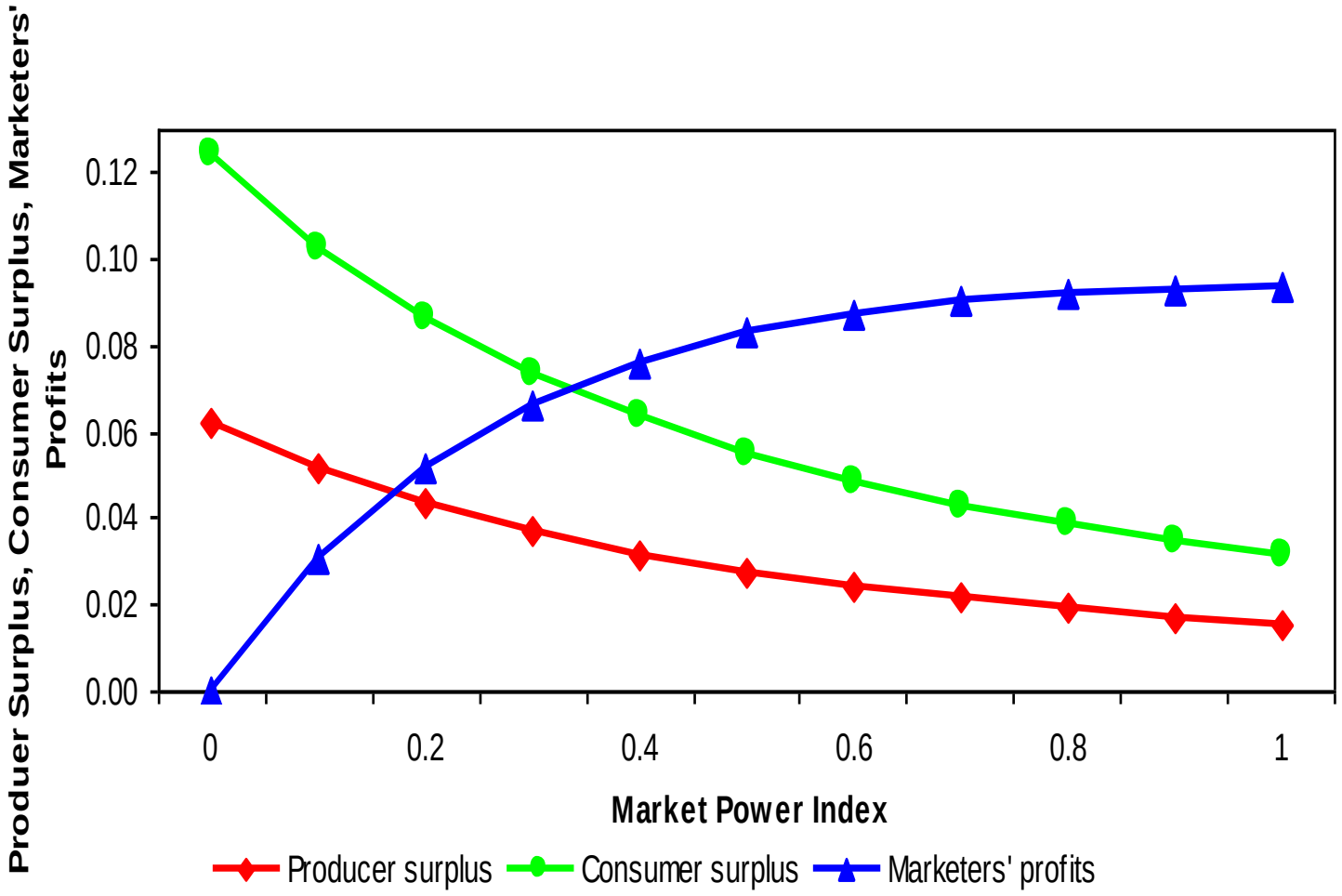
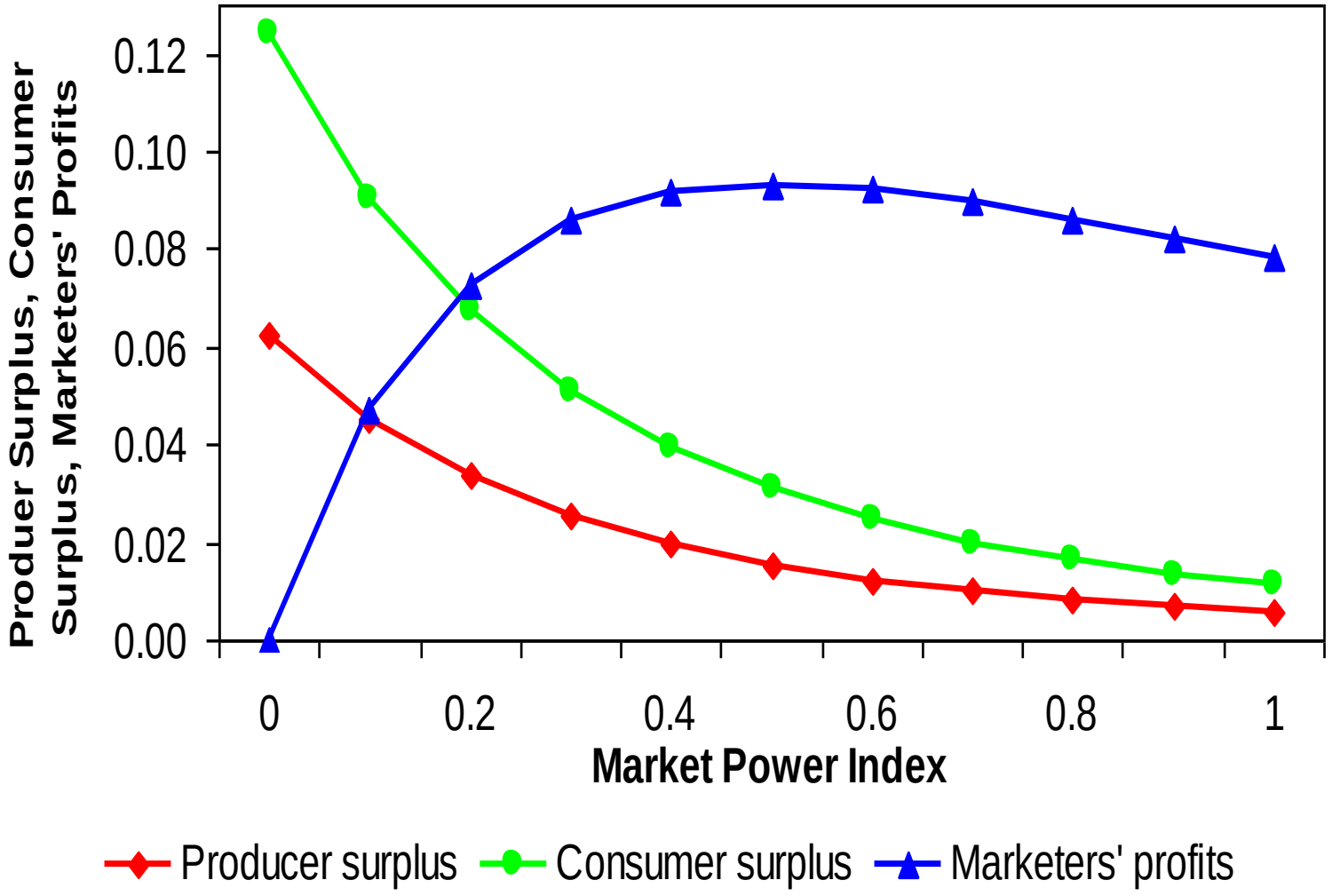


Figure 12: Change in Producer Surplus, Consumer Surplus and Marketers' Profits from Trade Liberalization for Case of Successive Oligopoly with Processor Oligopsony



What Does Analysis Miss?

- **Domestic farm sector ignored in DCs**
- **Tariffs are usually *ad valorem* not *per unit* – results in rotation rather than shift in farm supply curve**
- **Explicit analysis of tariff escalation required, i.e., tariffs levied on both raw and processed coffee**
- **Rich nature of vertical structures, e.g., vertical restraints such as slotting allowances and retail price maintenance**

Conclusions

- **Structure of food marketing system in DCs matters for who gains from trade liberalization**
- **Increasing consolidation in food marketing system may reduce share of consumer's "food dollar" going to LDC exporters**
- **LDC exporters may gain as much from vertical integration into value-adding activities as from trade liberalization**