Bitter Chocolate: The Market Structure and Tariff Escalation that Prevents Fair Trade from being Free*

The life and times of cocoa and chocolate

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Abstract

This paper develops a two-firm model illustrating the connection between the cocoa market and the chocolate market due to their dependency in the chocolate value-chain. The model shows how differing market structures and an application of a downstream tariff can be detrimental to cocoa producers. A duopoly and a tariff in the chocolate market constrains the quantity of cocoa demanded. However, due to the dependancy of the markets, a duopoly in the chocolate market translates into an oligopsony in the cocoa market. The oligopsony in the cocoa market constrains the price of cocoa. Tariff escalation is explored as a cause of the concentration in chocolate producers and the solution of removing the effective rate of protection is discussed.

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There can be no doubt that without cocoa, there is no such thing as chocolate. Why, then, do cocoa farmers on average only have access to less than a tenth of the final value of chocolate [Haque, 2004]? In order to be legally defined as chocolate in the European Union (EU); dark, milk and couverture chocolate must each contain a minimum of 43%, 30% and 16% of cocoa solids respectively [European Parliament, Council, 2000], so notwithstanding the definitional importance of cocoa in chocolate, the percentage of the chocolate price that goes to cocoa is smaller than the percentage of the final product of which it consists.

This paper will illustrate how the market structure of the chocolate market is an important factor suppressing the relative value of cocoa compared to chocolate. The key purpose of this paper is to highlight the importance of reducing trade barriers in order to induce entry into the chocolate market. However, the type of trade barrier that is being considered is specifically tariff escalation along the value chain for chocolate. This is due to the effect that tariff escalation has on the suppression of firm entry in the chocolate market of the largest chocolate consuming nations.

Many of the studies concerning the connection between the cocoa and the chocolate market have been specifically focussed on fair trade case studies. The rationale for fair trade and paying the fair trade price for cocoa is that cocoa farmers are frequently exploited by middlemen and not given an opportunity to add value to their product [Richardson et al, 2007]. This is largely due to a lack of access to financing opportunities, physical distance from the end (consumer) market and imperfect information [Richardson et al, 2007]. In particular, the success of the Day Chocolate Company in its operations as a fair trade chocolate company has been extensively discussed in much of the literature [Tiffen, 2002] [Twin, 2008]. These case studies have emphasized the importance of a strong farmer cooperative that can manage their own interests [Doherty et al, 2005].

The company sets prices according to the Fairtrade minimum price with the addition of a premium for the process of social infrastructure development [Doherty et al, 2005]. Fair prices are based on the benevolency of the purchasing company and the strength and initiative of the farmer cooperative [Tiffen, 2002] in the country and not prevailing market conditions. This paper aims to show how a price increase can be achieved by altering the prevailing market conditions and thereby achieving a sustainable fair price for cocoa. The fair price is sustainable in that it is reached through market mechanisms and can be more generally applied, as opposed to the voluntary application by ethical chocolate producers.

The relationship between international trade and industrial organisation has been dealt with extensively in the literature. Large multinational corporations that exhibit a substantial degree of market power are considered to be the dominant actors in international trade [Fieldhouse, 2000]. Market structure has often been used as motivation for engag-

ing in trade. Ohlin (1933) introduced the idea of increasing returns as a motivation for firms engaging in international trade with a formal model of this phenomenon being developed by later authors and synthesised with the model of comparative advantage to create the theory of intra-industry trade [Krugman, 1983]. However, the impact of this market concentration on the input market for the good is not considered.

Similarly, there are vasts swathes of literature concerning tariff escalation. This is when the import duties on processed products are higher than the import duties on their inputs [Nassar et al, 2007]. The result is that foreign firms do not perceive the benefit of manufacturing value-added goods. This creates a greater incentive to export commodities (if the country produces the commodity) rather than processed goods. This means that chocolate is effectively protected to a larger extent than can be considered at face value. Tariff escalation also occurs when a blanket reduction in tariffs on unprocessed goods is introduced in the guise of trade liberalisation.

In order to measure the actual level of protection, the effective rate of protection (ERP) needs to be calculated. This will incorporate the protection at each level of processing and demonstrate how this method of tariff application distorts incentives [Nassar et al, 2007]. The ERP is related to the difference between the tariff on the processed and the tariff on the unprocessed good, while accounting for the value-added from processing. It is important to note that while tariff escalation does indicate effective protection of value-added production; it is not the only way of doing so [Chevassus-Lozza et al, 2003]. Applying the same tariff on successive goods in a value chain, where the unprocessed good has a higher elasticity of demand, has the same effect as tariff escalation where the demand elasticities are the same [Chevassus-Lozza et al, 2003].

In the next section of the paper some characteristics of the cocoa-chocolate value-chain will be discussed. Stylised facts with respect to the different market structures and different tariff applications at successive levels of the value-chain will be analysed in this discussion. Once these facts are established, a model of the chocolate and cocoa markets will be built with the facts regarding market structure and tariff escalation imbedded within it. Thereafter, the model will be graphically illustrated and explained. The welfare implications of the structure of the markets is then explained, paying particular attention to the cocoa producer. Critical aspects of tariff escalation and its relationship with market structure is the final aspect that will be discussed before the paper is concluded.

Facts The chocolate and cocoa market are characterised by a few distinguishing features that make their relationship interesting to discuss and model. First, it is interesting to know what characterises a cocoa exporting country and what characterises a chocolate exporting country. Over 50% of the world's cocoa supply is supplied by Africa [UNCTAD, 2008]. The European Union (EU) chocolate consumption accounts for 49% of world chocolate consumption; whereas Africa, in contrast, accounts for 3% of world chocolate consumption [UNCTAD, 2008]. The structure of cocoa and cocoa product

exports from the five top cocoa exporters and the five top chocolate exporters is shown in the table below.

Table 1: Structure of chocolate-related exports from cocoa exporters and chocolate exporters in 2008

Top 5 Cocoa Exporters				
	Cocoa	Processed Cocoa	Industrial Chocolate	Consumer Chocolate
Ivory Coast	3193455.277	105130.056	272896.307	50250.744
Ghana	1794688.376	35.06	19.721	0.034
Indonesia	1014405.732	53535.108	22148.466	256.593
Nigeria	845258.81	2025.124	1383.582	-
Cameroon	763400.118	-	219.109	997.575
Top 5 Chocolate Exporters				
	Cocoa	Processed Cocoa	Industrial Chocolate	Consumer Chocolate
Belgium	318636.947	6052.006	869732.282	216379.4
Germany	16731	55980	290240	679349
France	5988.97	86325.278	190037.749	267332.366
Switzerland	1385.047	666.098	21056.233	309258.313
United States	0	25988.381	145293.607	66203.867

There is no overlap between the cocoa exporters and chocolate exporters. The cocoa producers consist of developing countries, whereas the chocolate producers are all developed countries. Cocoa can only be produced around a narrow band around the equator. This can attribute to why cocoa production is concentrated amongst developing countries. The concentration of chocolate production in developed countries can be attributed to the fact that chocolate consumption is concentrated to these economies [ICCO, 2007].

In pursuit of an export-led growth strategy, developing countries have expanded cocoa production, but the expanded production has not led to a substantial amount of economic growth [**?**]. This is partially due to stagnating cocoa prices [UNCTAD, 2008], which is illustrated in figure 1.

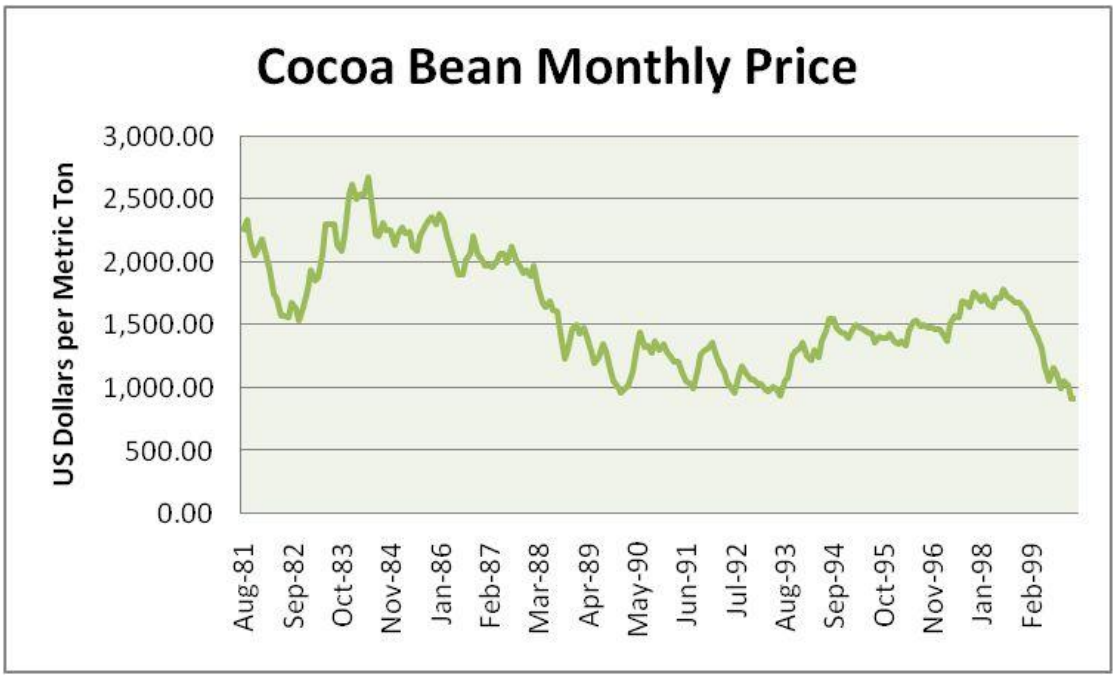

Figure 1: Cocoa prices between 1980 and 2000 [ICCO, 2011]

The 80s and 90s have been characterised by declining prices in the price of cocoa by an average of 0.25%, largely due to the escalating supply of cocoa as a result of the pursuit of export-led growth strategy of cocoa producers without the same escalation in the demand of cocoa. In the past decade prices have started to rapidly rise, with the exception occuring during the financial crisis [**?**]. However, this can be attributed to the political turmoil in the largest producer of cocoa, Côte d'Ivoire, which produces over 40% of the world cocoa production [UNCTAD, 2008]. While these rises in prices might seem to be beneficial to the residual cocoa producers, the prices of chocolate have risen correspondingly. However, the cocoa content in chocolate is priced at 10% of the price of chocolate, in spite of the absolute minimum cocoa content (in order to qualify as being defined as chocolate) of 16%. The implication is that the market itself is artificially depressing the cocoa price.

This paper argues that the market distortion is created by certain structural characteristics along the chocolate value chain. The argument is that differing market structures along the value chain can create distortions at other points on the value-chain. In table 2 below indicates the degree of market concentration at different levels of processing in the chocolate value chain.

Table 2: Market concentration along the chocolate value chain

	Top 5 Producers' Share of the Market
Cocoa	5-10%
Processed Cocoa	52%
Industrial (Couverture) Chocolate	80%
Consumer Chocolate	57%

Source:[UNCTAD, 2008]

Oligopsonies are considered to have a smaller negative impact than oligopolies would in consideration of mainstream industrial economics [Roger et al, 1994]. However, both imperfections stem from the utilisation of market power to maximise consumer surplus (for the oligopsonist) and to maximise net revenue (for the oligopoly) [Robinson, 1933]. The increased concentration further along in the level of processing shows that there is a greater degree of market power in the processed versions of cocoa. The demand for cocoa will be constrained not by the market imperfections within it's own market (there is little to no concentration in the cocoa market), but it can be constrained by the market imperfections further along the value chain. The duopoly in the chocolate market constrains the amount of chocolate demanded, which in turn constrains the amount of cocoa demanded (given that cocoa is a vital component in chocolate manufacture).

There are four reasons for the pervasive effect of the oligopsonies in the chocolate industry. First, supply of cocoa is relatively inelastic. Secondly, cocoa is mostly used to make chocolate (as opposed to other products). Cocoa is a bulky product to transport and, therefore it is expensive to transport. The final reason is, of course, the high level of market concentration on the chocolate producing end of the chain [Roger et al, 1994]. Producer concentration in the chocolate market can spill over into cocoa market by creating a concentration in cocoa buyers. The oligopsonist buyer is trying to maximise consumer surplus, but with full knowledge that competing buyers are attempting to do the same thing. Entrants on the cocoa consumption side are constrained by the scale economies on the chocolate production side.

In a perfectly competitive factor market, the buyer would take the price as given, but in the situation of a concentration in buyers, the buyer can influence the price it is given by manipulating the quantity of cocoa it demands. The amount of cocoa that the buyer will demand will depend on the point at which the marginal cost of cocoa is equal to the competitive demand price, as opposed to where the supply price equals the demand price [Robinson, 1933]. The marginal cost is greater than the average cost to the market, so the amount of cocoa demanded will restricted, thereby driving the price of cocoa down [Perloff, 2008]. Unlike the effect of the duopoly, which operates through the chocolate market, the effect of the oligopsony is within the cocoa market, but arises from imperfections originating in the chocolate market.

There is a possibility that a reduction in tariff escalation can bring about the significant welfare effect for cocoa producers by inducing entry, so it is interesting to establish

whether or not incidences of tariff escalation do occur to any significant level. The top five consuming nations of chocolate are the Unites States, Germany, France, United Kingdom and Japan[ICCO, 2007]. The graph below illustrate that tariff escalation is used by these countries.

Table 3: Tariff structure among the top 5 chocolate consuming nations in 2004-2005

	Cocoa	Processed Cocoa	Industrial Chocolate	Consumer Chocolate
France	1.875555556	6.739	23.20875	11.20777778
Germany	0	5.081111111	21.49222222	11.20777778
Japan	0	2	44.47	9.772857143
United Kingdom	0	4.66375	21.49222222	11.20777778
United States	0	7.4925	22.5325	11.86571429

The escalation occurs in the first two stages of processing and then the tariff falls. This indicates that it is the intermediate process that is being provided with the most protection.Tariffs have a two-fold negative effect on the cocoa industry. The first negative effect arises from the imposition of a tariff by a high chocolate demand country in order to protect domestic chocolate producers from all foreign chocolate producers. The second negative effect arises from the same country applying a higher tariff on chocolate than it does on cocoa in order to prevent cocoa-producing countries from becoming chocolate-producing countries. This prevents these foreign chocolate producers from competing against domestic chocolate producers.

The first effect in the context of a duopoly would result in the Cournot duopoly with nonidentical firms. This is because the tariff is incorporated into the costs of the foreign chocolate producers. Therefore, the domestic firm is able to exercise more market power than the foreign firm, due to their non-identical cost structure. The total quantity of chocolate produced will be even lower than in a standard duopoly consisting of two identical firms. Therefore, the total quantity of cocoa demanded will also be lower than under a standard duopoly case[Perloff, 2008]. In the case of tariff escalation, the second effect, the tariff is used to mask the potential increase in return that a cocoa producer would receive as a result of shifting from the production of cocoa to the production of chocolate.

Ordinarily, the positive bias on the return to the production of the actual chocolate in the entire value chain as opposed to the cocoa production would attract chocolate-producing entrants from cocoa-producing countries. They would perceive a greater return from producing chocolate rather than cocoa. After enough chocolate producers have entered the chocolate manufacturing market, the return to chocolate would have fallen and the return to cocoa would have risen, so that they reflect the proper value of cocoa in the final product. However, the presence of the tariff disincentivises the move into chocolate production, because the rents that attract entrants to chocolate producing are being eroded by the tariff.

The cocoa producers do not switch to chocolate manufacturing and the asymmetry in the return to chocolate versus the return to cocoa remains unchanged. The effect of both the tariff on chocolate and the escalation that exists from cocoa to chocolate is combined to illustrate the effective rate of protection on chocolate [Flatters, 2004]. It is important to note that non-tariff barriers can also be considered when evaluating whether there are instances of tariff escalation.

1 A Two-firm Model

By incorporating the characteristics that were determined in the previous section into a model, a representation of the chocolate value chain can be created. This allows the model to properly map out the welfare implications to the cocoa producers. In this model, there are assumed to be two inter-dependent markets, the chocolate market and the cocoa market. The model incorporates a variant of the Cournot duoply model to describe the chocolate market and an oligopsony model to describe the cocoa market. First, the effect of the Cournot duopoly on the cocoa market will be illustrated. Then the concentration will be carried further and the cocoa market will be remodelled to incorporate the oligopsony.

1.1 Duopoly

One of the base models of this paper will be the non-identical Cournot duopolist. The reason for using non-identical firms is that it incorporates the market structure of the chocolate market and at the same time, the tariff that is applied to chocolate manufacturers outside of the chocolate consuming nation. The simplifying assumptions are that there are only two firms in the world manufacturing chocolate, no more firms can enter the manufacturing market and that there is one chocolate consuming nation (CCN). One of the chocolate manufacturing firms is based in the CCN and the other is based elsewhere. The costs of both the firms are identicall, except for the tariff that is applied to the foreign firm. Assuming there is a Cournot market structure, the product, chocolate, is assumed to be identical across the two firms and both the firms choose the quantity of chocolate that they will produce simultaneously [Perloff, 2008]. The pricing of both firms will remain identical. As the duopoly arises in the chocolate producing stage, this will first be modelled and thereafter, the effects of the imperfection will be shown in the cocoa sector.

The Chocolate Market
The firms both face the same inverse demand function in the CNN for chocolate:

$$P^{choc} = a - bQ^{choc} \qquad a, b > 0 \tag{1}$$

$$P^{choc} = a - b(q_1^{choc} + q_2^{choc}) \tag{2}$$

where P^{choc} is the price that both firms face in the market as a result of their choice of output, q_1^{choc} and q_2^{choc} for for the home firm and the foreign firm respectively, combined to create the market supply of chocolate, Q^{choc}.
The cost functions for each firm are identical, except for the tariff applied to chocolate for the foreign firm (TC_2):

$$TC_1 = F + mq_1^{choc} \tag{3}$$

$$TC_2 = F + mq_2^{choc} + tq_2^{choc} \tag{4}$$

A constant marginal cost, m, is assumed for both firms, but with the addition of the tariff for firm 2.

Equilibrium in the Chocolate Market

The firms choose their quantity by calculating their best response functions, which starts with determining the profit function for each firm where each firm's profit function can only be optimised with respect to its own quantity:

$$\Pi_1 = [a - b(q_1^{choc} + q_2^{choc})]q_1^{choc} - mq_1^{choc} \tag{5}$$

$$\Pi_2 = [a - b(q_1^{choc} + q_2^{choc})]q_2^{choc} - mq_2^{choc} - tq_2^{choc} \tag{6}$$

These consist of the inverse demand function multiplied by the the quantity the firm will produce minus the total cost functions that were defined above.
Each firm treats the output of the other firm as a constant so the first order conditions, or best response functions of the profit functions are:

$$q_1^{choc} = \frac{a - bq_2^{choc} - m}{2b} \tag{7}$$

$$q_2^{choc} = \frac{a - bq_1^{choc} - (m + t)}{2b} \tag{8}$$

The best response functions of the two firms are solved simultaneously for the quantities of chocolate produced by each firm in order to obtain the Nash-Cournot equilibrium [Perloff, 2008]:

$$q_1^{choc} = \frac{a - m + t}{3b} \tag{9}$$

$$q_2^{choc} = \frac{a - m - 2t}{3b} \tag{10}$$

The tariff generates a disparity between the two quantities. The additional cost to firm 2 from the tariff means it cannot act as aggressively in acquiring market share. It has access to a smaller residual demand. This can be interpreted as a reduction in overall competition, so the equilibrium price is higher, but both firms face the same price. Firm 1 will produce $\frac{t}{b}$ more chocolate than firm 2, because the former is relatively low-cost

compared to firm 2 and the profit of firm 1 will be higher.

The Cocoa Market

The cocoa market has been assumed to be inter-dependent with the chocolate market. Therefore, the distortion in the chocolate market needs to be carried over into the cocoa market by including the effect of the duopoly and the tariff in the cocoa market. The total cost of the chocolate producing firms can be restated to incorporate the fact that chocolate is made from cocoa:

$$TC_1 = F + P^c q_1^c \tag{11}$$

$$TC_2 = F + P^c q_2^c + t q_2^c \tag{12}$$

The cost functions still have a fixed component, F, as well as the marginal cost of chocolate, but the marginal cost of chocolate is the price of cocoa, P^c, because we assume that cocoa is the only input to chocolate. This price is also common to both firms, because in this situation the firms are price-takers. Notice that the tariff is included in the cost function of the second firm, due to the simplifying assumption that cocoa input is one-for-one with chocolate output [1], or

$$q_1^{choc} = q_1^c \qquad ; \qquad q_2^{choc} = q_2^c \tag{13}$$

Using the best reponse functions from the chocolate market (7 and 8), as well as the simplifyingassumptionm the factor demand functions for each firm can be calculated:

$$q_1^c = \frac{a - bq_2^c - P^c}{2b} \qquad ; \qquad q_2^c = \frac{a - bq_1^{choc} - P^c - t}{2b} \tag{14}$$

Solving the factor demand functions simultaneously yields the following equilibrium quantities:

$$q_1^c = \frac{a - P^c + t}{3b} \tag{15}$$

$$q_2^c = \frac{a - P^c - 2t}{3b} \tag{16}$$

where the total quantity of cocoa in the market will be:

$$Q^c = \frac{2}{3}\frac{(a - P^c)}{b} - \frac{t}{3b} \tag{17}$$

In comparison, the equilibrium quantity of cocoa and chocolate under perfect competition are both $\frac{a-P^c}{b}$. The demand for cocoa has exogenously contracted due to the market structure and imposition of a tariff in the chocolate market. The equilibrium price and quantity of cocoa are, as a result, both constrained.

[1] The true relationship more closely resembles $q^{choc} = \phi q^c$, but for the sake of simplicity we assume that ϕ=1

1.2 Oligopsonist

The previous model fails to take into account another relationship between the chocolate market and the cocoa market: the chocolate producers are the consumers of chocolate. The concentration on the production side of chocolate implies a concentration on the consumption side of cocoa. The chocolate producing firms have more opportunities to extract rents from the system. Now, instead of letting the firms be price-takers in the cocoa market, they will be allowed to exercise their market power and choose their own quantities. In order to shift the focus from the chocolate market to the cocoa market without losing the effects of the duopoly and the tariff, a few changes have to be made to the chocolate market:

The Chocolate Market

The total cost functions have to wholly changed in order to illustrate the connection between the chocolate and the cocoa market:

$$TC_1 = F + P^c(q_1^c + q_2^c)q_1^c \qquad TC_2 = F + P^c(q_1^c + q_2^c)q_2^c + tq_2^c \tag{18}$$

where the price of cocoa is no longer exogenously given, but $P^c(q_1^c + q_2^c)$ is the price of cocoa as a function of the market demand for cocoa, as determined by the choice of cocoa purchased by each firm calculated according to the residual market supply function that each firm faces. It is the mirror image of an oligopoly. The market supply function is an increasing function of total quantity, so the pricing function of each firms will also be an increasing function of their own quantities.

The profit functions of the firms can then be restated to incorporate these changes. They do not need to be solved, because the effect on the cocoa market can be evaluated by analysing the cocoa market directly.

$$\Pi_1 = P^{choc}q_1^{choc} - F - P^c(q_1^c + q_2^c)q_1^c \qquad \Pi_2 = P^{choc}q_2^{choc} - F - P^c(q_1^c + q_2^c)q_2^c - tq_2^c \tag{19}$$

$$\Pi_1 = [a - b(q_1^{choc} + q_2^{choc})]q_1^{choc} - F - P^c(q_1^c + q_2^c)q_1^c \tag{20}$$

$$\Pi_2 = [a - b(q_1^{choc} + q_2^{choc})]q_2^{choc} - F - P^c(q_1^c + q_2^c)q_2^c - tq_2^c \tag{21}$$

The Cocoa Market

Once again using the simplifying assumption that chocolate and cocoa are used one for one:

$$q_1^{choc} = q_1^c \qquad ; \qquad q_2^{choc} = q_2^c \tag{22}$$

the profit functions constructed in 20 and 21 can be restated to incorporate 22, so that

the profit functions are now stated in terms of the quantities of cocoa set by each firm instead of the quantities of chocolate, thereby allowing the affect of the duopoly, the tariff and the oligopsony to intermingle:

$$\Pi_1 = [a - b(q_1^c + q_2^c)]q_1^c - F - P^c(q_1^c + q_2^c)q_1^c \tag{23}$$

$$\Pi_2 = [a - b(q_1^c + q_2^c)]q_2^c - F - P^c(q_1^c + q_2^c)q_2^c - tq_2^c \tag{24}$$

The first order conditions in this instance will be restated slightly to take into account the fact that price is now a function instead of a constant.

$$a - 2bq_1^c - bq_2^c - \left[\frac{\partial P^c(q_1^c + q_2^c)}{\partial q_1^c}q_1^c + P^c(q_1^c + q_2^c)\right] = 0 \tag{25}$$

$$a - bq_1^c - 2bq_2^c - \left[\frac{\partial P^c(q_1^c + q_2^c)}{\partial q_2^c}q_2^c + P^c(q_1^c + q_2^c)\right] - t = 0 \tag{26}$$

The firms will purchase cocoa up to the point where the marginal revenue product of cocoa (which is the residual demand function faced by each firm) is equal to the marginal expenditure of cocoa. The first order conditions can be split into these component parts. The marginal revenue product or the marginal utility [Robinson, 1933] to the firms of purchasing cocoa in order to produce chocolate can be mathematically represented in terms of the elasticity of demand facing the firm for chocolate [Perloff, 2008].

$$MRP_1^c = a - 2bq_1^c - bq_2^c = P^{choc}(q_1^c + q_2^c)\left[1 + \frac{1}{2\varepsilon}\right]MP^c \tag{27}$$

$$MRP_2^c = a - bq_1^c - 2bq_2^c = P^{choc}(q_1^c + q_2^c)\left[1 + \frac{1}{2\varepsilon}\right]MP^c \tag{28}$$

$$\varepsilon < 0$$

However, the marginal product of cocoa is just 1, because we assumed that there is a one-for-one relationship between cocoa and chocolate.

$$MRP_1^c = a - 2bq_1^c - bq_2^c = P^{choc}(q_1^c + q_2^c)\left[1 + \frac{1}{2\varepsilon}\right] \tag{29}$$

$$MRP_2^c = a - bq_1^c - 2bq_2^c = P^{choc}(q_1^c + q_2^c)\left[1 + \frac{1}{2\varepsilon}\right] \tag{30}$$

$$\varepsilon < 0$$

This chocolate demand function is being constrained to generate the marginal revenue product. In equilibrium, when marginal revenue product is equal to marginal expenditure, the chocolate demand function is greater than marginal expenditure. The marginal expenditure or the marginal cost to the oligopsonists can be written as:

$$\begin{aligned} ME_1^c &= \left[\frac{\partial P^c(q_1^c+q_2^c)}{\partial q_1^c}q_1^c + P^c(q_1^c+q_2^c)\right] \\ &= P^c(q_1^c+q_2^c)\left[\frac{q_1^c}{P^c(q_1^c+q_2^c)}\frac{\partial P^c(q_1^c+q_2^c)}{\partial q_1^c}+1\right] \\ &= P^c(q_1^c+q_2^c)\left[\frac{1}{\eta_1}+1\right] \end{aligned} \tag{31}$$

$$\begin{aligned} ME_2^c &= \left[\frac{\partial P^c(q_1^c+q_2^c)}{\partial q_2^c}q_2^c + P^c(q_1^c+q_2^c)+t\right] \\ &= P^c(q_1^c+q_2^c)\left[\frac{q_2^c}{P^c(q_1^c+q_2^c)}\frac{\partial P^c(q_1^c+q_2^c)}{\partial q_2^c}+1+\frac{t}{P^c(q_1^c+q_2^c)}\right] \\ &= P^c(q_1^c+q_2^c)\left[\frac{1}{\eta_2}+1+\frac{t}{P^c(q_1^c+q_2^c)}\right] \end{aligned} \tag{32}$$

The marginal expenditure to the oligopsonists is not equal to the supply price of cocoa, but greater due to the fact that the η_i, the elasticity of supply of cocoa, can be assumed to be positive [Robinson, 1933]. The quantities that will be demanded will, therefore, be below the quantity of the point at which the supply price equals the demand schedule. The marginal expenditure function is greater than the cocoa supply function at all levels of output. The oligopsonists will therefore buy less cocoa at a lower price than perfectly competitive levels. The marginal value that the oligopsonists places on cocoa is less than the marginal value that the cocoa produces receive.

In order to solve for the equilibrium quantity, some explanations and an assumption needs to be made about the slope of the supply curve, or the component of the marginal expenditure, $\frac{\partial P^c(q_1^c+q_2^c)}{\partial q_i^c}$ (where i=1, 2), which takes into account the increased price to all units of cocoa purchased when purchasing an additional unit of cocoa. Cocoa is homogenous,so the market supply curve for each firm is identical. An increase in a unit of cocoa from either firm has the same marginal affect on the price which bothe firms face. The slope of the supply curve is positive. For simplicity's sake, we assume that the slope is some constant, λ.

$$a - 2bq_1^c - bq_2^c - [\lambda q_1^c + P^c(q_1^c+q_2^c)] = 0 \tag{33}$$

$$a - bq_1^c - 2bq_2^c - [\lambda q_2^c + P^c(q_1^c+q_2^c)] - t = 0 \tag{34}$$

The best-response functions for each of the firms are:

$$q_1^c = \frac{a - bq_2^c - P^c(q_1^c + q_2^c)}{2b + \lambda} \tag{35}$$

$$q_2^c = \frac{a - bq_1^c - P^c(q_1^c + q_2^c) - t}{2b + \lambda} \tag{36}$$

Therefore, the equilibrium quantities for each firm in the case of the oligopsony and a tariff are:

$$q_1^c = \left[1 + \frac{b^2}{(2b+\lambda)^2}\right]^{-1} \left[\frac{a - P^c}{2b + \lambda} - \frac{b}{2b + \lambda}\left\{\frac{a - P^c - t}{2b + \lambda}\right\}\right] \tag{37}$$

$$q_2^c = \frac{a - P^c - t}{2b + \lambda} - b\left[1 + \frac{b^2}{(2b+\lambda)^2}\right]^{-1} \left[\frac{a - P^c}{2b + \lambda} - \frac{b}{2b + \lambda}\left\{\frac{a - P^c - t}{2b + \lambda}\right\}\right] \tag{38}$$

$$Q^c = \frac{a - P^c - t}{2b + \lambda} + (1 - b)\left[1 + \frac{b^2}{(2b+\lambda)^2}\right]^{-1} \left[\frac{a - P^c}{2b + \lambda} - \frac{b}{2b + \lambda}\left\{\frac{a - P^c - t}{2b + \lambda}\right\}\right] \tag{39}$$

2 A Picture is worth a Thousand Equations

The different quantities under different instance of market structure, as well as the effect of the addition of a tariff on foreign produced chocolate is summarised in the table below. The duopoly quantities are less that the perfect competition quantities, because there is an additional negative term in the numerator, $-bq_i^c$ (where i=1, 2). This comes about as a result of the strategic interaction between the two firms who are both trying to extract rents, but this is based upon what the other firm is doing. The quantity of firm 2 is directly reduce when the tariff is introduced and this is explicitly taken into account with the $-t$ in the numerator of q_2^c. The increase in the quantity of firm occurs as a result of the decrease in the quantity of firm 2, because each firm determines their output based on how much they believe the other firm will produce.

Table 4: Equilibrium cocoa quantity for different market structures and tariff

Market Structure		$\mathbf{q_1^c}$	$\mathbf{q_2^c}$	$\mathbf{P^c}$
Perfect Competition	A	$\frac{a-P^c}{2b}$	$\frac{a-P^c}{2b}$	$MC(Q^c)$
Duopoly	B	$q_1^c = \frac{a-bq_2^c-P^c}{2b}$	$q_2^c = \frac{a-bq_2^c-P^c}{2b}$	$\frac{a+2MC(Q^c)}{3}$
Duopoly + Tariff	C	$q_1^c = \frac{a-bq_2^c-P^c}{2b}$	$q_2^c = \frac{a-bq_1^c-P^c-t}{2b}$	$\frac{a+2MC(Q^c)+t}{3}$
Oligopsony + Tariff	D	$q_1^c = \frac{a-bq_2^c-P^c(q_1^c+q_2^c)}{2b+\lambda}$	$q_2^c = \frac{a-bq_1^c-P^c(q_1^c+q_2^c)-t}{2b+\lambda}$	$MC(Q_O^c)$ where $Q_O^c = q_1^c + q_2^c$

The prices that are associated with different market structures are in terms of the marginal cost of producing cocoa. The perfect competition price lies on the supply curve, so the price is the marginal cost at the perfectly competitive quantity. In the duopoly, the price lies above the supply curve and this is shown by the fact that the price equals an inflated marginal cost. The price of cocoa increases further aupon an introduction of the tariff in the chocolate market. In the oligopsony the price drops back to the marginal cost. However, the quantity that is produced is also significantly less that the perfect competition case. Therefore the price in the case of the oligopsony is deflated.

Figure 2 is a graphical representation of the different distortions that were explained in the previous section. E_p is the point at which there are no market distortions in the chocolate or cocoa market through market power or the use of tariffs. It is the situation of perfect competition. If there were only two firms in the market, but they were behaving in a perfectly competitive manner, then they would each demand the quantities of cocoa in row A in table 4. The total quantity produced at this point is $\frac{a-P^c}{b}$. It will be used as a basis for comparison for the situations that have been found to exist in the cocoa-chocolate market. The point E_d indicates the equilibrium quantities of each firm in the situation of the duopoly in the chocolate market with no tariff or market power in the cocoa market. The firms would each demand their respective quantities in row B in table 4 above. The quantity of chocolate produced (and, therefore cocoa demanded) is $\frac{2(a-P^c)}{3b}$, purely as a result of the concentration of the chocolate market.

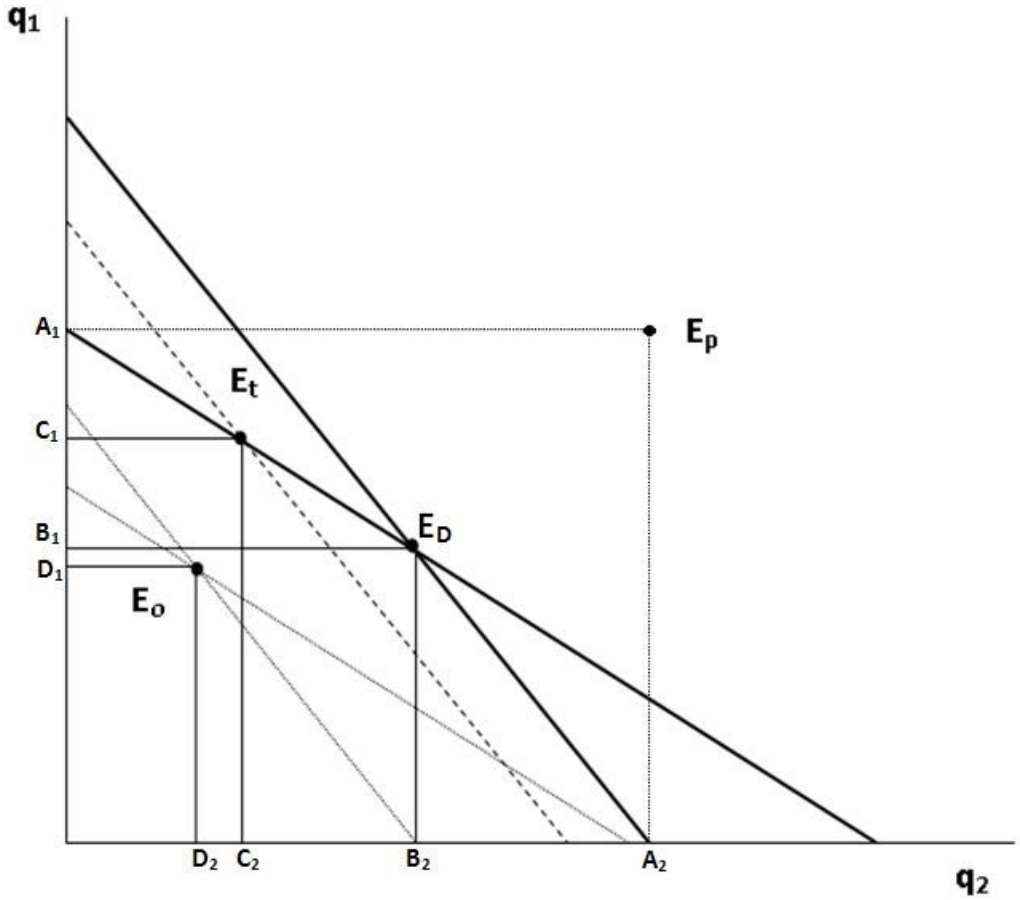

Figure 2: Equilibria under different market concentrations and tariff structures

The introduction of the tariff on chocolate to the situation of the duopoly in the chocolate market shifts the reaction function of firm 2 (the foreign firm) in the cocoa market inwards, because they demand less cocoa. This is the situation calculated in section 2.2. The new equilibrium for cocoa demand is at point E_t. The constraint on the amount of chocolate that firm two can produce increases the quantity of chocolate produced of firm one, hence the increase in the quantity of cocoa demanded by firm 1 (the domestic firm). The decrease in the amount of cocoa demanded by firm 2 is greater than the increase in demand by firm one. Therefore, the net change in cocoa demanded is negative. Firm 1 and firm 2 will each demand their corresponding quantities of cocoa in row C in table 4. The amount of chocolate produced (and, by assumption, cocoa demanded), the components of which can be found from equation 15-17 is $\frac{2}{3}\frac{(a-P^c)}{b} - \frac{t}{3b}$. This situation can be interpreted as a decrease in competition, because the firm that has an tariff imposed upon it is not able to compete as aggressively against the home firm as it would without the tariff.

The point E_o indicates the quantities of cocoa demanded when the oligopsony in the

cocoa market is introduced. Cocoa demand is directly constrained when buyer market power is introduced into the cocoa market. Both reaction functions in the cocoa market shift inwards, so that the equilibrium quantity demanded falls from E_t to E_o. The overall effect of the layered distortions in the cocoa and chocolate market together result in the demands for cocoa being skewed from the point E_p to the point E_o. Both firms' demand for cocoa will reduce to the quantities in row D of table 4. The solutions for the quantities produced by each firm at this point, as well as the total quantity produced, can be found in equation 37-39.

3 Welfare

In the chocolate market, the Cournot duopoly producers generate a deadweight loss in attempting to erode consumer surplus. In the cocoa market, the olgopsony buyers generate a deadweight loss in attempting to erode the producer surplus. Both the actions serve to reduce the potential producer surplus that the cocoa producer would have received if there were to be perfect competition in both markets.

In order to calculate the welfare allocated to the cocoa producers in the case of the oligopsony, the marginal cost of the cocoa producers needs to be determined in order to have a cocoa supply relation. First, an expression for total cost is constructed and then the marginal cost can be determined through differentiation.

$$TC(Q_c) = \alpha Q_c + \beta Q_c^2 \tag{40}$$

$$MC(Q_c) = \alpha + 2\beta Q_c \tag{41}$$

The total quantity for cocoa and chocolate (which were assumed to be equal) had been calculated and can be found in table 4 in section 3 in row D, but as it is cumbersome to work with, the general quantity Q_c^{d+t} will be referred to in the following depiction of the producer surplus.

$$PS = \int_0^{Q_c^{d+t}} P_c(Q_c^{d+t}) - (\alpha + 2\beta Q_c) dQ^c \tag{42}$$

It had been illustrated in table 4 that the equilirium quantity under a oligopsony in the cocoa market (with a duopoly and tariff in the chocolate market) is lower than both the case of perfect competition in both markets, as well as a duopoly in the chocolate market, but perfect competition in the cocoa market. This means that the quantity over which the integral is calculates is smaller in the cocoa market. The integrand on the other hand is also smaller, because the price of cocoa is depressed by how far the supply curve is from the marginal expenditure curve. The price of cocoa should be the same as the price of chocolate (by the assumptions of the model), but this only occurs when the chocolate producers are price takers (i.e. when η is infinite) [Perloff, 2008]. The rents that pass through the chocolate producer to the cocoa producer when there is no oligopsony is redirected to chocolate firms. The cocoa producers, therefore, lose some of

their producer surplus.

The loss to the cocoa producers is not the only loss that occurs due to the market structure of the cocoa-chocolate value chain. The consumers of chocolate will also lose some of their consumer surplus. In addition, a deadweight loss to society will be generated in both markets due to the exploitation of market power.

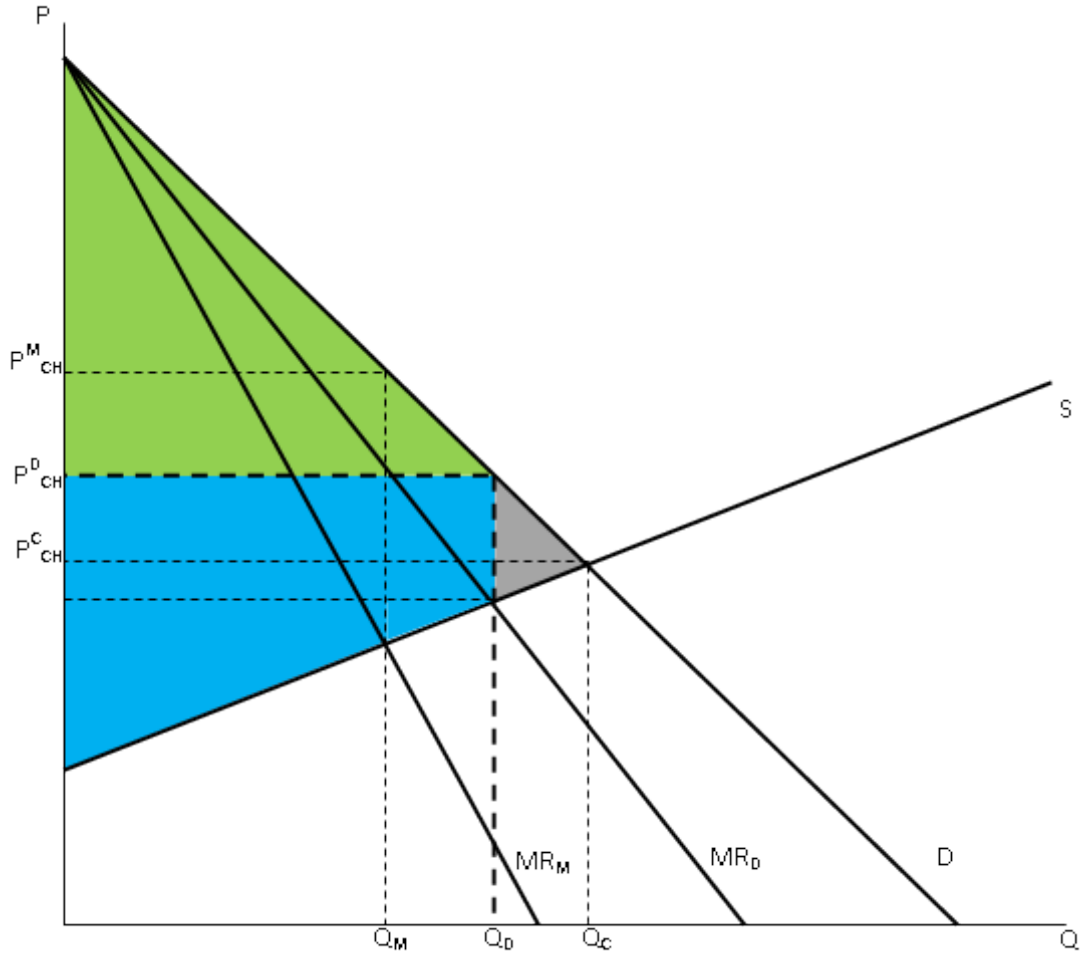

Figure 3: Welfare in the Chocolate Market in a Cournot Duopoly

The graphical depiction of the welfare distribution in the chocolate market is illustrated in figure 3. The green area depicts the welfare that consumers of chocolate derive in the chocolate market. Ordinarily, under perfect competition, the green area would extend downwards to encompass a part of the blue area and a part of the grey are from P^D_{CH} to P^C_{CH} up until the perfectly competitive quantity of cocoa, Q_c. However, by exploiting their market power, the producers of chocolate are able to extract the blue area that would have gone to consumers as part of their producers surplus, but, in the process,

the grey area is lost, as well as the remaining grey area that would have been a part of the producer surplus under perfect competition. This occurs as the quantity falls to Q_o.

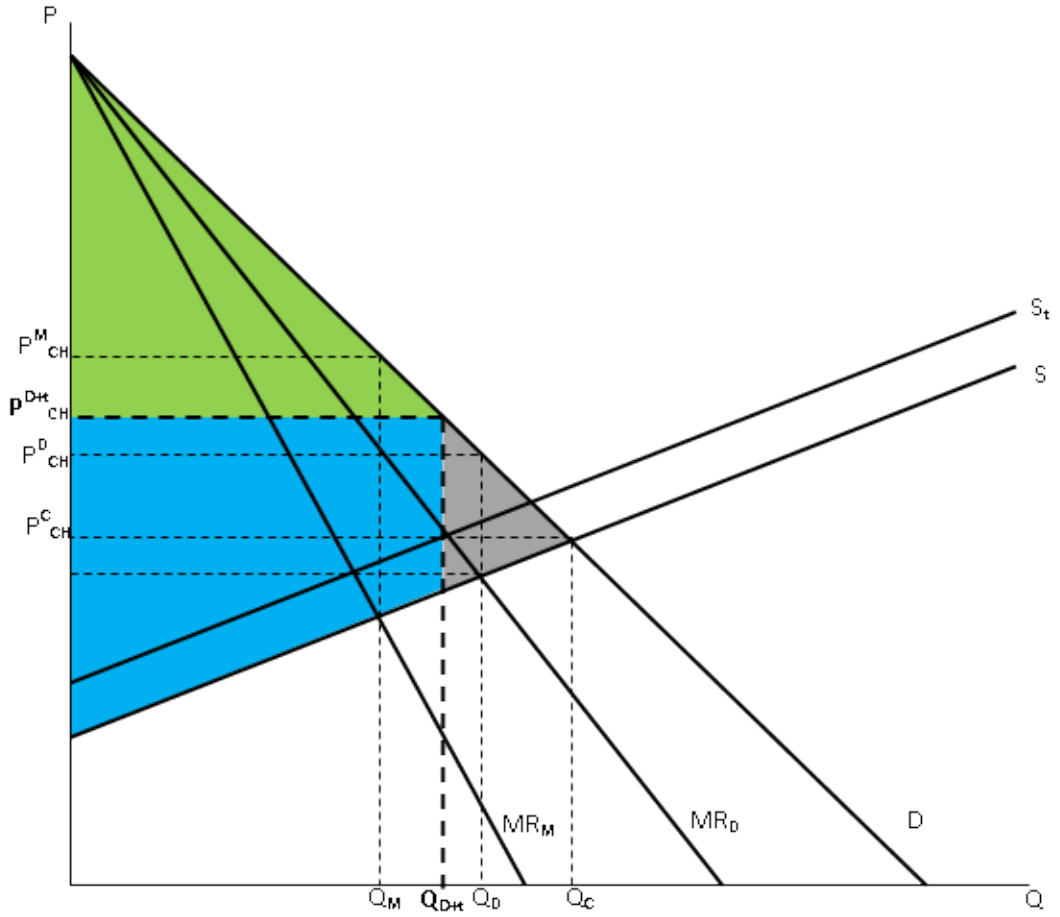

Figure 4: Welfare in the Chocolate Market in a Cournot Duopoly with a tariff

By introducing the tariff into the chocolate market we are altering the marginal cost of one of the firms that operate in the duopoly. Therefore, of the supply curve shifts up. The quantity that will be produced is lower than a symmetric duopoly (the quantity drops from Q_D to Q_{D+t}) and the price of chocolate is also higher (it rises from P^D_{CH} to P^{D+t}_{CH}). The deadweight loss increases with the establishment of a tariff on chocolate and consumer surplus is further eroded by producer surplus and the deadweight loss. The consumer surplus shrinks by the blue area between the prices P^D and P^{D+t} that is reallocated to the chocolate producers and the grey triangle grows to incorporate the area between the duopoly quantity and price and the new quantity and price.

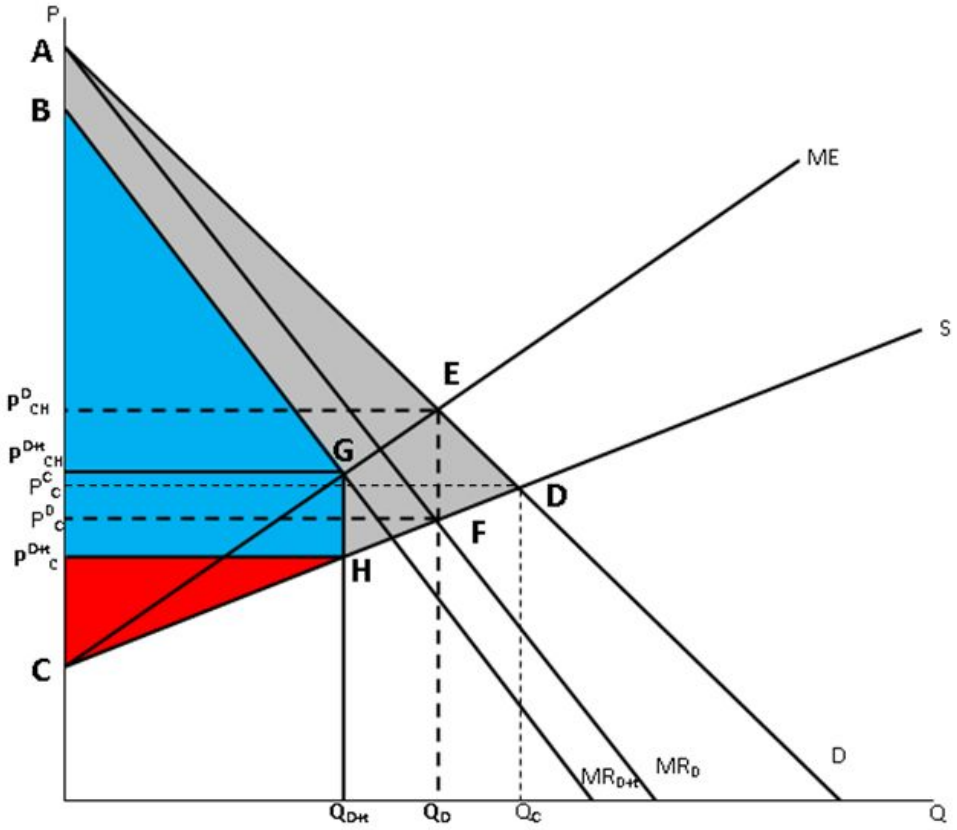

Figure 5: Welfare in the Cocoa Market in a Oligopsony

The welfare distribution in the cocoa market illustrates the effect of the oligopsony in figure 5. The quantity of cocoa demanded is constrained in the same way as in the chocolate market. It falls from Q_D to Q_{D+t}. This accommodates the assumed one-for-one relationship between the quantity of cocoa and the quantity of chocolate. However, a price wedge is created, through the exploitation of buying power, between the price of chocolate (P^D_{CH}) and the price of cocoa(P^D_C). The blue area between the prices P^C_C and P^D_C has been captured by the chocolate producer (i.e. the cocoa buyer) away from the cocoa producer. The grey area is the deadweight loss, which is generated by the duopoly and the tariff. The oligopsony does not generate a further deadweight loss.

Table 5:Welfare in the Cocoa Market

	Perfect Competition	Duopoly	Tariff	Oligopsony
Consumer Surplus (CS)	ADP^C_C	AP^D_{CH}	$BGP^D + t_{CH}$	$BGHP^D + t_C$
Producer Surplus (PS)	CDP^C_C	$CFEP^D_{CH}$	$CHGP^D + t_{CH}$	$CHP^D + t_C$
Welfare (CS+PS)	ADC	AEFC	BGHC	BGHC

The welfare allocations, as a result of the introduction of the different anomalies of the cocoa market can be summarised in table 5. The oligopsony does not result in an additional reduction in overall welfare, because the welfare loss was already captured through the reduction of the quantity of cocoa demanded as a result of the concentration of the chocolate market. The difference between the two is the change in the distribution of the welfare between the cocoa producers and the cocoa buyers. The tariff does not alter the distribution of the welfare. Were it not for the presence of the oligopsony, the cocoa producer would be receiving an efficient price for the cocoa (namely, the chocolate price).

4 Breaking the Oligopsony

The critical aspect highlighted by this paper is that tariffs, while distortionary in their own right, are not the sole, nor the predominant source of cocoa farmer exploitation. In the presence of a tariff on chocolate, the cocoa market should still be able to adjust and reach an equilibrium. The cocoa producer would be selling a smaller quantity, but the price it would be selling this quantity at would be higher. It is upon the introduction of the oligopsony in the cocoa market that welfare gets shifted out of the hands of the cocoa producers and into the hands of the chocolate producers. The presence of the concentrated cocoa buyer can be thought of as being the equillibrium outcome once certain external stimuli have been introduced into the market. In order to bring the market back to the situation of perfect competition, the market conditions have to alter, so that perfect competition is the equilibrium outcome.

The paper has illustrated the effects of a tariff on the chocolate market and how it indirectly affects the cocoa market by stunting the demand for cocoa. However, what is not explicitly stated, but merely alluded to in the model, is the effect of tariff escalation. It occurs when the tariffs on unprocessed goods are lower than the tariffs on processed goods. This means that the protection that is provided to processed goods is greater than the protection provided to unprocessed goods [McCorriston et al, 2009]. This creates a disincentive for firms outside of the country that utilises tariff escalation to enter that country's market. In the model, the tariff on cocoa was zero and the tariff on chocolate was positive, effectively amounting to escalation.

In order to eliminate the foreign entry disincentive, the effective rate of protection (ERP) needs to be eliminated. This end supports the use of formula tariff reduction methods [McCorriston et al, 2009]. However, in order to do so, the ERP needs to be calculated. The ERP is the difference between the value-added of processing with tariffs and the value-added of processing in a situation of free trade as a percentage of the value-added of processing in free trade [Nasredin et al, 2004]. The value-added of processing in a situation of free trade is the difference between the price of the processed good and the sum of the inputs' share of the total cost. The value-added of processing when there is protection is the same thing, except the price of the processed good is inflated by the

tariff on the processed good and the each of the inputs share of the total cost is inflated by each of their respective tariffs [Nasredin et al, 2004]. In the case of a single input and a single output, this can be simplified to:

$$ERP = \frac{P_{choc}t_{choc} - \alpha t_c}{P_{choc} - \alpha} \tag{43}$$

α: share of total cost that is attributed to cocoa; $0 \leq \alpha \leq 1$

t_{choc}: the tariff applied to chocolate

t_c: the tariff applied to cocoa

Once the effective rate of protection has been calculated, a suitable formula should be adopted to reduce the escalation. The consensus is that the Harbinson formula is the most effective at reducing tariff escalation, because it specifies the reduction framework that does not allow countries to dodge reductions on items with traditionally high tariffs [McCorriston et al, 2009].

The relationship between the removal of the effective rate of protection and the entry of foreign is a simply a matter of whether the ERP is greater than the ability of foreign firms to create more value than domestic firms. A foreign firm is only going to enter the chocolate market if they can afford to operate in the domestic market. The rate of entry is therefore a function of how much of the value generated by the foreign firm is being outstripped by the ERP. The larger the ERP, the less number of firms enter the local market.

If the incidence of tariff escalation occurred in the largest chocolate consuming nations, then market structure would be concentrated in each of those markets independently of each other. In the first section of the paper it was showed that tariff escalation was apparent in the largest chocolate consuming nations. This indicates that market concentration is highly likely in these markets and that cocoa producers are losing out on welfare that would ordinarily be due to them.

5 Conclusion

Trade barriers are not the only trade distorting barrier in the cocoa and chocolate market. Market structure appears to be a significant barrier to trade for cocoa producing nations. The question is whether the tariff that is applied is significant enough to be the cause of the market distortion and whether the elimination of the tariff will be the requisite change to induce the desired result. The desired result being the increase in the demand for cocoa, due to an increase in the amount of entrants into the chocolate manufacturing market.

In the case of the duopolist, lower tariffs can influence cocoa producers in two ways.

The eliminations of the tariff can increase chocolate sales due to the fall in costs, or through a decrease in the oligopsonistic power in the cocoa market. If the elimination of the cost of the tariff is not enough to induce entry into the chocolate market, then there will be no effect on the oligopsony in the cocoa market. That is not to say that it does not improve the welfare of the cocoa producers to eliminate tariffs on chocolate, but the effect is minimal and eliminating the tariff will not be able to solve the imperfection that extracts the most rent from the cocoa producers which is the oligopsony power in the cocoa market.

However, if the reduction in tariffs is significant enough to induce entry in the chocolate manufacturing sector, then there will be two more impacts on the welfare of cocoa producers. First, there will be enhanced competition in the chocolate manufacturing market, which will increase the demand for cocoa, thereby increase the equilibrium price and quantity of cocoa. Secondly, the oligopsonistic power in the cocoa market will be reduced, which will further increase the equilibrium price and quantity of cocoa. The gains to cocoa producers from eliminating the market structure distortions are amplified to a significant degree in comparison with the mere elimination of the trade barrier in the chocolate market.

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