

The Influence of Product Differentiation on International Trade Policy

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Abstract

This paper reviews the literature on product differentiation and international trade. It touches upon the competitiveness gains of increasing technological diffusion, and the resulting division of international market power. The formulation of international trade policy is assessed and the impacts of product differentiation on this process are weighted. The author analyzes the possibility of product differentiation influencing the degree of trade liberalization in government policy.

1. Introduction

The ground-breaking work by Krugman (1980) and Helpman and Krugman (1985) has had a substantial influence in the field of international economics. Their research reveals that there is a significant difference between homogeneous and differentiated products on the world market. In view of this fact, technological diffusion, and improvements to R&D investment can both improve the competitiveness of trade policy. Thus, horizontal and vertical product differentiation may be improved if national governments compete in international markets. Other more protectionist policies have also been applied such as during the restrictive regime (pre-1985) in India.

One of the fundamental questions to be addressed is: What influence does product differentiation have on the formulation of international trade policy? Of equal interest is whether product differentiation leads to more liberal or protectionist trade policies. A number of studies analyze the international trade policy of distinct industries typical of product differentiation worldwide; see Aggarwal (2000), and Scheerlinck, Hans and S'Jegers (1996). Thus, the paper analyzes both questions simultaneously, and addresses the gap in the literature.

The remainder of the paper is organized as follows. Section 2 discusses technology and product differentiation in international trade. Section 3 describes the implementation of international trade policy with product differentiation and section 4 presents a case study of the food industry whereby consumer awareness and strategic considerations are addressed. Section 5 concludes.

2. Technology and Product Differentiation in International Trade

Investment in research and development (R&D) is a major priority in national governments' agendas. Improving the international competitiveness of domestic firms is the primary motivation behind public R&D and the support for private R&D. I will analyze the effects of subsidizing product innovation, the pursuit of "leapfrogging" international policies, the pursuit of in-house R&D versus technology imports and the international patent race for new product technology.¹ Two main issues will be looked at. The first will deal with the possible link between increased technological diffusion and product differentiation. The second will focus on the effects of international trade liberalization on market power and product differentiation. As we will see, trade liberalization is beneficial to developing countries, as well as to the Asian Tigers.

Herguera and Lutz (2003) analyze the impact of subsidies on product innovation when the domestic government permits a leapfrogging international trade policy. They studied the behaviour of a lagging domestic industry within the framework of a model of vertical product differentiation.² The higher profits that go to the industry with the better quality product are indeed a large incentive for national governments and firms alike, to innovate. The international marketplace is classified by high and low quality products that are substitutable. For the purpose of this article, international trade is conducted in one (domestic) market.

¹ Leapfrogging is defined as the process by which: "...a leading firm is overtaken by a laggard firm because the former's absolute superiority in an existing technology gives the latter a comparative advantage in the new technology" (Motta, Thisse, and Cabrales, 1997, p.810).

² Products are vertically differentiated if consumers unanimously agree on which product or brand is preferred (Church and Ware, 2000, p.369).

The authors state that: "...the cost of developing the new product quality, which is the innovation cost, is often modeled as a quality-dependent, fixed cost which is sunk at the later stage of actual production" (2003, p.466). Due to the differences in income available for research and development (R&D) in different countries, and heterogeneous consumer demands, there exist regional asymmetries in products. Herguera and Lutz (2003) found that there exists one (pure-strategy) Nash equilibrium in qualities. This equilibrium is representative of the lagging industry's jump from one equilibrium to another that is higher and this is induced by following a leapfrogging policy.

To ensure a greater probability of success, national governments subsidize their domestic industry and hence, their investment towards product differentiation. If the government intervenes, then the representative cost structure of firm i (or industry i) transforms into:

$$c_i = (1 - \sigma_i) b_i s_i^2$$

where c_i represents the costs, b_i is a quality cost parameter, s_i is the single quality attribute, and σ_i is the percentage cost reduction induced by the subsidy.³

If the quality-dependent cost parameter (b_i) were to increase, then the process of product innovation would become more expensive and the number of new products would decline. Moreover, this decline in product differentiation would be a big opportunity cost to the international market since the highest quality product is not produced and hence, the profits earned are not as high as they could be. This would reduce the profit-shifting purpose for leapfrogging. Nevertheless, the domestic government would still choose to subsidize its industry since the profits of the market leader are still higher than those of

³ Herguera and Lutz (2003, p.472).

the lagging industry. The authors put forth a specific caveat: “If both governments subsidize (domestic and foreign), a prisoner’s dilemma situation may arise with no leapfrogging taking place” (2003, 475).

Similar to the work done by Herguera and Lutz (2003), Motta, Thisse and Cabrales (1997) analyze the persistence of leadership or leapfrogging in international trade. They study the competitive advantage over a trading partner based on autarky product quality.⁴ Once trade is liberalized, two possible strict Nash equilibria may take place within the oligopolistic model of vertical product differentiation. The first equilibrium implies that the quality leader maintains its standing (E_1), whereas the second equilibrium involves leapfrogging (E_2).

Motta, Thisse and Cabrales (1997) find that the risk dominance criterion picks the equilibrium with *persistence of leadership* (E_1).⁵ They found that the likelihood of players choosing one equilibrium over the other is dependent upon the distance between their individual payoffs ($LA_1 \cdot LB_1 - LA_2 \cdot LB_2$), where LA_1 is the payoff to player A for accurately predicting her rival’s adjacent move. The other payoffs are analogous to this way of thinking, where the subscript 2 represents the leapfrogging equilibrium. This comparison of risk dominance is visible in Figure 1, which is on the next page.

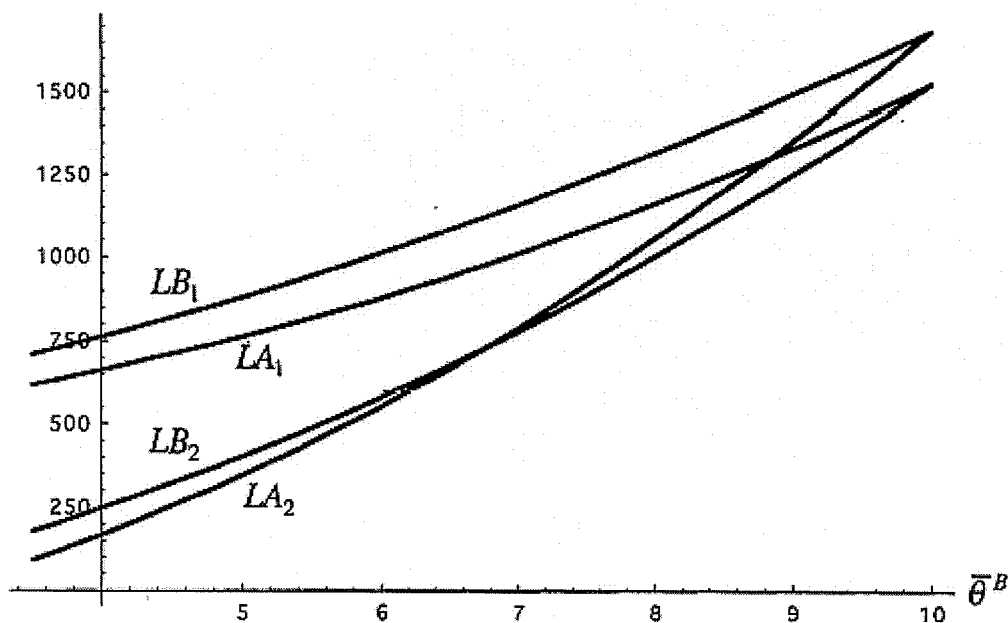
The larger the difference between the payoffs of E_1 and E_2 , the lower the possibility of E_2 risk dominating E_1 . The intuition is that technological differences are too large to

⁴ There are two trading partners (countries A and B) that have distinctly different quality expectations.

⁵ The mixed strategy equilibrium will be picked if both countries have identical populations.

allow the laggard firm to use the leader's existing superior technology to leapfrog over the leader in terms of new product quality. The authors hint that the quality leader in the international marketplace is the firm that produces the better quality product under autarky. Typically, the richer nation with a bigger market size and more consumers displaying higher quality demands, leads to this quality differential.

Figure 1: Risk Dominance Comparisons



Source: Motta, Thisse and Cabrales (1997, p.822): Figure 5.

Aggarwal (2000) focuses on the effects of deregulation policy during the mid-1980s in India on technology imports and the in-house R&D uphill struggle. The analysis looks at the two different policy regimes in the same country, whereas Motta, Thisse and Cabrales (1997) compared two different countries on the international market for technology. The Indian manufacturing sector imports technology from foreign firms, but the pace of importing is highly dependant upon the regime.

The author performs an econometric testing of two different hypotheses concerning the relationship between internal R&D efforts and technology imports.⁶ Two main explanatory variables within the model are market concentration (CR4) and product differentiation (ADI). Aggarwal (2000) suggests that as India becomes more deregulated, the threat of foreign competitors entering the market will push Indian firms to purchase more technology imports. Moreover, product differentiation has a tendency of being a result of firm investment in licensed technology. As firms invest in technology imports, new improved products are introduced.

Unfortunately, the resulting coefficient of market concentration (CR4) was insignificant. However, the impact of the ratio of advertising purchases to sales (variable AD1) was found to be highly significant for the post-regulated period. Thus, one of the proxies for product differentiation was able to explain a good deal of the variability in the intensity of technology licensing (the dependent variable).⁷ The opposite of this result transpired for the test during the regulated regime in India (pre-1985) since the coefficient of product differentiation (AD1) is insignificant.

Thus, these results are indicative of the author's premise that during the restrictive regime, technical innovation through introducing improved products was discouraged by the government of India (2000, p.1085). Instead, the government allowed for technology imports to infiltrate into the struggling core and priority industries. During the restrictive

⁶ Hypothesis #1: Regardless of the government's policy regime, internal R&D effects are a perfect substitute for technology imports. Hypothesis #2: There is a positive relationship between in-house R&D efforts and the adoption of foreign technology.

⁷ The coefficient on AD1 is 0.291 and it is significant at the 5% level.

regime, the government's focus was on improving the state of technology diffusion in the domestic market, and not on improving India's international competitiveness.

Surprisingly, the variable for market concentration was not significant during the restrictive regime. One would expect it to be significant since a regulated regime is characteristic of more government intervention and hence, monopolistic firm behaviour. These results for the deregulated period support the second hypothesis of the econometric model.⁸ Therefore, Aggarwal (2000) supports the premise that a more liberal regime increases technological licensing (imports) and the level of in-house R&D by increasing product differentiation. The author emphasized the importance for technological diffusion of international standards into India in order to build vitality in India's economy.

Jensen and Thursby (1996) analyze anticipatory product standards that are manipulated by national governments to improve the competitive advantage of domestic firms in the international patent race. International R&D competition often results in the development of products that are classified by horizontal product differentiation.⁹ If the United States sets the standard to benefit the domestic market, this may prove to be problematic if the foreign firm develops the product first or if the domestic product is inferior. For example, the United States' Federal Communications Commission (FCC) set their high definition TV (HDTV) on a signal that was not compatible with Japan Broadcasting's MUSE

⁸ Data used for the study is from the Reserve Bank of India.

⁹ Products are horizontally differentiated if consumers have heterogeneous preferences regarding the most preferred mix of different attributes – there is no agreement among consumers regarding which particular product or brand is best (2000, p.369).

system.¹⁰ This reduced the level of choice made available to U.S. consumers and thus, reduced welfare.

In comparison, the authors analyzed an interesting case whereby the government implements a state-contingent standard that benefits both a lagging firm and the public alike. The appeal of this standard is that quality leading firms must license their technology patents at a small fee. As said by Jensen and Thursby (1996), "... this policy is interesting in several ways. First, in equilibrium the lagging firm may drop out of the race and wait to acquire a license from the foreign firm. Second, the policy is shown to be time consistent whether or not the lagging firm drops out" (1996, p.23).

On the flip side, if standards are set before products are completely developed then lagging firms are unable to purchase the license to the superior technology patent. Hence, the model shifts towards one of vertical product differentiation and a unique subgame perfect equilibrium (SPE) is found where both firms produce products simultaneously with different quality patents. If the difference between the technology of the quality leader (foreign firm) and the lagging domestic firm is sufficiently large, then the possibility of leapfrogging vanishes.

This result also materialized in the afore-mentioned study by Motta, Thisse and Cabrales (1997) whereby the risk dominance criterion selects the equilibrium with *persistence of*

¹⁰ The U.S. policy was implemented in September of 1988.

leadership (E_1).¹¹ The difference is that Jensen and Thursby (1996) consider the potential behaviour of the firm with the inferior patent. They reveal that dropping out is never subgame perfect if the foreign government does not intervene in the setting of standards.

The international R&D rivalry between the United States and Japan is not limited to the broadcasting industry. Audretsch and Yamawaki (1988) discuss the impact of the late 1970s ballooning U.S. trade deficits with Japan. The authors try to answer the question: How is the Japanese comparative advantage strengthened by different components of R&D expenditure? They tested this hypothesis to the extent of product differentiation with the use of an empirical model and the method of Ordinary Least Squares (OLS).¹²

Audretsch and Yamawaki (1988) modeled the comparative Japanese international trade advantage, with trade balance (TB) as the dependent variable. The model was tested using not only OLS, but also the logit method and is as follows:

$$TB = \alpha + \beta_1 [(R \& D)_J - (R \& D)_{US}] + \beta_2 (R \& D)_{US} + \sum_{i=1}^L \gamma_{1i} IP_i + \sum_{j=1}^m \gamma_{2j} MS_j + \sum_{k=1}^n \gamma_{3k} FE_k + \epsilon.$$

This equation includes Japan's additional R&D purchases $\beta_1 \cdot [(R\&D)_J - (R\&D)_{US}]$, the United States individual R&D efforts $\beta_2 \cdot (R\&D)_{US}$, Japanese industrial policy (IP_i), Japan's market structure (MS_j), and Japan's factor endowments (FE_k). The logit technique was employed because the dependent variable fluctuates between minus one and plus one. Hence, the logit results were compared to those of the OLS method.

¹¹ The risk dominance criterion was introduced by Harsanyi and Selten (1988). It assumes that only one of two equilibrium strategy pairs will be played and the one picked is based on the level of associated risk.

¹² The hypothesis was that: "...the four major components of R&D – Japanese expenditures on process innovation, product quality improvements, new products or new technology, and technology transfer – had disparate effects on the trade balance" (1988, p.439)

The results of both the OLS and logit methods revealed that additional R&D expenditure on process innovation and product quality improvements was successful at improving Japan's comparative advantage. The signs of the estimated coefficients on both these variables imbedded within the first variable are negative and statistically significant at the 95% level. The test results also revealed that monies put into R&D on new products and technology, and on technology transfers reaped negligible benefits since their estimated coefficients were insignificant.

Evidence suggests that: "...some of Japan's trade success during this period can be attributed to the procurement of existing U.S. technology and the subsequent application of domestic R&D resources towards improving upon the quality of existing products" (1988, p.447). It is very interesting to be able to discuss an applied version of the international trade theory of leapfrogging in terms of product qualities in the real world.

Over the early 1990s Japan's competitive advantage in manufacturing was overthrown by a number of Asian newly industrialized economies (NIEs).¹³ These *growth miracles* have gained much international market power. Muscatelli, Stevenson and Montagna (1995) estimate an integrated demand and supply model to test their hypothesis that product differentiation and product innovation influenced the success of NIE exports. Moreover, the authors found it peculiar that Hong Kong and Singapore constantly faced high income elasticities for their export demand. They pondered the question: Why is it so?

¹³ The NIEs are made up of Hong Kong, Taiwan, Thailand, Singapore, Malaysia and Korea.

The authors developed a long-run demand (X^d) equation for the NIE exports:

$$X^d = f_1 (P^x, P^w, Y^w)$$

where P^x is the price of NIE exports, P^w is the price of world exports and Y^w is the scale variable.¹⁴ Equations for each one of the NIE countries were tested with the Phillips and Hansen (1990) fully-modified least squares estimator. This procedure was employed since export prices are highly endogenous and this technique tolerates simultaneity in the regressors. The first table is consistent with the general test, whereas the second table includes the impact of a product innovation proxy variable.

Table 1: Long-run Elasticities of Export Demand

Country	$(p^x - p^w)$	y^w
Korea	-2.27 ^a	2.11 ^a
Singapore	-3.32 ^a	1.87 ^a
Taiwan	-1.62 ^a	1.94 ^a
Hong Kong	-1.64 ^a	1.63 ^a
Thailand	-2.57 ^a	2.26 ^a
Malaysia	-1.63	1.63 ^a

**Table 2: Long-run Elasticities of Export Demand
Allowing for Product Innovation**

Country	$(p^x - p^w)$	y^w	k
Korea	-1.65 ^a	2.45 ^a	0.07
Singapore	-1.65 ^a	-0.58	2.32 ^a
Taiwan	-0.16	1.39 ^a	0.92 ^a
Hong Kong	-1.28 ^a	0.83 ^a	0.55 ^a
Thailand	-1.36 ^a	0.82 ^a	1.26 ^a
Malaysia	-0.88 ^a	-0.14	1.41 ^a

^a A parameter which is significantly different from zero at the 5% significance level; this has been calculated using asymptotic standard errors.

Source: Muscatelli, Stevenson and Montagna (1995, pp.153-154): Table 2 and Table 3.

The results reveal that in all cases other than Korea, the product innovation proxy (the capital stock) is actually statistically significant and hence, able to explain some of the

¹⁴ The scale variable is indicative of the position of world demand.

variability in long-run export demand.¹⁵ Simultaneously, the value of the scale elasticity drops in Hong Kong, Thailand and Taiwan. Also, the scale variable becomes insignificant in Singapore and Malaysia. But, what does this all mean? Intuitively, R&D purchases per nation are variable and thus, the negative signs on the coefficients of the scale variables for Singapore and Malaysia may be due to the competitive pressures of the other Asian NIEs.

Likewise, the scale variable decline in three countries is likely to be the result of greater innovation, and thus, an increase in world consumer demand options (horizontal product differentiation). Nevertheless, the large scale elasticities indicate that non-price factors such as product innovation and product differentiation are probably a substantial driving force behind these fast-growing economies. Whether or not the national governments in these countries adopted leapfrogging international trade policies is unknown, but highly probable.

In the case of security or military technology, affiliated agencies use their discretion as to what may or may not be sold abroad. Garcia-Alonso (2000) analyzes the role of such a technology within the framework of an international trade policy model involving the U.S. with horizontal product differentiation. This study is of substantial interest since the international trade of weapons should cater to U.S. business while at the same time restricting the sale of the latest U.S. technology to potential enemies. In the United States, the Nuclear Suppliers Groups (NSG) restricts the export of nuclear technology. On the

¹⁵ The coefficients are all of a positive sign indicating a positive relationship with long-run export demand.

other side of the world, the Australia Group (AG) controls the exports of biological and chemical technology.

The individual national governments are faced with a dilemma as to how to juggle the security of the nation while at the same time allowing for weapons manufacturing firms to maximize profits. The quality of the products exported is determined by firms after the government decides upon an international trade policy. The government may choose to subsidize the domestic firms' investment in R&D or tax it. Interestingly, according to Garcia-Alonso (2000), the security technology of country i is inversely related to its maximum product quality by $S_i = -\theta_i q_{max}$, whereby θ_i is the degree of security nervousness.

The optimal policy is dependent upon the security regime and hence, the degree of security alarm. Garcia-Alonso (2000) found that "Under a bilateral security regime, if the degree of security concern of both governments is sufficiently high, a tax on R&D is the optimal industrial policy" (2000, p.763). Contrary to the research of Herguera and Lutz (2003), the sensitivity of the technology inhibits the desire for national governments to subsidize R&D investment and so too the leapfrogging opportunity of competing governments.¹⁶

In summary, the literature suggests plausible solutions to the two main issues postulated at the beginning of this paper, namely that product differentiation does influence

¹⁶ It is interesting to note that Carmen and Alonso (2000) analyze the leapfrogging advantage from the foreign firm perspective and the potential threats to security if the foreigner is an enemy.

international trade policy and vice-versa. The studies by Herguera and Lutz (2003) and Motta, Thisse, and Cabrales (1997) revealed that if the qualities of the products (vertical product differentiation) were similar for both competing firms then technological diffusion would induce the lagging industry government to engage in a leapfrogging policy. Under horizontal product differentiation, Jensen and Thursby (1996) discovered that the licensing of patents in the international market enabled the different governments to increase their differentiated new products base.

The second issue of interest was whether product differentiation leads to international trade liberalization, or not. Aggarwal (2000) revealed that deregulation policy in India improved industrial efficiency since in-house R&D efforts and technology imports became strategic complements. This improved India's international competitiveness and the degree of product differentiation increased. Audretsch and Yamawaki (1988) provide evidence that additional R&D expenditure on process innovation and product quality improvements improved Japan's competitive advantage over the United States.

Muscatelli, Stevenson and Montagna (1995) are in concurrence with the finding of this second issue of interest since it also applies to the growth of international market power acquired by the *Asian Tigers*.¹⁷ Although, contrary to the findings by Herguera and Lutz (2003), Garcia-Alonso (2000) provided insights into the horizontally differentiated military weapons industry whereby national security inhibits R&D subsidies and the international market share since profits decline.

¹⁷ The Asian Tigers make up nations in eastern Asia that have maintained high growth rates between the early 1960s and 1990s, namely Singapore, Taiwan, South Korea, etc.

3. International Trade Policy and Product Differentiation

Up until now, governments in different countries continue to shape the world's policy on matters of trade in that they pick strategies that will best fit and improve national welfare. Government policy to subsidize technology diffusion within the domestic industry and increase product innovation, are two examples of positive shocks to the economy. In both cases, there was evidence of international trade liberalization. However, one may ponder: Does product differentiation (horizontal or vertical) really lead to more liberal policies, or does it lead to more protectionist policies?

I will discuss the possible effects of the government's choice of either a *laissez-faire* or protectionist approach to the formulation of trade policy. The resulting impact of product differentiation on international markets will be looked at by the use of trade instruments, such as quotas and tariffs. This analysis is applicable to a multiplicity of different industries worldwide. The U.S. burley tobacco industry, the Belgian textile and clothing industry, and the U.S. Automobile industry will be analyzed to illustrate the policy issues.

Snell and Reed (1993) analyzed the effects of strategic government policy and vertical product differentiation on the imperfectly competitive international burley tobacco industry. Worldwide, consumers of burley tobacco find it to be highly differentiated due to perceived differences in quality. These perceived quality differentials are due in part to the implicit value that cigarette manufacturers place on different blends of burley tobacco. As a result, consumers are willing to pay an elevated price for a better quality product. Governments distort this inherent price differential to provide a means of

subsidizing the incomes of domestic tobacco farmers and to fund plant pathology research.

Over the past few decades, the United States has had the highest burley tobacco quality, and has maintained the largest export market. This country is also the largest producer, but Malawi, Italy, Japan and Brazil have recently materialized as key players in the world burley tobacco market. With this in mind, Snell and Reed (1993) investigate: "...whether countries react to U.S. burley policies and whether the United States incorporates this reaction into its policy formation." (1993, p.229)

The foreign tobacco is considered to be homogeneous and the U.S. tobacco is a differentiated product. Hence, the substitution in world markets between the two products is of significant interest and is expressed by Snell and Reed (1993, p.230) as:

$$dP_F/dP_{US} = - (\partial MS_{USF}/\partial P_{US} / \partial MS_{USF}/\partial P_F) > 0$$

where P_F is the foreign price, P_{US} is the U.S. price, and MS_{USF} is the U.S. burley tobacco share in a given foreign market. There exists a price differential (U.S./foreign) denoted α_t^* whereby manufacturers (normally government monopolies) are indifferent between buying foreign or U.S. product.

This equation represents the slope of the price indifference curve (PIC) that is instrumental in the measure of U.S. and foreign strategic trade policy. As it so happens, the U.S. enjoys an increased market share in foreign markets if the slope of its PIC is small (the curve is flat) and as a result, the U.S. is able to raise its price of burley tobacco

without its market share shrinking; this is due to the increased demand for and rents paid to higher quality tobacco.

Snell and Reed (1993) took their model one step further by endogenizing strategic government policy implementation. Empirical investigation revealed that the U.S. follows a Stackelberg model in prices, whereby Italy and Japan were the followers.¹⁸ They also found that the United States does incorporate the reactions of other countries to their burley tobacco policy into their own policy formation.

This incorporation of other countries' reactions into U.S. burley tobacco policy is due to the U.S. policy conjecture (δ_{US}):

$$\delta_{US} = \left| \frac{\partial USBX_{1t,1..t,n}}{\partial \alpha_{1t,1..t,n}} \cdot \frac{\partial \alpha_{1t,1..t,n}}{\partial P_{US1t,1..t,n}} \right|$$

where USBX is the U.S. burley export demand function and α is the U.S./foreign price differential (Snell and Reed, 1993, p.232). This policy conjecture is representative of its competitors' past reactions and U.S. penalties of resulting lost market share.

Ultimately, the authors found that a large value of α (the U.S./foreign price differential) was able to explain the decline in import demand for U.S. burley tobacco in Italy, but that it had a negligible impact on the importing behaviour in Japan. They revealed that the results reflect a relatively flatter price indifference curve (PIC) in Japan, as opposed to Italy. Also, the price differential that Japan is willing to pay is still higher than that in the world market.

¹⁸ They used time series data for the U.S. and Italy from 1960 to 1987; for Japan from 1963 to 1987.

Unlike the previous article, Kohler and Moore (2003) focus on the analysis of domestic welfare as opposed to the market share of an exporting country. This study analyzes the welfare of a domestic government pursuing a *laissez-faire* trade policy in the presence of strategic foreign policy. They first looked at the case of strategic substitutes within a duopoly model of Cournot competition. Based on a function of domestic welfare comprised of consumer surplus and domestic firm profit ($W = CS + \pi$), they concluded that an increase in the foreign strategic export subsidy (s^F) would improve domestic welfare.

The foreign government will subsidize its export market if and only if the foreign firms are profitable in the domestic market $(P - mc^F) > 0$ and if the domestic country will not implement a countervailing import tariff. The authors postulate that consumer surplus in the domestic market will increase substantially due to the reduction in the homogeneous product's foreign price. Hence, the consumer surplus of the domestic market is supposed to exceed the lost profit of domestic firms. Overall domestic welfare should improve, if and only if the foreign firm is not strategically dumping its output on the domestic market.

Secondly, Kohler and Moore (2003) studied the duopoly in the presence of Bertrand competition, product differentiation and strategic price complements.¹⁹ The Bertrand model is indicative of levying an export tax on the foreign output sold in the domestic market. An increase in the strategic foreign export tax (t^F) will bring about an overall

¹⁹ Prices are the strategic complements, since a marginal increase in P^F will have a marginal impact on the domestic firm's profits.

domestic welfare improvement the following equation holds. Thus, the derivative of domestic welfare with respect to the foreign export tax is:

$$\left. \frac{dW}{dt^F} \right|_{t^F = t^{*F}} = \frac{dP}{dt^F} \left[(-X - Y + (P - c) \times X_{P^F}) \left(-(P^F - c^F) \times \frac{Y_P}{Y_{P^F}} \times P^F \times \frac{1}{t^{*F}} \right) \right]$$

where we hold the foreign export tax (t^F) equal to t^{*F} (the optimal foreign export tax), the foreign firm sells good (y) and the domestic firm sells good (x).²⁰

Kohler and Moore (2003) rewrite the equation above in terms of the domestic price-cost markup since the authors are interested in measuring the effects of foreign policy on a) the cross-price elasticity of demand ($\epsilon_{x/y}$) and b) the degree of product differentiation ($-y_P^F/y_P$). Thus, we see that this equation becomes:

$$\frac{P - c}{P} > \frac{P^F}{P} \times \frac{1}{\epsilon_{x/y}} \times \left[\frac{t^{*F}}{P^F - c^F} \times \left(-\frac{Y_{P^F}}{Y_P} \right) + \frac{Y}{X} \right]$$

where the LHS variable $(P - c)/P$ is the domestic price-cost markup. Kohler and Moore (2003) analyze the cross-price elasticity of demand that is defined by $\epsilon_{x/y} = (\partial x / \partial P^F \cdot P^F / x)$. They found that the greater the value of $\epsilon_{x/y}$, the better the chance that *laissez-faire* domestic trade policy will improve overall domestic welfare.

In the case of product differentiation, the term $(-y_P^F/y_P)$ represents the brands' measure of differentiation (BMD). They also found that as the value of the BMD approaches 1 (the degree of differentiation increases), the more likely it is that the foreign trade policy will not improve domestic welfare. It is interesting to compare the two different duopoly models (Cournot and Bertrand) with homogenous and differentiated products. The study

²⁰ For simplicity, I have changed the superscripts denoting the foreign firm from * to F in my paper, and parallel variables without this superscript are deemed to be domestic.

suggests that a *laissez-faire* domestic trade strategy is more likely to improve domestic welfare if the different goods possess a sizeable elasticity of substitution ($\sigma_{xy} \rightarrow \infty$).

The position of lobbyists in the Belgian textile and clothing industries reflects pressure upon the domestic government to behave in a way that is more protective than a *laissez-faire* trade policy. Scheerlinck, Hens, and S'Jegers (1996) analyze the opinions of a sample of domestic firms in the industry about the potential for phasing out the Multi-Fiber Agreement (MFA) and a number of related trade issues.²¹ The authors research the question: "Do they [Belgian textile and clothing firms] favour protection or trade liberalization?" (1996, p. 724) They pulled information from an earlier industry-wide survey that was sent out to the Boards of Directors or Governing Councils of both the Association of Belgian Textile Firms and the Belgian Clothing Association.²²

Scheerlinck, Hens, and S'Jegers (1996) derived an econometric model that incorporated the main proposed determinants of domestic firm position on trade policy. In Table 3 – Trade Policy Issues and Firms' Positions (% of total response), the 8 issues (questions) based on firms' trade positions are utilized as dependent variables in a series of tested econometric equations. The three key independent variables are: the international competitive threat facing the firm, whether the firm has foreign establishments, and the degree of the firm's product differentiation.

²¹ The Multi-Fiber Agreement (MFA) is to be phased out July 1, 2005 and the WTO will then set the rules.

²² Of the questionnaires sent out (over 950), 220 responses comprised the sample pool.

It is interesting to note from the responses in Table 3 below that approximately 48% of the Belgian textile and clothing firms were opposed to the GATT phasing out of the Multi-Fiber Agreement (MFA) and that 17% were strongly opposed. Thus, the Belgian textiles industry could be classified as favouring more protectionist government policy.

Table 3: Trade Policy Issues and Firms' Positions
(per cent of total response)

Issue	Strongly in favour	In favour	Opposed	Strongly Opposed
1a EU Common External Trade Policy	21	60	13	6
1b Idem, exceptions	11	41	35	13
2a EU Internal Free Trade	45	46	8	1
2b Idem, exceptions	9	27	44	20
3a GATT, non-discrimination	21	55	21	3
3b Idem, exceptions	7	36	43	14
4a GATT, reciprocity	22	64	12	2
4b Idem, exceptions	4	32	51	13
5a GATT, import tariff reduction	8	43	36	13
5b Idem, exceptions	9	42	41	8
6 Market access for non-EU firms	4	37	45	14
7 Less restrictions on import from low-wage countries	5	17	44	34
8a GATT, phasing out of MFA	5	30	48	17
8b Firm's preferred phasing-out period of MFA (years)				

Source: Questionnaire sent June 1994 by Scheerlinck, Hens and S'Jegers (1996, p. 727): Table 1.

The authors suggested that if a Belgian firm's product is highly differentiated, then it will have a competitive advantage and will be able to thwart the entry of competitive foreign firms. If the incumbent finds it profitable to deter entry into the domestic market, it may wish to apply brand proliferation or brand preemption strategies.

Unfortunately, the results of the ordered probit and Ordinary Least Squares (OLS) tests specified only weak evidence that product differentiation was significant in explaining some of the variation in Belgian firm positions on trade policy. The ordered probit technique was employed by Scheerlinck, Hens, and S'Jegers (1996) since the regressions

focus on qualitative dependent variables that are represented by discrete ordered values. This finding is contrary to the research conducted by Pugel and Walter (1985), and Salorio (1991). Although, Scheerlinck, Hens, and S'Jegers (1996) found that the domestic firm's level of protectionism grew if their level of competitiveness and number of foreign subsidiaries declined.

The potential barriers to entry discussed for the Belgian textile market are in contrast to that in which a drop in the market's foreign quantity is due to voluntary export restraints. Similar to the findings of Kohler and Moore (2003), Chao and Yu (1996) find that foreign strategic trade policy, (i.e., voluntary export restraints (VER) in the case of the latter) is beneficial for both foreign and domestic firms. But, Chao and Yu (1996) reveal that a free-trade (*laissez-faire*) domestic import policy is irrelevant to whether or not the profits of both the foreign and domestic firm improves. Under price competition, the authors discover that in the duopolistic domestic market, the domestic firm acts as a Stackelberg leader.

Chao and Yu (1996)'s duopolistic model is comprised of two firms, one domestic and one foreign, that sell differentiated products and are exposed to constant marginal costs and linear demands. The authors make one critical assumption by adding conjectural consistency. This condition implies the absence of a simultaneous output or price choice by firms. Hence, they are able to take their rival's move into consideration before choosing the level of output to produce or the price to charge. Thus, firms are

sophisticated enough to predict their rival's reaction to their own strategic behaviour.²³ Moreover, Chao and Yu (1996) analyzed the impact that the degree of product differentiation had on the profits earned by the foreign firm.

The foreign firms' behaviour under price competition revealed that the self-inflicted voluntary export restraint (VER) created a more collusive international trading atmosphere. This result is highlighted by the following equation that displays the changes in relative prices:

$$(\partial p_f / \partial p_h)_{ER} > (\partial p_f / \partial p_h)_{CCE}$$

where the export restraint (ER) and the free-trade consistent conjectural equilibrium (CCE) are the two different trade policies. This statement exhibits that the value of conjectural variation for the scenario with the export restraint $[(\partial p_f / \partial p_h)_{ER}]$ is greater than that of free-trade. Thus, the profits of both firms, domestic and foreign, improve due to the coercive price fixing that exists in the market with ERs.

However, the magnitude of the profit increase for the foreign firm is dependent upon the degree of product differentiation. Under the voluntary export restraint foreign policy, the foreign level of output decreases and pushes up the foreign price of the good. The domestic product's price rises in accordance with this foreign adjustment, but to a lesser extent. Conversely, according to Chao and Yu (1996): "...when the home and the foreign goods are more substitutable, the gap of the conjectural variations between situations of VERs and CCE shrinks." (1996, p.108) Therefore, the decline in product differentiation

²³ This conjectural consistency condition was first proposed by Bresnahan (1981, 1989).

leads to more competition and this inadvertently makes the scale of foreign firm profits decline.

Contrary to the research by Kohler and Moore (2003) and Chao and Yu (1996), Hwang and Mai (1991) support the theory that the domestic government should levy optimal discriminatory tariffs. The authors analyze the possibility that national domestic welfare will increase if the domestic government levies differential import tariffs on different foreign countries. The authors utilize an oligopolistic Cournot-Nash model whereby two foreign firms (countries 1 and 2) compete against each other for domestic market share; one of the firms is a low cost firm (more efficient) and the other is considered less efficient due to higher costs of production.

Moreover, according to Hwang and Mai (1991): "...it is assumed that the domestic government understands the structure of the industry and is able to set credible tariffs on imports in advance of the output decisions by the two foreign firms." (1991, p.694) Thus, the domestic government proceeds by maximizing national welfare:

$$\text{Max}_{(t, t^*)} W = \int_0^Q P(v) dv - PQ + tq + t^* q^*$$

where the first two terms represent domestic consumer surplus and the last two terms signify the revenues from the domestic differential tariffs. Once product differentiation is added into the model, the authors' maximization problem becomes more invasive since they now must choose the optimal tariffs (t and t*) under this new specification.

As a result, the authors derive the equation above and arrive at the solution rule. This rule specifies the difference between optimal discriminatory tariffs as:

$$t - t^* = \frac{1 - 2\bar{\epsilon} + \epsilon\bar{\epsilon}}{3 - \epsilon} (C^*_{q^*} - C_q)$$

where t is the import tariff on country 1, t^* is the import tariff on country 2, $\bar{\epsilon}$ is the elasticity of marginal cost for both countries, $C^*(q^*)$ is the total cost function for country 2 and the total cost function for country 1 is $C(q)$. The term ϵ is representative of the degree of product differentiation; ϵ close to zero implies low substitutability between the two foreign goods, and values of ϵ close to one imply perfect substitutes.

Under a linear cost structure ($\bar{\epsilon} = 0$), as the degree of product differentiation declines ($\epsilon \rightarrow 1$), the tariff difference becomes superior to that of the cost difference. If the products were to become more homogenous, then the low cost producer would be able to infringe upon its rival's market share and increase its profits. Hence, the domestic government would levy a higher tariff on the low cost foreign firm since it would have greater taxable revenue.

This domestic government policy raises the issue of whether or not the *General Agreement on Tariffs & Trade* (GATT) policy should disqualify the usage of discriminatory tariffs for different countries, and whether the Most-Favoured-Nation (MFN) clause should still apply. As explained by Hwang and Mai (1991), their research suggested that: "...in order to maximize social welfare, a developed country ought to give preferential tariff treatment to developing nations." (1991, p.701) This issue was also analyzed by Scheerlinck, Hens, and S'Jegers (1996) whereby the position of Belgian

firms on the Multi-Fiber Agreement (MFA) and the degree of protection against third world countries was widely debated.

Klette (1994) also analyzed the domestic government's policy choice with respect to its own exporting industries, but the analysis was for an oligopolistic market. The author utilized the Cournot-Nash equilibrium that is found in the Spence-Dixit-Stiglitz model. After careful manipulation, the author derives the case for a domestic government to levy an export tax on domestic producers. The numerical case for an export tax is:

$$\left(1 - \frac{1}{vn}\right) (1 - e) - \left(1 - \frac{1}{n/2}\right) \rho > 0$$

where v is the relative number of domestic firms, n is the total number of firms, e is the scale elasticity of marginal costs and ρ refers to the degree of product differentiation.²⁴

Thus, the author summarizes by stating that: "...with price competition, the case for imposing a tax on the domestic producers is weaker the larger is the domestic consumption of the differentiated product." (1994, p.305) If domestic consumption is classified by a high degree of choice among many differentiated products (both domestic and foreign), then the government's policy to levy a tax on domestic producers would be detrimental. The tax to domestic producers would likely be borne in part by consumers and the price of domestic products would increase. Thus, the competitiveness of domestic firms would decline.

²⁴ As ρ (p) increases, so too does the homogeneity of the products.

On the other hand, imposing an export subsidy with quantity competition improves upon domestic pre-tax profits and consumer surplus if the degree of product differentiation declines. If the domestic government were to subsidize domestic firms in a market characteristic of low product differentiation, then domestic producers would be able to produce more output and hence, potentially takeover a fraction of their foreign competitor's share of the international market. This is plausible since both foreign and domestic goods are reasonably similar and hence, substitutable.

Goldberg (1995) analyzes a similar issue to that of Klette (1994) since it is of product differentiation and oligopoly in international markets. Goldberg applied this analysis to the U.S. automobile industry. The automobile industry in the United States boasts a high degree of product differentiation whereby the consumer is indeed the king. Whether or not to purchase a subcompact, luxury or sports sedan from Germany, Sweden or Japan, and the level of torque, horsepower or engine size, are all decisions that must be made. Foreign competition in the U.S. automobile industry is substantial enough that the domestic government applies tariffs on imported vehicles.

However, as put by Goldberg (1995): "...Japanese auto sales in the United States have been limited by the *Voluntary Export Restraint* (VER) that begun in April, 1981" (1995, p.892). As we see, the use of tariffs is not the only method to reduce competition... or is it? According to Chao and Yu (1996), if the domestic government pursues a somewhat *laissez-faire* trade policy, so as to be relatively non-threatening, then the trading market should become more collusive and lucrative to both trading partners. Conversely, the

U.S. government promotes protectionism. Hence, the magnitude of increased collusion is probably lower than that of a less protectionist domestic market.

Moreover, the author tested his theory that tariffs are superior to quotas in improving domestic welfare.²⁵ Unfortunately, Goldberg (1995) was not able to decipher the impact of the Japanese VER on domestic production in the United States. On the flip side, the price effects of an equivalent quota did turn up. It is implied that the quota is responsible for unambiguously raising prices and thus, reducing new car purchases.

Nevertheless, consumers in high income brackets do benefit since the relative price of higher quality luxury sedans drops. According to Goldberg (1995): "If the primary goal of the VER was to increase domestic employment rather than profits, the effectiveness of quotas seems doubtful" (1995, p.932). The author's comparison of an equivalent tariff revealed that a general tariff raises the prices of European imports more so than Japanese imports. Thus, consumers of foreign imports have less substitution possibilities and have a greater probability of switching to domestically produced cars.

In summary, there is reason to believe that one country's trade policy does influence its rival's strategic best response. Moreover, Snell and Reed (1993) uncovered that this theory was applicable to the U.S. government's burley tobacco industry trade policy. Conversely, Kohler and Moore (2003) found that the best response for a domestic market would be for the government to pursue a laissez-faire trade policy approach. Although, a more protectionist view was taken by Hwang and Mai (1991).

²⁵ Goldberg (1995) used data from the Consumer Expenditure Survey (CES) for the time period 1983-1987.

These authors put forth a logical explanation as to why the degree of product differentiation is instrumental in the government's choice of optimal discriminatory tariffs. Once applied to the U.S. automobile industry by Goldberg (1995), a tariff was deemed more successful at improving domestic welfare than an equivalent quota or voluntary export restraint (VER). Intuitively, a tariff increases the price of foreign luxury sedans, but decreases the relative price of automobiles produced in the United States.

4. The Food Industry: International Trade & Policy

4.1 Consumer Awareness and Policy in the Food Industry:²⁶

The U.S. pork industry, the global soybean industry and the French processed foods market all have one common thread: product differentiation. The presence of product differentiation allows consumers to experience a greater variety of choice, whether this is based on the quality or presence of traceability, transparency, and assurance (TTA) programs, the inclusion or exclusion of genetically-modified organisms (GMOs) or an aggregate consumer bias for domestic or European Union (EU) goods as an alternative to those from the rest of the world (ROW). These issues were analyzed by Liddell and Bailey (2001), Sobolevsky (2002), and Surry, Herrard and Le Roux (2001). Their findings deliver insights into the international trade of food products.

According to Liddell and Bailey (2001), the “mad-cow” disease (*bovine spongiform encephalopathy*) and rising media coverage of e.coli outbreaks were instrumental to the implementation of TTA programs worldwide. The United States’ competitors (the EU, Canada and Australia/New Zealand) all outpaced the U.S. rate of TTA adoption and this could prove to be detrimental to the U.S. if Japan, their largest buyer, decides to restrict the import of less regulated meat. This scenario could plausibly transpire since the Japanese import market has recently met public and political concern by placing restrictions on the import of grains produced by GMOs. Also, Japan has become stricter with the labeling of final products.

²⁶ This issue is in view of the fact that safety regulations and activism have an increasing impact on the regulation of food products today.

Due to the level of sensitivity surrounding meat products, Hobbs (1996b) found that according to supermarkets, the ability and ease of tracking the inputs of the products they bought was more heavily weighted than the competitiveness of the prices that different processors offered. With this in mind, could the United States be overlooking a possible market opportunity? Liddell and Bailey (2001) believe that this is the case and state: "... the U.S. pork industry may face additional threats to its markets in the future as consumer awareness and concerns about the processes and inputs used to produce food continue to increase." (2001, p.8)

As the U.S. pork industry experiences the possibility of lost revenues and efficiency, so too do world soybean markets. Welfare losses are to be expected while governments (notably the EU) ban the import and production of genetically-modified (GM) crops. This is unfortunate, since genetically-modified seeds grow crops that are either toxic to insects that will damage their growth, or tolerant to strong herbicides that will be utilized for the elimination of weeds. Evidence seems to suggest that the diffusion of GM crops would have substantial efficiency gains in terms of lowering costs and produce waste at the farm-level.

However, the true effect of GMOs is hotly debated. EU agriculture ministers and segments of the European public alike, turn down products containing GMOs. In a Greenpeace press release (2004), it was revealed that Austria, Greece and Italy are among the many European countries voting against the imports of the new genetically-modified

product, Monsanto's NK603 maize, in Brussels.²⁷ The benefit of such a modified product is its tolerance to the biotech company's Roundup herbicide. The opposition of GM crop imports is in view of the fact that they produce unexpected toxins and possibly allergens. Moreover, consumers are not informed about GMOs in poultry feed or in dairy products at grocery stores since labeling is not required.

Sobolevsky (2002) focuses in part on the case where production and import bans are levied on Roundup Ready (RR) products in the rest of the world.²⁸ The implications of this scenario should be felt heavily upon two of the three top producers of soybean oil, the United States and Argentina. Collectively, they produced approximately 95 million metric tons (MT) of soybeans per (1998-1999) year.²⁹ Brazil (the second largest soybean producer in the world) would not experience a negative impact since it does not include GMOs in its production process.

Sobolevsky utilized the model developed by Moschini, Lapan and Sobolevsky (2000) that evaluated the welfare effects of the introduction of GMOs in soybean production. He has added on to this existing model by specifying that RR soybeans are not a process innovation, as deemed in the past, but actually a product innovation. This revelation has altered the microeconomic theory behind the soybean, since biotech and conventional soybeans are no longer considered to be perfect substitutes in consumption.

²⁷ Source: <http://www.eu.greenpeace.org/downloads/gmo/PRonAgriCouncilVoteOnNK603.pdf>.

²⁸ Soybeans made of Roundup Ready seeds are genetically-modified ones.

²⁹ U.S. Department of Agriculture (2002a).

Hence, consumers are able to distinguish between the two different types of soybean and this creates unique aggregate demands and supplies. The right of consumers to choose between the two is of great value in the world soybean market. As a result, Sobolevsky extends the model to include the cost of separating the GM and conventional soybeans down the supply chain. The results of this model's calibration are insightful to policy for the case when the rest of the world (ROW) bans the production and import of RR products as disclosed in Table 4 below.³⁰

Table 4: Economic Impacts of the Simultaneous Production and Import Bans.
Changes from No-Ban Scenario (millions of U.S.\$)

Region	RR Production and Import Ban in the ROW				RR Production Bans in Brazil and ROW and Import Ban in ROW			
	ΔCS Total	ΔPS Total	$\Delta \Pi^M$	ΔW Total	ΔCS Total	ΔPS Total	$\Delta \Pi^M$	ΔW Total
Segregation cost: \$19.8/MT								
USA	119	-161	-411	-452	328	-474	-463	-608
BR	129	-213		-84	-294	339		45
AR	42	-130		-88	70	-224		-154
ROW	-1618	401		-1217	-1200	246		-954
World	-1327	-102	-411	-1840	-1094	-113	-463	-1671
Segregation cost: \$13.2/MT								
USA	52	-66	-393	-408	197	-288	-447	-539
BR	96	-166		-70	-236	194		-42
AR	32	-102		-70	52	-169		-117
ROW	-1166	225		-941	-872	118		-754
World	-987	-108	-393	-1489	-859	-144	-447	-1451
Segregation cost: \$6.6/MT								
USA	2	6	-304	-296	84	-120	-359	-396
BR	74	-130		-55	-167	43		-125
AR	25	-81		-56	36	-119		-82
ROW	-750	41		-709	-586	-18		-604
World	-649	-163	-304	-1116	-634	-214	-359	-1207
Zero segregation cost								
USA	33	-49	-270	-285	50	-73	-326	-349
BR	19	-25		-6	-133	-37		-170
AR	6	-19		-12	9	-26		-17
ROW	-478	-78		-557	-451	-90		-542
World	-420	-170	-270	-860	-524	-226	-326	-1077

Source: Sobolevsky (2002, p.99): Table C14 of the Appendix.

³⁰ The model's calibration was performed with the use of the U.S. Department of Agriculture (USDA) data.

The absence of GMOs in the world market for soybeans is not only detrimental to its major producers, but also to the ROW. The levying of simultaneous production and import bans is welfare reducing, as measured in millions of USD. At the highest segregation costs, the United States loses \$608 million USD, Argentina loses \$154 million USD, and the ROW incurs a loss in welfare of \$954 million USD. Interestingly, after levying the product and import bans, the ROW experiences a much greater loss in welfare than even the exporters of soybeans consisting of GMOs.

However, Brazil is the only leading exporter that posts a positive welfare change of \$45 million USD. Overall, the benefit that Brazil derives from the ban of GMOs is not significant enough to outweigh the costs incurred by the ROW and therefore, a trade policy such as this one should not be applied by governments around the world.

In France, trade policy in the processed foods market was modeled by three economists. Surry, Herrard and Le Roux (2001) have focused on two main questions: “Do French consumers discriminate between imports and home production? Or do they have a European preference at the expense of imports from the rest of the world (ROW)?” (2001, p.10) They found weaknesses in the Armington model and proceeded by developing a model that is a better fit for the processed food industry.³¹

The new model allows for the separability of products based on geographical production and it is able to capture general consumer preferences without placing restrictions on the model, such as product homogeneity and constant elasticity of substitution (CES). Surry,

³¹ In this article, the Armington model is the base of the constant difference of elasticity (CDE) model.

Herrard and Le Roux (2001) identify a weak separability of a representative consumer utility function that consists of each good (q_i), for $i = 1, 2, \dots, n$, being supplied by a set of geographically heterogeneous products (q_{is}), for $s = 1, 2, \dots, m$. The authors assume a process of two-stage utility maximization. For example, the consumer of canned fish or cheese will first decide the amount of the good(s) she demands, and then she will spend her money accordingly on domestic and imported processed goods.

This representative consumer utility function is as follows:

$$U[q] = U[v_1(q_{11}, q_{12}, \dots, q_{1m}), v_2(q_{21}, q_{22}, \dots, q_{2m}), \dots, v_n(q_{n1}, q_{n2}, \dots, q_{nm})]$$

where it is an aggregate of the subgroup indirect utility functions. Once utility is optimized subject to a budget constraint:

$$B = \sum_{i=1}^n R_i,$$

where R_i is the total expenditure of processed foods consumed, conditional Marshallian demand functions are derived and the authors introduce a link to the constant difference of elasticity (CDE) function.

This indirect, implicitly additive CDE function was utilized to measure the relative interactions between product demands based on shares of differing products. The CDE functional form is represented below:

$$\sum_{s=1}^m B_s v^{e_s b_s} z_s^{b_s} \equiv 1$$

where $z^{b_s} = (p_s/R)$ is the product price normalized by total expenditure on purchases. B_s and e_s are simply distribution and expansion parameters, respectively. The parameter b_s

denotes the normalized price variable's (z^{bs}) importance in utility. Applying Roy's identity and transforming the equation into logs has allowed the authors to develop an econometric relationship that was estimated using French data. The method of non-linear two-stage least-squares (NL2SLS) was utilized and the testing revealed a number of very interesting findings for international trade in the processed foods market.

Firstly, Surry, Herrard and Le Roux (2001) found that the estimated values of the elasticity of substitution with the use of the Armington model were biased.³² Thus, the CDE model would need to be used for policy simulations. The Armington model follows a relatively normal distribution, with the elasticity of substitution (σ) for ten of the eleven food products being between zero and four. Cheese was the exception to this observation. The Armington model measured only domestic products within France, and this may well be why the distribution is even.

The CDE counterpart revealed more scattered and potentially realistic results than the latter. The CDE model is thus less likely to be biased since it measures the elasticity of products from France with importers from the EU and the ROW. It was not evident from the estimates between the EU and France (σ_{13}), or the estimates between the ROW and France (σ_{23}) that consumers in France favored domestic or EU products over their ROW competitors.

³² Introduced by Armington (1969), the model implies that utility is homogenous and weakly separable, and that the consumer's decision is made up of two stages. In the first stage, consumers choose their level of demand for processed food. In the second stage, consumers purchase either the home-produced or imported food, or a combination of both. This model was first implemented in the 1970s to agricultural trade in the international wheat and feed grain markets.

Unfortunately, the thesis of their paper was left unanswered due to a lack of econometric reliability. The econometric estimates should be more robust; this would be likely to occur if a number of changes were to be made to their modeling and testing methods. They might consider including more than just a constant, real price indices of imports and domestic products, a time trend variable, real GNP and its price deflator as instrumental variables (IV) in the NL2SLS testing method.

Interest rates, real GDP in France and the Euro exchange rate could potentially be included in the IV test since these variables might influence consumption in France.³³ The set of instrumental variables are employed for the purpose of estimating the qualitative dependent variables: whether French consumers discriminate between imports and home production or if they have a European preference at the expense of imports from the rest of the world (ROW). As well, the authors suggested the method developed by Rimmer and Powell (1996), the constant ratio of elasticity substitution homothetic (CRESH) function, could look promising.

4.2 Game Theory and Strategic Policy in the Food Industry:

The previous articles discussed implications for trade policy that did not rely on the use of Game Theory. However, the next three articles will. International trade policies for importers such as the EU and Japan will be developed as a result of the best fit strategies in Game Theory. The unique market structure and firm behaviour surrounding each individual country will be analyzed. The domestic food market for the U.S. will be

³³ The method of instrumental variables (IV) was employed since the regressors (the price of processed food product from France and the price of imports from the EU) were correlated with the error term.

analyzed according to the magnitude of influence input and output tariffs have on the entry or exit of firms. The EU banana market, with special emphasis on Germany, will be the first differentiated market to be discussed.

Florido, Aldanondo and Jacob (2002) focused on the implementation of the New Theory of International Trade in their article since it studies: "...the importance of market structure and firms' strategies in order to determine the welfare effects of different trade policy measures." (2002, p.319) The article by Carter and MacLaren, which will be discussed soon after, also acknowledges this school of thought.

Due to the oligopolistic structure of the EU banana market, three major players (Chiquita, Dole and Del Monte) supply more than 70 per cent of their total banana imports (2002, p.322). As well, these three international conglomerates control the majority of the production in Latin America. It is interesting to question the degree of market power these banana producing firms hold within the overall global market for fruit in general.

As in the case of the Surry, Herrard and Le Roux (2001) article, weak separability is considered. In this case, weak separability implies restrictions on the elasticity of substitution between bananas and other (domestic and foreign) fruits, such as mangoes or pineapples, and between bananas of different countries. Unfortunately, the specific restrictions to place on the elasticity of substitution (σ) are not included in the article.³⁴ The linear almost ideal demand system (L/AIDS) revealed non-separability and this has

³⁴ One would expect [$1 < \sigma < \infty$], where 1 is differentiation and ∞ is homogenous (elastic demand).

an impact upon the strategies of banana producing firms since there are close substitutes that could redirect demand.³⁵

The bananas are differentiated by geographical area of production: South America (SA), Central America (CA), and Africa, the Caribbean, Pacific Ocean Countries, French overseas countries, Jamaica, etc. (OTHER). The degree of product differentiation in this study is further increased by the introduction of important scale economies from the advertising and marketing process. Through publicity investments incurred in Germany, consumers will also be able to distinguish between the different brands of bananas at a level that exceeds what each country's own production would deliver.

Based on the degree of product differentiation in the EU banana market, six models were specified according to the associated inverse demand, supply and benefit functions for each exporter. One Bertrand model (M_1), two Stackelberg models for price (M_2 & M_3), one Cournot model (M_4), two Stackelberg models for quantity (M_5 & M_6) and finally, one tacit collusion model (M_7) were tested. The Vuong (1989) econometric test was applied to test the competing models using international trade data. This test was also applied by Carter and MacLaren (2002), and will subsequently be discussed at greater length.

The result of the non-nested hypotheses test of Vuong (1989) discloses a midway strategy for multinational firm behaviour that is between the Cournot and collusion models. The Stackelberg model for quantities (M_5) included: one firm from CA, four firms from SA,

³⁵ The linear almost ideal demand system (L/AIDS) was developed by Deaton and Muelbauer (1980).

and twenty-four firms from the category OTHER. This model reveals that firms take on a leader-follower strategy in quantities, whereby the firms with the greatest market power (Chiquita, Dole and Del Monte) engage in collusion and set the market's production level at the start of the game. The rest of the firms act as followers and pick up the remaining share of output to be supplied in the market. Interestingly, the results obtained above prove to be somewhat contrary to those found by Carter and MacLaren (2002) for another type of perishable product (meat).

Carter and MacLaren (2002) conclude that multinationals trading perishable products (beef) should adopt a trading strategy based on price. This is a more general result since it applies to a market that is not characterized by vertically integrated companies. Their result is sensible for the case of meat products, whereas the Stackelberg model for quantities found by Florido, Aldanondo and Jacob (2002) is optimal for banana multinationals since they benefit from the ability to regulate quantity through contract farming in South America and Central America. As well, quantity is the strategy of choice for the international banana market since there is a purposeful excess production of bananas on plantations to hedge the risk of crop destruction by hurricanes and/or other natural disasters.

Surprisingly, Carter and MacLaren (2002) explain the reasons behind why either a price or quantity strategy should be adopted in a conflicting way from that of Florido, Aldanondo and Jacob (2002). They argue that using price as the strategic variable should be used for less perishable commodity stocks, such as rice, and wheat (2002). This

conflicts with their end result of price competition in the highly perishable global beef market.

Japan is the world's largest import market for beef. Carter and MacLaren (2002) analyzed the strategic interactions between the two leading beef exporters, the U.S. and Australia. Contrary to the New Empirical Industrial Organization (NEIO) approach applied by Karp and Perloff (1989), they consider horizontal and vertical product differentiation. The Japanese beef import market suits this criterion since its products are highly diversified at the wholesale level, such as: chilled/frozen beef, carcass cuts, and the feed of the cows (grain or grass fed).

Quality issues were also means for product differentiation since the beef from the U.S. was regarded as being of higher quality. For simplicity, they modeled the U.S. as exporting high quality beef that is grain-fed, and Australia as exporting low quality grass-fed beef. On the flip side, Japanese consumers distinguish between the appearance of the packaged beef, the fat content and taste. The best fitting strategy for this market was tested by the same means as Florido, Aldanondo and Jacob (2002), the test developed by Vuong (1989).

Carter and MacLaren (2002) applied the Vuong (1989) test with the use of international trade data from the Japanese Ministry of Finance and the International Monetary Fund (IMF). This test utilized the likelihood ratio (LR) for each pair of the fifteen possible non-nested hypotheses of model selection based on Cournot, Bertrand or Stackelberg. The

results from this statistical test revealed that the Stackelberg model with price leadership by Australia best fit the data. This result is counterintuitive. I would probably not think of the U.S. as being the follower in the global beef market since the U.S. has a larger economy than its competitor and it exports the high quality product (grain-fed beef).

Lanclos and Hertel (1995) analyzed the effects of tariffs on intermediate farm and food inputs, and final goods in the U.S. food processing industry. Likewise, this article is depicted by imperfect competition, but this time it is monopolistic competition since the firms within this industry produce differentiated consumer goods. The effects of these tariffs on firm cost structure, market structure: entry and/or exit of firms, and output levels were of interest to their research. The authors perform a numerical testing of this model's unique endogenous product differentiation as effected by a simplistic tariff (T).³⁶

Lanclos and Hertel (1995) make use of the Venables model of monopolistic competition (Venables, p.700). This model allows for regional variation in the share of purchases on domestic and foreign consumer goods that are the result of preference biases. They extend the scope of this model since up until now, research on trade has relied upon symmetric preferences (e.g., Krugman 1981). Given that the effect of a tariff on both intermediate inputs and final goods simultaneously is ambiguous, the result from just a tariff on the inputs will be analyzed.

The authors proceeded by calculating the change in output per firm (qf_1) in country 1:

$$qf_1 = -p_{11} = -MK_1\Omega_1^L t$$

³⁶ Where $T = (1 + \tau)$ signifies the power of the tariff and τ is the rate of the tariff.

where $-MK_1\Omega_1^1t$ is the marginal cost (MC) and output per firm (qf_1) moves in an opposite direction than the change in the price level, which is equal to the MC. As well, the use of estimates for the mark-ups (MK) and cost shares (Ω_1^1) are essential to their calculations; it should also be noted that t is the change in the tariff. Country 1 is the *relatively* small importing economy that levies the tariff (the U.S.) and country 2 is the rest of the world (ROW).

Output per firm declines following the 1% tariff on imports of farm and food producer goods in all of the five food processing industries listed in Table 5. This numerical illustration includes industries that are likely to be classified by product differentiation and imperfect competition. This result is not surprising since a tariff on intermediate inputs raises the cost of production the producer incurs and thus, she produces less as a result of this tariff.

The table points out an interesting observation w.r.t the level of the cost share incurred by a specific industry. Comparison of the milled consumer goods (MCG) and the beverages (Bev) industry reveals that the drop in output per firm is larger in the industry with the higher cost share. *Ceteris Paribus* (including respective mark-ups), the MCG industry experiences a decline of 31%, whereas the Bev Industry realizes a drop of only 12%. Lanclos and Hertel (1995) also calculated the change in the number of firms (n_1) operating in the U.S. food processing industry. They conclude that a levied tariff on inputs would also cause a decline in the number of firms in all of the five industries.

Table 5: Percentage Change from a 1% Tariff on Imports of Farm and Food Producer Goods.³⁷

Commodity	Cost Share ^a	Mark-ups	qf_1	n_1	$q_1(M)^b$	$q_1(P)^b$
Fruit and veg. (FV)	0.21	1.20	-0.25	-0.67	-0.92	-0.53
Mil. Cons. Goods (MCG)	0.25	1.25	-0.31	-0.64	-0.95	-0.54
Confect. (Con)	0.29	1.21	-0.35	-0.87	-1.12	-0.70
Beverages (Bev)	0.10	1.25	-0.12	-0.26	-0.38	-0.22
Other food (OF)	0.22	1.17	-0.26	-0.82	-1.08	-0.62

^a Source: Tables A.1 and D.1 from Peterson (1989). (Cost share refers to all farm and food inputs used by the sector).

^b M = monopolistic competition, P = perfect competition.

In Table 5, the final fifth and sixth columns $q_1(M)^b$ and $q_1(P)^b$ reveal that the effects are more pronounced under imperfect competition. Thus, there is evidence that in a market with product differentiation, a 1% tariff on imports reduces output by more than if perfect competition were the case. In other words, firms exit this food processing market in search of greener pastures where the costs of production are less expensive!

In summary, Liddell and Bailey (2001) suggest that the U.S. will face additional threats to its markets if its pork industry does not speed up its rate of traceability, transparency, and assurance (TTA) program implementation.³⁸ Similarly, horizontal product differentiation would be lessened if the world decided to collectively ban imports of genetically-modified organisms (GMOs). Even if the absence or presence of GMOs is mainly a quality issue, it is also an issue of heterogeneous consumer preferences since an industry based on Organic foods is gaining market power. Unfortunately, the article by Surry, Herrard and Le Roux (2001) did not draw any firm conclusions considering product differentiation and the product market in France.

³⁷ Table 5 represents the percentage change in output per firm, number of firms, and total sectoral output from a 1% tariff on imports of farm and food producer goods.

³⁸ The Japanese pork market is one that is classified by vertical product differentiation.

Instead of focusing on ethical reasons for international trade policy, the second part of this section discussed the impacts of strategy. In the EU banana market, Florido, Aldanondo and Jacob (2002) found collusion to be the best strategy for Chiquita, Dole and Del Monte. Unexpectedly, Carter and MacLaren (2002) found that the Stackelberg model with price leadership by Australia best fit the data. This result was counterintuitive since the Japanese beef market is typical of vertical product differentiation and Australia is the low quality beef exporter. Moreover, Lanclos and Hertel (1995) find that a 1% tariff on imports of farm and food producer goods decreases output by far more in a monopolistically competitive market.

5. Concluding Remarks

This paper is a comprehensive review of the literature on product differentiation and international trade. The second section revealed some interesting findings concerning technological diffusion in international markets. The studies by Herguera and Lutz (2003) on subsidizing product innovation, and the parallel work by Jensen and Thursby (1996) on the licensing of patents in the international market have revealed that technological innovation increases the degree of product differentiation.

Aggarwal (2000) revealed that trade liberalization policy in India improved its efficiency since in-house R&D efforts and technology imports became strategic complements. Muscatelli, Stevenson and Montagna (1995) are in concurrence with this finding since it also applies to the growth of international market power acquired by the *Asian Tigers*.

Once this knowledge was applied to the third section on international trade policy, I discussed how there is reason to believe that one country's trade policy does influence its rival's strategic best response. Snell and Reed (1993) uncovered that this theory was applicable to the U.S. government's burley tobacco industry trade policy. Conversely, Kohler and Moore (2003) found that the best response for a domestic market would be for the government to pursue a laissez-faire trade policy approach. On the other hand, a more protectionist view was taken by Hwang and Mai (1991).

But, how would this apply to one specific industry, say the food industry? Liddell and Bailey (2001) found that the liberalization of the international trade of pork would have a

detrimental impact on the U.S. if they did not improve the advertised quality of their product. Thus, vertical product differentiation increases as trade liberalization does. Similarly, horizontal product differentiation would be lessened if the world decided to collectively ban imports of genetically-modified organisms (GMOs). Thus, another argument for the negative relationship between product differentiation and protectionist trade policy.

Strategically, a liberalized international market typical of product differentiation results in collusion for Chiquita, Dole and Del Monte in the EU banana market. Unexpectedly, Carter and MacLaren (2002) found that the Stackelberg model with price leadership by Australia (the low quality beef exporter) best fit the data. Moreover, Lenclos and Hertel (1995) find that a 1% tariff on imports of farm and food producer goods decreases output by far more in a monopolistically competitive market. Thus, protectionist policy is more damaging in a market with a high degree of product differentiation.

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