A Game Theory Model of Welfare Analysis for Price Change of Imports

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Abstract

Trade theory generally advocates for free trade yet protectionisms persist in many markets based on government action often supported by domestic firms in the industry. Using a three-stage game theory model the paper shows that the total surplus in the domestic economy can be anticipated to increase when the price of imports increases if the number of firms in the domestic industry is sufficiently small and the cross price elasticity of domestic product to import price is sufficiently inelastic. The paper further shows that the degree of product differentiation or substitutability among the domestic products is also important determinant of the welfare outcomes of imported good prices on total welfare in the economy. The study provides predictions regarding the conditions under which it can be anticipated that a welfare (i.e., total surplus) maximizing government would implement protectionist policies even if consumer surplus would be harmed by such actions.

JEL Classifications: F12, F13, L13

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1. Introduction

It is generally accepted that free trade improves welfare through efficiency gains as well as the realization of production and consumption opportunities in the economy. Free trade has therefore been promoted as a prefer policy posture as compared with other trade policies, such as protectionism, to be pursued by government. Nonetheless, it can be anticipated that the welfare effects of international trade policies will be affected by the competitive structure of the domestic market.

Consumer and producer surpluses represent common metrics used to demonstrate the social welfare gains from free trade. The pursuit of free trade in the international area is however muted by the persistence of protectionism. Hence, a social welfare maximizing government choice of protectionism can seemingly only be explained by the government being co-opting by special interest groups (Baldwin and Magee, 1998). If this special interest emerges from the production section, then clearly the industrial structure can not be perfectly competitive within the domestic market given the zero profit condition. The co-opting of government to implement protectionism by industry must therefore be dependent on the market structure being bounded away from perfect competition. On the other hand, it is difficult to demonstrate how the interest of consumers (e.g., consumer welfare) can be improved by protectionism without making direct reference to consumer income (or marginal value product) so implying a corresponding argument for producer surplus.

Trade policies, such as tariff, quota, VRE, affect the price of the import goods. The stylized analysis of trade policy argues that protectionism decreases welfare because this policy tends to increase the price of imported good comparing to the free trade

(Krugman and Obstfeld 2003, Yarbrough and Yarbrough 2005). This postulate is based on the assumptions of perfect competition and no distortions in production or consumption as well as perfect substitutability between imported good and domestic produced goods.

The literature on the welfare effects of free trade under imperfect competition is pioneered by Brander (1981), Brander and Krugman (1983) and Brander and Spencer (1985). These papers relate to the discussion the welfare effects of free trade using the two country Cournot duopoly model. Clarke and Collie (2003) argue that there are always welfare gains from free trade using the Bertrand duopoly model with differentiate products. They conduct a two-country Bertrand duopoly model with linear demands and constant marginal costs. In this model, there is a single imperfectly competitive firm in home country and another in the foreign country resulting in welfare gains no matter whether there is unilateral or multilateral free trade. Douglas R. Nelson and Shunichi O. Tsutsui (1994) examine the effect of industrial policy (subsidies to scale) and trade policy (subsidies to exports and quantity controls on exports). The paper follows Brander-Spencer (1985) model but relax the capacity choice. Several other authors provide some discussions about welfare effect with the price change of imports (Webb 1992, Dixit 1987, Day and Mohanty 1987, Anderson, Schmitt and Thisse 1995). However, most of these papers focus on restrictive trade policy such as anti-dumping duties.

The literature has covered the welfare effect of free trade based on either Cournot duopoly or Bertrand duopoly. However, there has been no through analysis of the welfare effects of free trade under *N*-firm Cournot model with differentiated home produced products. Our paper attempts to address this gap in the literature. Specifically, this paper

analyzes the welfare effect of protectionist trade policy in an economy with a home good produced under oligopolistic competition and the good being a near substitute to the imported good. The price of the imported good is used as a proxy for the level of protectionism imposed by the domestic government. On the other hand, the variation of the number of firms in the *N*-firm Cournot-Nash model provides a mechanism for approximating the market structure. A game theoretic framework is used to represent the economy. In particular, at stage one, the government chooses a trade policy to maximize total surplus (i.e., consumer and producer surplus). The trade policy is assumed to be a discrete choice between protectionist and free-trade for simplification. At stage two, the firms (assuming with the same marginal cost) in the domestic industry observes the government's trade policy and chooses the level of output to maximize profit given the anticipated consumer demand. At stage three, the consumer observes the prices of the domestic and imported goods and chooses the level of each good to maximize utility given income.

The key results of the paper are the number of domestic firms, the substitutability between domestic and imported goods as well as the level of differentiation among the domestic goods under protectionism will influence whether or not welfare gain are achieved from the home government switches its trade policy from protectionism to free trade.

The analysis of this paper is organized as follows. Section 2 considers a basic model focuses on the welfare effects when the domestic industry produces a homogenous product. Section 3 modifies that model to consider differentiated domestic products. Section 4 provides concluding remarks.

2. Basic Model of Homogenous Domestic Substitute Product

Consider an economy with identical consumer in the home country with preferences over two goods denoted by Q_1 and Q_2. Good Q_2 is produced in a foreign country and imported by the home country while the good Q_1 is domestically produced. It is assumed that Q_1 is an imperfect substitute for Q_2. For instance, consider an economy importing foreign styled clothing and domestic firms producing locally styled clothing. Labor is assumed to be the only factor of production in the home country and it can be purchased in a competitive market at a constant wage rate. All home country producers of Q_1 are assumed to be profit maximizing and have the same cost function denoted by $C(q_{1i})$, where: q_{1i} is the production of the *i*th firm in the industry producing a total output $Q_1 = \sum_{i=1}^{N} q_{1i}$. The economy also consists of a government that determines the trade policy to maximizing social welfare.

2.1 Homogeneous Substitute Goods

In the follows, the sequential game is formally described and solved through backwards induction.

At stage three, the consumer chooses the utility maximizing consumption level of the foreign good, and the homogenous near substitute domestic goods given the price of the foreign good P_2, the price of the home good P_1, and income *Y*. The consequence of the consumer's choice is represented by a quadratic indirect utility function follows:

$$V(P_1,P_2) = -a_1P_1 - a_2P_2 + \frac{b_1}{2}P_1^2 + \frac{b_2}{2}P_2^2 - dP_1P_2 + Y = v(P_1,P_2) + Y, \text{ where } a_1 > a_2 > 0 \qquad (1)$$

Since the price and income are separable in equation (1), price changes do not involve an income effect. Applying Roy's identity, the demand functions are

$$Q_i = a_i - b_i P_i + dP_j \quad \text{where } i, j = 1, 2 \; ; i \neq j \quad \text{and } b_i > d > 0. \tag{2}$$

Here, b_i and d can be viewed as factors of own-and cross-price elasticity of demand. If $d = 0$, the market demands for the two goods are independent. As d rises, the products become more substitutable and the total demand becomes more elastic. The assumption of $b_i > d > 0$ ensures that the products are substitutes with the own-demand effect exceeding the cross-effect. For the domestic production sector, we assume there are N firms producing total output of a homogenous good in the home market denoted by Q_1.

At stage two, the firms anticipate the market demand denoted by equation (2) and chooses the profit maximizing level of output. Therefore, it can be demonstrated that the social welfare in the home country is:

$$W = v(P_1, P_2) + Y + P_1 \sum_{i=1}^{N} q_{1i} - \sum_{i=1}^{N} C(q_{1i}) = v(P_1, P_2) + Y + P_1 Q_2 - NC(q_{1i}) \tag{3}$$

where $C(q_{1i})$ is the total cost function of firm i in the home economy.

At stage one, the government chooses protectionism over free trade if social welfare is decreasing when the price of the foreign good decreases. The impact of the foreign price on the social welfare of the country is given by the derivative of W with regard to P_2. From equation (3) and using Roy's identity, we obtain[1]

$$\frac{\partial W}{\partial P_2} = -Q_2 + (P_1 - C'(q_{1i})) \frac{\partial Q_1}{\partial P_2} \tag{4}$$

The first term of Equation (4) reflects the change in consumer surplus associated with imported good market which is as expected inversely related to the foreign imports.

[1] The detailed derivation is shown in Appendix (A).

The second term of Equation (4) reflects the change in the total welfare in the home substitute goods market and is positive only when P_1 exceeds the marginal cost (i.e. $C'(q_{1i})$). Therefore, the argument for free trade with perfectly competitive market is obvious.

Under perfectly competitive market, P_1 equals to marginal cost $C'(q_{1i})$ so that equation (4) implies $\partial W / \partial P_2 = -Q_2$ which is always negative when imports occur. A welfare maximizing government therefore has an incentive to choose to lower protectionist barriers and promote free trade as mechanisms for reducing the price of the imported good and increasing welfare. This situation can be explained in the other way. When home substitute good market is perfectly competitive the Lerner Index approach to zero. Therefore, the total welfare will be always negatively relating import price.

It follows that imperfect competition in the substitute good market in the home economy implies that $P_1 > C'(q_{1i})$. The change in the home country's total welfare depends on the home firms' price setting strategy and the change in the quantity of home production associated with the price change of imported good. In the Cournot-Nash model of oligopolistic competition, the home price P_1 is a function of the number of the domestic firms, *N*, in the industry. The relationship between the home price and the number of firms in the industry is represented by $P_1(N)$, where: it is assumed that $\partial P_1(N) / \partial N < 0$. As shown in Appendix (B), it therefore follows that there exists a value for *N*, say N_0, defined by:

$$\mathrm{N}_0 = \left\{ N : -Q_2 + [P_1(N) - C'(q_i)]\varepsilon_{12} \frac{Q_1}{P_2} = 0 \right\}$$

where ε_{12} is the elasticity of demand for the home good with respect to the foreign good price.

The proposition below follows directly from this relationship.

PROPOSITION 1:

If $N > N_0$, then $\partial W / \partial P_2 < 0$ meaning a decrease in the foreign price is welfare improving for the domestic industry. Otherwise, $\partial W / \partial P_2 > 0$ when $N<N_0$ meaning a decrease in the foreign prices is welfare decreasing for the domestic economy.

The proposition implies that welfare is inversely related to the foreign price when the number of firms producing the substitute good in the home industry is sufficiently large. A sufficiently large number of firms are consistent with perfect competition and a lack of incentives for producers to lobby for protectionism. On the other hand, $N < N_0$ implies that the negative impact on producer surplus is not sufficiently offset by consumer surplus gaining from a decrease in the foreign good price when switching from protectionism to free trade. This result is obviously also dependent on the cross elasticity of demand.

A change in the foreign price has no impact on domestic welfare when the demand is perfectly cross inelastic as $|\varepsilon_{12}| = 0$. As the cross elasticity of demand becomes more elastic (i.e. $|\varepsilon_{12}|$ increases), N_0 decreases meaning that proposition holds for a small industry size then otherwise. This observation is explicitly expressed below.

PROPOSITION 2

The total welfare of the home country will decrease (increase) with a price increasing (decreasing) of imported good when

$$\frac{\partial W}{\partial P_2} > 0 \text{ if } \varepsilon_{12} > \frac{R_{21}}{L_1} \quad \text{or} \quad \frac{\partial W}{\partial P_2} < 0 \text{ if } \varepsilon_{12} < \frac{R_{21}}{L_1}$$

where R_{21} *is the revenue ratio of imported good to home produced good (i.e.* $R_{21} = P_2 Q_2 / P_1 Q_1$ *) and* L_1 *is the Lerner Index of the domestic firms,(* $i.e.\ L_1 = (P_1 - C')/P_1$*).*

2.2 **A Numeric Example**

A numeric example is provided here to support the analysis. We assume that there are *N* home firms with the same increasing marginal cost competing in quantity in the home produced goods market. Specifically, these firms play a Cournot competition game taking the price of the imported goods P_2 as given. The total cost function of home firm *i* is as $C(q_{1i}) = cq_{1i}^2/2$, where *c* > 0. Then, the firm's marginal cost is $C'(q_{1i}) = cq_{1i}$. The demand curve is as defined in equation (2).

The *i*th firm chooses q_{1i} to maximize profit resulting in the following reaction function:

$$r_i(q_{-1i}) = \arg\max[\frac{1}{b_1}(a_1 + dP_2 - Q_1)q_{1i} - \frac{1}{2}cq_{1i}^2] \text{ for all } i \in \{1,2,3..,N\} \qquad (5)$$

The symmetric Cournot-Nash equilibrium output for each of the *i*th firm is given by: $q_{1i} = q_1^c = Q_1^c / N$. Then,

$$q_1^c = \frac{a_1 + dP_2}{N+1+b_1 c} \ , \ \ Q_1^c = Nq_1^c = \frac{N(a_1 + dP_2)}{N+1+b_1 c} \tag{6}$$

From the demand function (2), we have

$$P_2 = \frac{1}{d}(Q_1^c - a_1 + b_1 P_1^c) \tag{7}$$

Combining (6) and (7), we have the "Cournot Expansion Path (CEP)":

$$P_1^c = \frac{(1+b_1 c)}{Nb_1} Q_1^c = \frac{1+b_1 c}{b_1(N+1+b_1 c)}(a_1 + dP_2) \tag{8}$$

The CEP gives the relationship between the Cournot equilibrium price P_1^c and the imported goods price P_2, holding the number of home firms as given. Equation (8) illustrates clearly how the price of home produced goods changes under the change of imports when the domestic market is oligopolistic.

Since the firm's marginal cost can be written as $C'(q_1^c) = cq_1^c = cQ_1^c / N$, Equation (8) can be written as:

$$P_1^c - C'(q_1^c) = \frac{a_1 + dP_2}{b_1(N+1+b_1 c)} \tag{9}$$

Substituting (8) into (2), we have

$$Q_2 = a_2 - b_2 P_2 + dP_1^c = a_2 - b_2 P_2 + \frac{d(1+b_1 c)(a_1 + dP_2)}{b_1(N+1+b_1 c)} \tag{10}$$

Taking (6), (9) and (10) into (4), we have the direction of welfare changes when there is a price change of imported good,

$$\frac{\partial W}{\partial P_2} = -Q_2 + (P_1 - C')\frac{\partial Q_1}{\partial P_2} = -[a_2 - b_2 P_2 + \frac{d(1+b_1 c)(a_1 + dP_2)}{b_1(N+1+b_1 c)}] + \frac{Nd(a_1 + dP_2)}{b_1(N+1+b_1 c)^2} \tag{11}$$

It is obvious that equation (11) is greater than zero only if $a_2 - b_2 P_2 < 0$.[2] This result brings us the following corollary.

Corollary 1

Given the linear demand functions for both imported good and home produced like good, home country's welfare may be decrease with import price decreasing and increase with import price increasing when the import price is relatively high i.e. $a_2 - b_2 P_2 < 0$.

The intuition of Corollary 1 is obvious. If the import price is relatively high there is relatively large number of consumer demand domestic produced product. Then, any changes of import price will have a large effect on the total welfare in the domestic good market.

Since the domestic produced good is a substitute good to the imported one, the substitutability between two goods will play a very important role in the welfare analysis. To clearly illustrate this, we conduct data simulation by interesting on *d* and *N* given a_1 = 40, a_2 = 30, b_1 = 5, b_2 = 3 c = 5 and P_2 = 11. The simulation results are presented in Figure 1.

Figure 1 show that the welfare change with the change of imported price dominated by both number of domestic firms and cross substitute factor *d*. It appears that the change of welfare will positively relate to the imported price when there are a large number of domestic firms (*N*) and a small cross substitute factor between the home and

[2] See Appendix (D) for the proof.

imported goods (*d*). In order to see the effect of market structure on the welfare change, we parameterize cross substitute factor, *d*, by choosing $d \in \{1, 2, 3\}$ and iterate on *N*. The results are showing Figure 2.

Figure 1 Effect of Imported Good Price on Welfare ($\partial W / \partial P_2$)

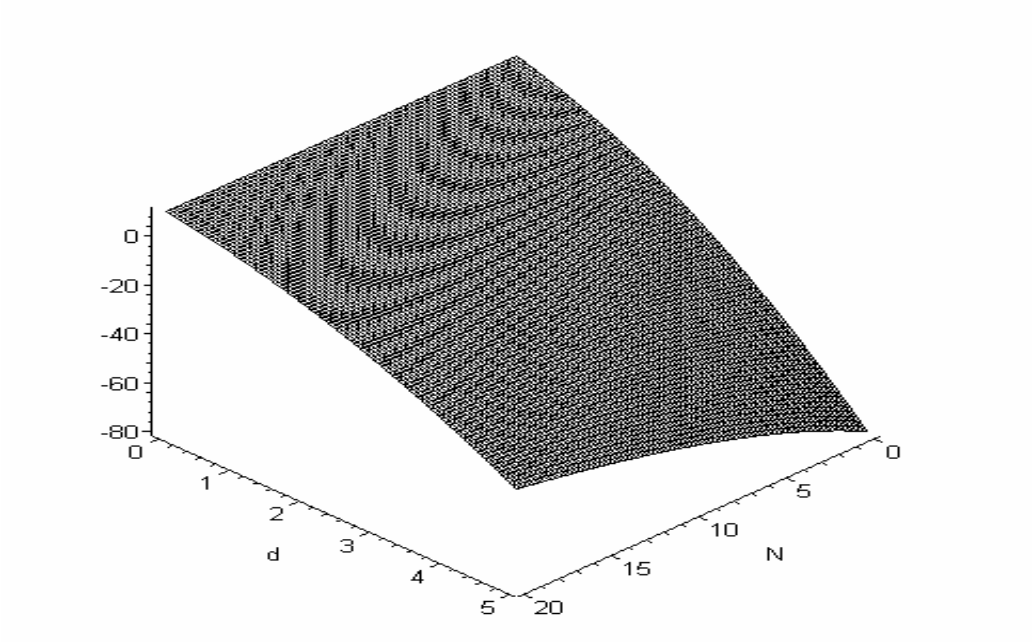
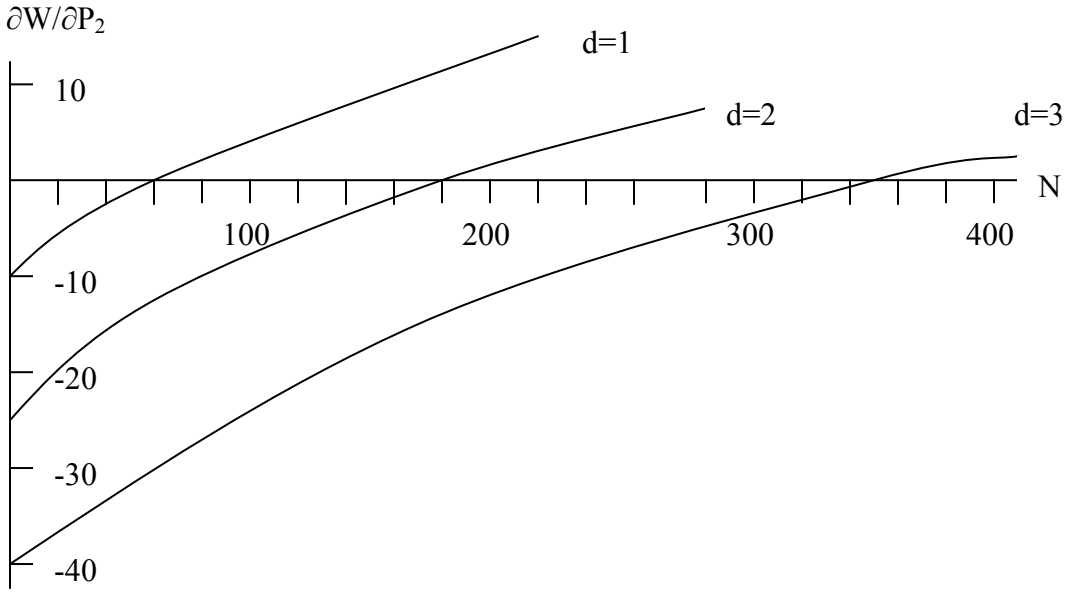


Figure 2demonstrates that the value of $\partial W / \partial P_2$ will be greater than zero if *N* is relatively large and *d* is relatively small. Specifically, when *d* is relative small, fewer consumers will switch their consumption to imported goods if the price of the imported goods drops. The consumer surplus gain from imported good market will be small when *d* is relatively small. Therefore, the total surplus loss emerges from a large number of domestic firms in the home produced good market can possibly larger than the consumer surplus gain in the imported good market. Thus, the aggregated total surplus cross both domestic produced good market and imported good market will decrease with a decrease in the price of imports. This result brings us another corollary as follows.

Figure 2 The Welfare Changes and the Substitutability between Domestic and Imported Goods



Corollary 2

The price decrease in imported good more likely will decrease home country's welfare if the imported good has a relatively high differentiation from the domestically produced good.

3. The Model of Differentiated Substitute Domestic Goods

An economy with the near substitute to the imported good is now generalized to consider differentiated goods being produced in the domestic market. For instance, in an eastern country the domestic economy produces clothing that is differentiated according to manufacturer in the domestic market yet these goods remain near substitutes to the imported good, such as, local traditional clothing produced by different local

manufacturer and western clothing is imported. To simplify the model we assume that consumer's preference can be represented by a quadratic utility function[3]

$$U = Q_0 + \alpha(Q_1 + Q_2) - \frac{1}{2}[\beta(\sum_{i=1}^{n} q_{1i}^2 + Q_2^2 + 2\theta\sum_{i=1}^{n} q_{1i}Q_{-1i}) + 2\gamma Q_1 Q_2] \quad (12)$$

which yields the following demand functions

$$P_{1i} = \alpha - \beta(q_{1i} + \theta Q_{-1i}) - \gamma Q_2 \quad (13)$$

$$P_2 = \alpha - \beta Q_2 - \gamma Q_1 \quad (14)$$

where P_{1i} is the price of q_{1i} and $Q_1 = \sum_{i=1}^{n} q_{1i}$, $Q_{-1i} = \sum_{j=1}^{n-1} q_{1j}$, $i \neq j$.

The parameter θ measures the degree of product differentiation for the home produced goods. If θ = 0, demands are independent and each home producer is then a monopolist of its own brand within the domestic market. If θ =1, and the products are homogeneous as discussed in the previous section. In what follows, we assume θ ∈ (0, 1) which means that home produced goods are imperfectly substitutable for each other.

At stage two, the *N* domestic producers engage in a Cournot-Nash game taking the price P_2 as given. It is assumed that the domestic firms have a constant marginal cost, *c*, to simplify the analysis. The reaction function of firm *i* is:

$r_i(q_{-1i})$= arg max$(\alpha - \beta q_{1i} + \beta\theta Q_{-1i} - \gamma Q_2 - c)q_{1i}$

The reaction function for the i^{th} firm can be observed to be linear in q_{1i}. Hence, a symmetric single-period Couront Nash equilibrium exists in which $q_{1i} = q_1^c$ witch implies $P_{1i} = P_1^c$. In this case, we solve *N* reaction functions and have

[3] For simplification it is assumed that $\alpha_1 = \alpha_2 = \alpha$ and $\beta_1 = \beta_2 = \beta$ in the generalized model comparing to the previous section.

$$q_1^c = \frac{1}{\beta[2+(N-1)\theta]}(\alpha - \gamma Q_2 - c) \tag{15}$$

The total output of the domestic produced goods is

$$Q_1^c = Nq_1^c = \frac{N}{\beta[2+(N-1)\theta]}(\alpha - \gamma Q_2 - c) \tag{16}$$

Then, at Nash equilibrium the demand function (13) becomes,

$$P_1^c = \alpha - \frac{\beta[1+(N-1)\theta]}{N} Q_1^c - \gamma Q_2 \tag{17}$$

Solving Q_2 from (17)

$$Q_2 = \frac{\alpha - P_1^c}{\gamma} - \frac{\beta[1+(N-1)\theta]}{N\gamma} Q_1^c \tag{18}$$

Substituting (18) into (16), we have the Cournot Expansion Path (CEP):

$$P_1^c = \frac{\beta Q_1^c}{N} + c \tag{19}$$

Again from the demand functions (14),

$$Q_2 = \frac{1}{\beta}(\alpha - P_2 - \gamma Q_1^c) \tag{20}$$

Substituting (20) into (16),

$$Q_1^c = \frac{N[\beta(\alpha - c) - \gamma(\alpha - P_2)]}{\beta^2[2+(N-1)\theta] - N\gamma^2} \tag{21}$$

In this paper we have an implicit assumption of $P_2 > c$ which means we exclude the case of below cost dumping. Also we assume that there exists a certain level of differentiation among the domestic produced goods which means

$$\theta > \frac{N\gamma^2 - 2\beta^2}{\beta^2(N-1)} \tag{22}$$

At stage one, the government choose protectionism over free trade if $\partial W / \partial P_2 > 0$. In order to simplify the model without loss generality we sign some numerical numbers to some parameters in the model with $\alpha = 40, \beta = 5, c = 5, P_2 = 11$ and $\gamma = 3$[4]. It is known that $\partial W / \partial P_2$ is reflected by equation (4) and the frontier defined by $\partial W / \partial P_2 = 0$ can be expressed in terms of (θ, N) space using equation (19), (20) and (21).[5] Specifically, we have:

$$\frac{\partial W}{\partial P_2} = \frac{1320N}{[50 + 25(N-1)\theta - 9N]^2} - \frac{29}{5} + \frac{264N}{5[50 + 25(N-1)\theta - 9N]} \tag{23}$$

To see the effect of market structure of domestic industry on the welfare change, we parameterize the differentiation factor, θ by choosing $\theta \in \{0.4, 0.6, 0.7\}$ and iterate on N. The results are showing Figure 3.

Figure 3 suggests that a decrease in the foreign price causes welfare to decrease (i.e. $\partial W / \partial P_2 > 0$) when the domestic product is sufficiently differentiated (e.g. θ decreases) and the number of firms is sufficiently large (e.g. N increases). On the other hand, if given the number of domestic firms, say $N > N^0$ the welfare is more likely decreases with a decrease in the foreign price when $\theta < \theta^0$[6].The opposite situation will hold when $N < N^0$. The relationship between the number of firms in the domestic industry and the level of product differentiation in the domestic market along the frontier of the implicit function $\partial W / \partial P_2 = 0$ can be reflected in Figure 4.

[4] Since we are interested the differentiation among the domestic goods the role of γ is treated a fixed value here.

[5] As in equation (4), $\frac{\partial W}{\partial P_2} = -Q_2 + (P_1 - C'(q_{1i}))\frac{\partial Q_1}{\partial P_2}$. For detailed derivation see the Appendix (E).

[6] Let $\frac{\partial W}{\partial P_2} = 0$ and solve the θ in terms of N we have $\theta^0 = \frac{1}{N^0 - 1}\left(\frac{393N^0 + 2\sqrt{4356N^{0^2} + 47850N^0}}{725} - 2\right)$.

Figure 3 The Welfare Changes and the Level of Differentiation Among the Domestic Goods

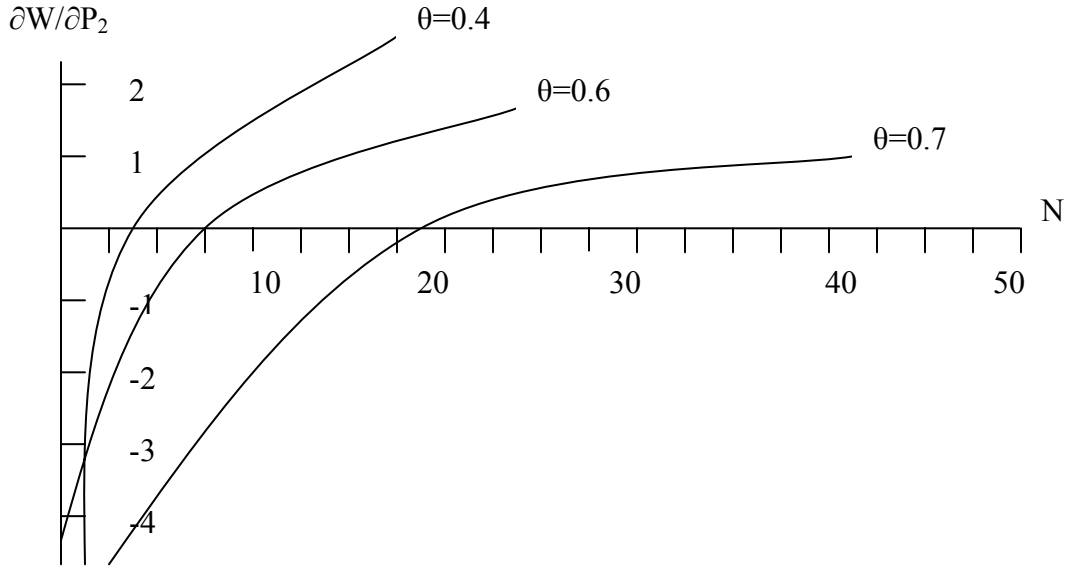
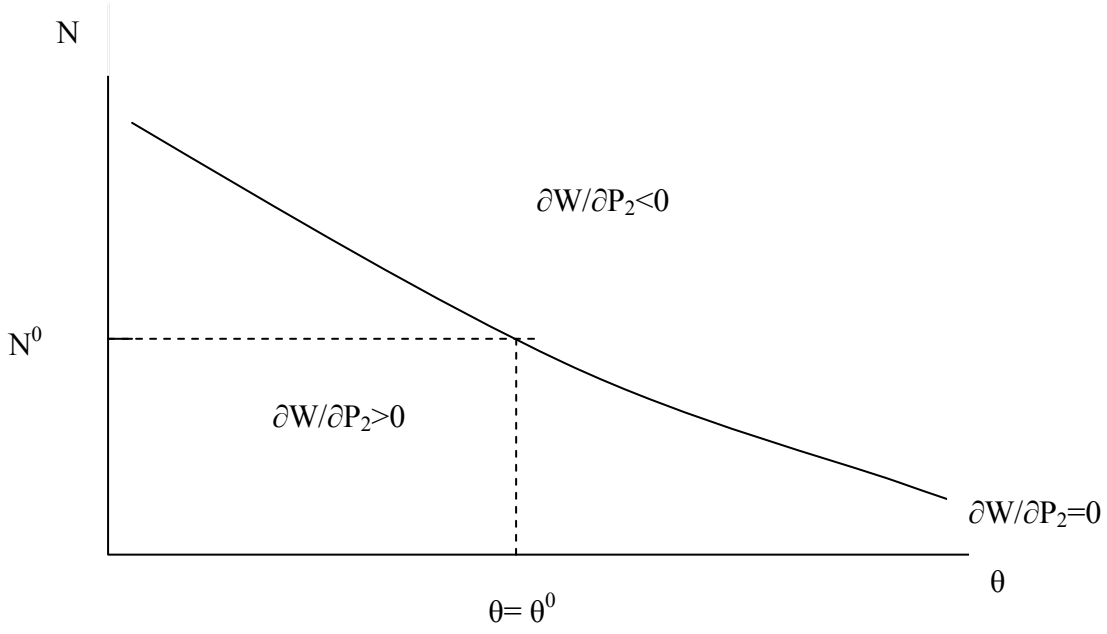


Figure 4 Welfare and Imported Good Price Frontier



The proposition below follows from these observations.

PROPOSITION 3

If the number of firms increases and/or the level of product differentiation in the home market decreases, then it increases the likelihood of welfare gains from protectionism.

The intuition for these results can be considered from two polar positions. At first, let us to look at the case that θ is close zero which means the domestic products very differentiated. Each firm operates like a monopoly producer and make monopoly profit. When imported good price decreases, the part of consumer demand switches to cheap imported good. Then, there will be a relative large total surplus loss in the domestic produced good market. On the other hand, the consumer surplus gain from the cheaper imported good market is not significant large due to the effects of both differentiation among the domestic goods and the substitutability between domestic and imported goods. Therefore, the social welfare counted in both domestic goods market and imported good market will be increasing if government moves from free trade to protectionism. Secondly, let us to look at the case that θ is close to 1 which means the domestic products are very less differentiated. Now, the analysis is much like the homogenous good model in this paper. The policy change from protectionism to free trade will increase social welfare. Therefore, there will be a social welfare gain when government moves from protectionism to free trade if θ is relatively large.

The results suggest that product differentiation interact with the number of firms in an industry to determine under which protectionism dominator free trade as a domestic policy posture. When the domestic product is sufficiently differentiated and the number

of the firms is sufficiently large, then the producer surplus gains from protectionism outweigh the consumer surplus loss and a sufficiently large compensate of consumers by producers for these losses may made protectionism efficient within the context of domestic policy makers. The industrial structure across different markets in an economy will vary causing it to be anticipated that there may be protectionist and free trade policy conducted for different goods within a single economy. This result is consisting with the heterogeneity observed in trade policy cross markets in an economy.

4. CONCLUDING REMARKS

The paper investigated how industrial structure can be anticipated to influence the choosing to pursue a protectionist as apposed to a free trade policy. The general argument for free trade is in opposition to the persistence of protectionism within many economies. A sequential game involving utility maximizing consumers and *N*-firms engaged in a Cournot-Nash game within the domestic economy given imports is utilized to address the research question.

The key findings of the study are as follows: First, in the case of homogenous domestic produced good protectionism dominates a free trade policy when both the number of firms in the industry and the substitutability between domestic good and imported good are sufficiently small. Second, in the case of differentiated domestic produced good protectionism can be anticipated in economies with sufficiently few firms in an industry with a sufficiently differentiated good. Third, if the price of the imported good is sufficiently high, then a decrease in its price may not be welfare improving for the domestic economy. The results of the study emerge of the relative changes in

consumer and producer surplus in the domestic economy as the foreign price changes in response to the foreign price (e.g., the imported good price increases as the domestic government switching from free trade to protectionism).

The results of the study suggest that, the degree to which foreign and trade policy is informed by domestic interest, it can be expected that protectionism will be pursued as a policy the combined conditions of the number of firms, level of product differentiation and the foreign product price meet a set of sufficiency conditions. Hence, a strong trade regulatory framework is necessary if private domestic interests are to be made secondary to the common global welfare good.

APPENDEX

(A). Derivation of welfare change with the change of price of imported good.

$$\frac{\partial W}{\partial P_2}=\frac{\partial v}{\partial P_2}+\frac{\partial v}{\partial P_1}\frac{\partial P_1}{\partial P_2}+\frac{\partial P_1}{\partial P_2}Q_1+P_1\frac{\partial Q_1}{\partial P_2}-N\frac{\partial C(q_{1i})}{\partial P_2}=-Q_2-Q_1\frac{\partial P_1}{\partial P_2}+\frac{\partial P_2}{\partial P_2}Q_1$$
$$+P_1\frac{\partial Q_1}{\partial P_2}-\frac{\partial C(q_{1i})}{\partial q_{1i}}\frac{\partial (Nq_{1i})}{\partial P_2}=-Q_2+(P_1-C'(q_{1i}))\frac{\partial Q_1}{\partial P_2} \quad \text{(a1)}$$

(B). Proof of Proposition 1

From (4):

$$\frac{\partial W}{\partial P_2}=-Q_2+(P_1-C')\frac{\partial Q_1}{\partial P_2}$$

Let $P_1=P_1(N)$ so

$$\frac{dW}{dP_2}=-Q_2-[P_1(N)-C']\frac{\partial Q_1}{\partial P_2}=-Q_2+[P_1(N)-C'](\frac{\partial Q_1}{\partial P_2}\frac{P_2}{Q_1})\frac{Q_1}{P_2}$$
$$=-Q_2+[P_1(N)-C']\varepsilon_{12}\frac{Q_1}{P_2} \quad \text{(a2)}$$

where: ε_{12} represents the cross elasticity between domestic product and import's price. Hence, there exists a N_0 such that

$$\frac{dW}{dP_2}|_{N=N_0}=0.$$

(C). Proof of Proposition 2

$$\frac{dW}{dP_2}=-Q_2+[\frac{P_1(N)-C'}{P_1(N)}]\varepsilon_{12}(\frac{P_1(N)Q_1}{P_2})=\{-1++[\frac{P_1(N)-C'}{P_1(N)}]\varepsilon_{12}(\frac{P_1(N)Q_1}{P_2Q_2})\}Q_2$$
$$=[-1+L_1(N)\varepsilon_{12}(\frac{1}{R_{21}})]Q_2 \quad \text{(a3)}$$

where: R_{21} represents the revenue ration of imported product to domestic product. Then we have the following results

(1) $\frac{dW}{dP_2}>0$ when: $-1+L_1(N)\varepsilon_{12}(\frac{1}{R_{21}})>0$ or $\varepsilon_{12}>\frac{R_{21}}{L_1(N)}$.

(2) $\frac{dW}{dP_2}<0$ when: $\varepsilon_{12}<\frac{L_1(N)}{R_{21}}$

(D). The proof of Corollary 1

From (11)

$$\frac{\partial W}{\partial P_2} = -(a_2 - b_2 P_2) + \frac{Nd(a_1 + dP_2) - d(1 + b_1 c)(a_1 + dP_2)(N + 1 + b_1 c)}{b_1 (N + 1 + b_1 c)^2}$$
$$= -(a_2 - b_2 P_2) + \frac{d(a_1 + dP_2)[N - (1 + b_1 c)(N + 1 + b_1 c)]}{b_1 (N + 1 + b_1 c)^2} \quad \text{(a4)}$$
$$= -(a_2 - b_2 P_2) - \frac{d(a_1 + dP_2)[1 + (2 + N) b_1 c + b_1^2 c^2]}{b_1 (N + 1 + b_1 c)^2}$$

Since the second term of (a4) is positive, the necessary condition of $\frac{\partial W}{\partial P_2} > 0$ is $a_2 - b_2 P_2 < 0$.
Q.E.D.

(E) The derivation of (23)
Substitute $\alpha = 40, \beta = 5, c = 5, P_2 = 11$ and $\gamma = 3$ into (21)

$$Q_1^c = \frac{N(55 + 3P_2)}{50 + 25(N-1)\theta - 9N} \quad \text{(a5)}$$

Take derivative of Q_1^c respect to import price P_2

$$\frac{\partial Q_1^c}{\partial P_2} = \frac{3N}{50 + 25(N-1)\theta - 9N} \quad \text{(a6)}$$

Substitute (a5) into (19) and (20)

$$P_1^c - c = \frac{\beta}{N} Q_1^c = \frac{440}{50 + 25(N-1)\theta - 9N} \quad \text{(a7)}$$

$$Q_2 = \frac{29}{5} - \frac{264N}{5[50 + 25(N-1)\theta - 9N]} \quad \text{(a8)}$$

Then substitute (a6), (a7) and (a8) into (4)

$$\frac{\partial W}{\partial P_2} = \frac{1320N}{[50 + 25(N-1)\theta - 9N]^2} - \frac{29}{5} + \frac{264N}{5[50 + 25(N-1)\theta - 9N]}$$

Q.E.D.

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