AN ABSTRACT OF THE THESIS OF

Bong-Jae Cho for the degree of Master of Science in Economics presented on May 29, 1992.

Title: The Economic Effects of Trade Liberalization Under Oligopoly

Redacted for Privacy

Abstract approved: _____
Chi-Chur Chao

In modern economies, national governments have a wide range of policies for restricting international trade and protecting domestic industries at their disposal. The most popular form of non-tariff trade policies is probably that of a direct quantitative restriction. This policy takes two principal forms: explicit import quotas and voluntary export restraints (VERs). A VER is a quota imposed by an exporting country upon exports to other countries in response to pressures exercised by the importing countries (i.e., in the form of threats of various types of import restrictions).

When these two policies are partially liberalized, subject to a reasonable foreign share in the domestic market, product differentiation between imported goods and domestic goods within an imperfect market can serve to increase welfare levels within the domestic economy. In this situation, the foreign share will not be as high as it

would be for the homogeneous assumption. Under a partial VER liberalization policy, if the degree of substitutability between domestic and imported goods is sufficiently small, then domestic welfare will improve as foreign imports are increased. That is, if domestic and imported goods are perfect substitutes, then the most favorable domestic policy will be to close domestic markets to the foreign country since no country can allow foreign market shares as high as 66 percent in the domestic market.

In a simulation of U.S. automobile industrial production, when a partial quota liberalization is observed, welfare levels can be increased by reducing the Japanese import market share to a level below 10 percent, that is, to a level which is less than the actual current foreign market share. In real terms, this implies that U.S. auto industry must be further liberalized to acquire additional domestic benefits under a VER policy, whereas the U.S. should restrict foreign market share below 10 percent to maximize domestic welfare levels under a quota policy. This will occur if the net consumer surplus is in excess of producer net excess profits under an imperfect market structure.

The Economic Effects of Trade Liberalization Under Oligopoly

by

Bong-Jae Cho

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Completed May 29, 1992

Commencement June 1993

APPROVED:

Redacted for Privacy

Assistant Professor Economics in charge of major

Redacted for Privacy

Head of Department of Economics

Redacted for Privacy

Dean of Graduate School

Date thesis is presented May 29, 1992

Typed by B. McMechan for Bong-Jae Cho

TABLE OF CONTENTS

Chapter		Page
I	INTRODUCTION	1
II	GENERAL MODEL OF WELFARE ANALYSIS	6
III	CRITICAL MARKET SHARE SUBJECT TO LINEAR DEMAND FUNCTIONS	18
IV	EMPIRICAL OUTCOME OF THE SIMULATED THEORY . .	25
V	CONCLUSIONS	31
	REFERENCES	33
	APPENDIX	35

LIST OF FIGURES

Figure		Page
III-1	Critical foreign share for different degrees of substitutability, foreign and domestic goods	26
III-2	Policy of quantity restriction, 1983	29

LIST OF TABLES

Table		Page
III-1	Simulated data for different variables . . .	25
III-2	Automotive trade variable, U.S. & Japan, three years	28

The Economic Effects of Trade Liberalization Under Oligopoly

CHAPTER I

INTRODUCTION

The purpose of this study is to examine the effects of trade liberalization on domestic welfare, using general equilibrium analysis under an oligopolistic market structure. In reality, there can be little doubt that a significant proportion of international trade takes place in imperfectly competitive markets. Thus, the principal analysis conducted for this investigation is to determine how larger a foreign market share should be permitted within a home economy in order to maximize domestic welfare. The government has the ability to set in motion a trade policy directed at changing an oligopolistic outcome in a favorable direction by the control of foreign trade inflow. Under monopolistic market structures, a release of trade restrictions may reduce a country's welfare due to the loss of market power by domestic industries (Eldor & Levin, 1990).

In a recent survey by Ono (1990), output restrictions of foreign goods in domestic markets lowered the surplus of consumption, but at the same time the domestic production

surplus increased for a host country with an oligopolistic market structure. Comparing the two effects, Ono found the condition under which the restriction on output by a foreign firm increased the total domestic surplus. This is an interesting point since the welfare consequences of trade policy in Ono's paper are quite different from what trade theory under perfect competition predicts. However, most of the analyses of trade liberalization that have been developed recently have been based on the assumption of homogeneous goods. In this project, a more general analysis that assumes product differentiation is used to derive domestic welfare performance. Simulating the results of the model, I find that when the trade liberalization of imports is applied to classes of Japanese automobile goods, which are imperfectly substitutable for those produced in the U.S, the U.S national welfare figure was increased above the autarkic level under VER, producing just the opposite result from those based upon the assumption of homogeneous production.

In recent years, in the literature of international trade, considerable attention has been devoted to the examination of possible effect of foreign market penetration in the case of an oligopolistic setting. The key to these assessments is to measure the social welfare gains achievable from government intervention, and then to relate them to a conveniently assumed and simple situation. However, these maintained hypotheses do not constitute a realistic

description of economic behavior for most societies. For example, since most of the real production of individual industries is differentiated, the most widely used homogeneous production assumption is unrealistic and may lead to faulty prdictions. A more satisfactory treatment is to relax some of the restrictive assumptions to the greatest degree possible.

Because rival interactions are likely to be varied in markets with only a few firms, an oligopolistic industrial structure provides difficulties in the establishment of a unified means of intuitive analysis. This type of complexity does not occur when an industry is composed of a single firm. Thus, it is natural for economists to make certain assumptions about the nature of these interactions. On the other hand, under perfect competition, the number of firms is so extensive that their interactions must be judged to be insignificant.

Some interesting studies have developed models for an analysis of the welfare effect when the host country's trade policy takes place in the oligopolistic market setting (Dixit, 1984; Eaton & Grossman, 1986; Brander & Spencer 1984, 1985; Eldor & Levin, 1990; Ono, 1990). In particular, studies by Eldor and Levin and by Ono have shown some intuitive figures of the critical market share for the foreign firms in a domestic market below which the autarkic economy achieves a higher total domestic welfare level. For the treatment of homogeneous production between

domestic and imported goods, these studies resulted in a highly critical foreign share (i.e., above 66%) below which the total trade prohibition increses domestic welfare level, indicating that the autarkic economy is of higher benefit to the domestic economy. Normally, the host government will not allow such a high foreign share within its domestic markets.[1]

Unlike the models developed by Eldor and Levin (1990) and Ono (1990), the present model incorporates differentiated products. The result is a lower critical market share at which the host country actually benefits from partial trade liberalization. This is true to at least the degree that the foreign share is higher than the critical market share. This model constitutes a generalization of the Eldor and Levin and Ono models and is organized as follows. Section II considers a general conjectural variations model for an oligopolistic economy, in which n symmetric home firms compete with foreign products within the domestic market. For this situation, it is not ruled out that the home country exports some of its outputs to other countries. To the degree that the home economy has penetrated foreign markets, these exported goods are manufactured only for foreign markets. Based upon this assumption, there is no loss of generalization since most of the products are produced under segmented market decisions.

By segmented market decisions, it is meant that the domestic supply produced by host country firms is always

equal to the demand for goods produced by the same firms. In this framework, potential gains and losses from partial trade liberalizations can be reviewed. The formulae for the general model cannot be clearly intuited. Therefore, in Section III a special case is considered in which the demand functions are linear. For this special case, the critical foreign market share in the domestic market is obtained under the assumptions of product differentiation and homogeneous production. In Section IV, these results are then extended to measure theoretical foreign market share based upon actual figures from the U.S automobile industry. Throughout this study, the analysis is based upon the assumption of constant marginal costs, further eliminating two of the market repercussion effects. The principal results of this research are summarized in a final section.

CHAPTER II

GENERAL MODEL OF WELFARE ANALYSIS

Consider that the home country produces goods X and Q, where the market for good X is imperfectly competitive and the market for good Q is perfectly competitive. Further assume that the home country exports Q and imports good Y, which is imperfectly substituted for good X. Let the consumer side of the domestic economy be represented by an expenditure function[1] $E(P_1,P_2,1,W)$, where P_1 equals the price for domestic good X, P_2 equals the price for import good Y, 1 equals the price for numeraire good Q, W indicates the level of welfare.

On the supply side, industry X is assumed to consist of n firms, where x and X denote, firm and industrial level outputs for industry X. Thus, $\Sigma x_i = X$ for each $i = 1,\ldots,n$. Let the inverse demand for the good X be given by

$$P_1 = P_1(X,Y) \ , \qquad \partial P_1/\partial X < 0, \ \partial P_1/\partial Y < 0$$

and[2]

$$P_2 = P_2(X,Y) \ , \qquad \partial P_2/\partial X < 0, \ \partial P_2/\partial Y < 0 \ .$$

On the basis of the neoclassical assumption that each firm is a profit maximizer, the i-th firm chooses quantities to maximize profits through interactions among the firms. However, imports are controlled by the government. Thus, if the foreign supply is restricted to a lower level than a

free trade level, the trade restriction policy is effective. As a result, the domestic price P_2 is greater than the world price P_w for Y, and the profits of the i-th domestic and foreign firms are, respectively,

(1) $$\pi_i=P_1x_i-f_i-c_ix_i$$

and

(2) $$\pi_f=P_2Y-f_2-c_2Y ,$$

where f_i and f_2 are the fixed costs of the i-th domestic and foreign firms and the corresponding marginal costs are expressed as c_i and c_2.

On the basis of the neoclassical assumption that each firm is a profit maximizer, the domestic i-th firm chooses quantities x_i that serve to maximize its profits given rival interactions. The first-order condition for maximizing equation (1) with respect to the choice variables x_i is

(3) $$P_1+(dP_1/dX)(1+\delta_i)x_i=c_i , \qquad i=1,...,n ,$$

where δ_i is the i-th domestic firms' conjectural variation with respect to the rival domestic firms' total output.[3] This first-order condition simply means that perceived marginal revenues are equal to marginal costs.[4] Note that this first-order condition is able to capture a wide range of firm behaviors, dependent upon the magnitude of the conjectural variation. The δ_i is constrained to lie between -1 and n-1. A value of -1 implies perfectly competitive (Bertrand) behavior, and an n-1 value implies collusive behavior. The classic Cournot model is generated when δ_i is equal to 0. Thus,[5]

(4) $\quad -1 < \delta_i < n-1 \ , \quad i=1,.....n \ .$

From equation (3), the second-order condition for profit maximization is

(5) $\quad dP_1/dX(1+\delta_i) + d^2P_1/dX^2(1+\delta_i)^2x_i + dP_1/dX(1+\delta_i) < 0 \ ,$

thus implying, since all other terms are negative, that the marginal change of the slope of price must be considered to satisfy the second-order condition. What is implicit in this second order condition is that for all possible outputs, the perceived marginal revenues generated by the oligopolistic economy are steeper than the demand function. This condition is met if d^2P_1/dX^2 is less than zero, which will be assumed to be true.

Assumption 1, where $d^2P_1/dX^2 \leq 0$.

From equation (3), the change in the equilibrium for domestic firm output with respect to the change in the quantities of imported goods can be obtained. For total differentiation with respect to Y, we have[6]

(6) $$\frac{dx_i}{dY} = \frac{|R|_{n*n}}{\lambda\beta} \ ,$$

where

$$|R| = \begin{vmatrix} r_{11} & \cdots & r_{1n} \\ \vdots & \ddots & \vdots \\ r_{n1} & \cdots & r_{nn} \end{vmatrix} \ ,$$

$$r_{ij} = 1 + \frac{[\frac{dP_1}{dX}(1 + \delta_j)]}{[\frac{d^2P_1}{dX^2}(1+\delta_j)x_j + \frac{dP_1}{dX}]} \ , \qquad for \ j = 2,..,n \ ,$$

$$r_{i1} = -\frac{\left[\frac{d^2P_1}{dXdY}(1+\delta_i)x_i + \frac{dP_1}{dY}\right]}{\left[\frac{dP_1}{dX} + \frac{d^2P_1}{dX^2}x_i(1 + \delta_i)\right]}, \quad for\ i = 1,..,n,$$

$$\beta = \prod_{i=1}^{n} \frac{\left[\frac{dP_1}{dX}(1 + \delta_i)\right]}{\left[\frac{dP_1}{dX} + \frac{d^2P_1}{dX^2}(1 + \delta_i)x_i\right]}, \quad for\ i = 1,..,n,$$

and

$$\lambda = 1 + \sum_{i=1}^{n} \frac{\left[\frac{d^2P_1}{dX^2}(1+\delta_i)x_i + \frac{dP_1}{dX}\right]}{\left[\frac{dP_1}{dX}(1+\delta_i)\right]}, \quad for\ i = 1,..,n.$$

By imposing a symmetry assumption, which implies that all firms are identical or that $x_i = x$, $i=1,...,n$, equation (6) can be reduced as follows:

(7) $$\frac{dx}{dY} = \frac{\mu}{\lambda\alpha},$$

where

$$\mu = -\frac{\left[\frac{d^2P_1}{dXdY}(1+\delta)x + \frac{dP_1}{dY}\right]}{\left[\frac{dP_1}{dX} + \frac{d^2P_1}{dX^2}x(1 + \delta)\right]},$$

$$\alpha = \frac{\left[\frac{dP_1}{dX}(1 + \delta)\right]}{\left[\frac{dP_1}{dX} + \frac{d^2P_1}{dX^2}x(1 + \delta)\right]}$$

and

$$\lambda = 1 + \frac{n[\frac{d^2P_1}{dX^2}(1 + \delta)x + \frac{dP_1}{dX}]}{[\frac{dP_1}{dX}(1 + \delta)]} .$$

The sign for dx/dY is dependent upon the shape of the inverse demand curve and δ. If the domestic demand curve (P_1), with respect to its own product and to foreign goods, is concave, then each domestic firm decreases production due to the increase of imports. Therefore, $dx/dY < 0$ can be achieved if $d^2P_1/dXdY < 0$ is satisfied. From Bullow, Geanakoplos and Klemperer (1985), this condition corresponds to the definition of strategic substitutes. The opposite case corresponds to the strategic complements. Hence, liberalization could decrease/increase the domestic output, dependent upon the shape of the demand curve P_1. Thus, we have:

Lemma 1. In the case of the linear demand function (P_1), the magnitude of dx/dY is between -1 and 0 as long as its own demand price effect is stronger than the cross price effect (i.e., $dP_1/dX > dP_1/dY$ in absolute values) since d^2P_1/dX^2 and $d^2P_1/dXdY$ are equal to zero. Thus,

$$-1 < n(dx/dY) < 0$$

is obtained.[7]

Lemma 2. In the case of a nonlinear demand function based upon the assumption of strategic substitutes, the magnitude of dx/dY will be between -1

and 0 for a stable economy since the stability condition[8] requires that the absolute value of the denominator dx/dY in equation (7) be greater than its numerator.

Lemma 3. If it is assumed that import and domestic goods are homogeneous (i.e., $d^2P_1/dX^2 = d^2P_1/dXdY$) and Assumption 1 is true, then the size of dx/dY is between -1 and 0 regardless of the demand shape. Thus, we have $-1 < n(dx/dY) < 0$.

Lemma 4. When both import and domestic goods are heterogeneous (i.e., the numerator in equation (7) is equal to zero), then dx/dY is equal to zero. Therefore, dx/dY = 0 is obtained.

The national welfare can be derived from the application of an expenditure function. Total expenditure in the domestic country is equal to the total national revenue in equilibrium. Therefore, the equality condition is

$$E(P_1,P_2,1,W) = P_1nx + (P_2-P_w)Y + Q \quad , \tag{8}$$

where P_w represents the world market price of the foreign product Y. The first term on the right-hand side of equation(8) corresponds to total production revenue, and the second component corresponds to such government revenues as quota license fees and tariff revenues. However, in the case of voluntary export restraints, there can be no accrual of domestic government revenue since the revenue is directed normally to the foreign government.

Now, consider that the domestic government announces a partial trade liberalization for good Y. The question is what is the effect of this partial trade liberalization upon the domestic welfare. To determine this effect, the differentiation of equation (8) is taken with respect to the import good Y. With simple manipulation,[9] the welfare impact of increased import quotas takes the form

$$(9) \qquad dW/dY = n(P_1-c)(dx/dY) + [n(dP_2/dX)(dx/dY) + dP_2/dY]Y - [n(dP_2/dX)(dx/dY) + dP_2/dY]Y - [(dP_w/dY)Y+(P_2-P_w)] .$$

Equation (9) can then be rewritten as

$$(10) \qquad dW/dY = n(P_1-c)(dx/dY) + (P_2-P_w) - (dP_w/dY)Y .$$

On the other hand, the welfare impact of increased VER for imports can be derived by consideration of equality condition

$$(11) \qquad E(P_1, P_2, 1, W) = nP_1x + Q .$$

Then, the equilibrium welfare change with respect to import trade liberalization becomes

$$(12) \qquad dW/dY = n(P_1-c)(dx/dY) - [n(dP_2/dX)(dx/dY) + (dP_2/dY)]Y .$$

The welfare change equations (10) and (12) provide a wide range of valuable information concerning the effect of trade policies. Specifically, it is confirmed that import liberalization is desirable if the welfare of the domestic economy is increased due to the import effect. Unfortunately, the sign of equations (10) and (12) is not clear. The first term on the right-hand side of equation (10) in-

dicates that domestic firms' profits change with respect to an increase in imports. Given the condition of strategic substitutes, the first term will be negative since prices in an imperfect market will be greater than the marginal costs for each firm. When the two goods are strategically complementary, by definition the first term will be positive. Given the condition of perfect competition, profits in the domestic economy fall to zero.

In turn, the second term is definitely positive as long as the domestic price of product Y is greater than the world price. This component is the government trade policy wedge induced between domestic and world prices, or the usual government revenues from one imported unit of good Y. Finally, the last term suggests the terms of the trade effect when the home country economy is large enough to affect world prices. Conversely, if the host country economy is small, this term will be zero. Thus, we have:

Proposition 1. Under an oligipolistic market structure for domestic industry, as long as the domestic price of good Y is greater than the world price, then a small home country will always derive a benefit[10] from allowing additional foreign goods into the home market. This is true, when domestic and foreign imported goods are strategically complementary, without consideration of past trade policies of the home country such as quotas or VER. However, though the two

goods are strategically complementary if the second-order condition of the welfare function is negative, the host country domestic welfare, though subject to short-range improvement, could decline as a result of further trade liberalization.

Proof: Based upon the assumption of a restricted host domestic economy, the last term of equation (10) is zero. For strategically complementary oligopolistic industries, the first and second terms of equation (10) are positive. In the case of VER, the welfare change equation (12) is positive since the first and second terms of equation (12) are always greater than zero. If the second-order condition of welfare is considered, then the sign of d^2W/dY^2 remains unclear. Thus, the welfare function with respect to imported good Y can be either concave or convex, dependent upon the second-order condition.

Proposition 2. In the case of VER policy based upon strategic substitutes, the net welfare of a host country with a restricted economy will decrease for a substantial range due to an increase in imports so long as d^2W/dY^2 is positive and $n(dx/dY)$ is between -1 and 0.

Proof: From equation (12), at Y = 0, domestic consumption is equal to oligopolistic output, hence

the production surplus falls by exactly the same amount. However, the greater the quantity of imports allowed, the greater the effect upon the second term of equation (12). Finally, the welfare level will start to increase above autarkic level.

Proposition 3. In the case of a quota policy with strategic substitutes, the net welfare for a host country with a restricted economy can be decreased or increased, dependent upon the size of the first and second terms of equation (10).

Proof: If the policy-induced price wedge between domestic and imported goods is greater than the profits of domestic firms, then the welfare level improves due to partial trade liberalization. Moreover, from the stability condition,[11] when the demand curves are linear the second-order condition of the welfare function with respect to imports is always negative.

In this chapter, the general prospects for a welfare gain/loss from partial reforms in a protected economy were considered for different outcomes subject to different settings. Thus, to gain clear insights into the effects of these variables upon domestic welfare, it was assumed that the domestic demand curves are linear. Hence:

Lemma 5. If the linear demand functions and conditions of Cournot oligopoly are assumed, partial

trade liberalization under VER will initially deteriorate welfare levels, finally resulting in the improvement of welfare levels for a host country with a restricted economy.[12]

Lemma 6. If linear demand and the condition of Cournot oligopoly across all firms are assumed, then a partial trade liberalization under a quota policy will deteriorate welfare levels for a host country with a restricted economy as long as dP_1/dY is greater than $(P_2 - P_w)$ in absolute values.[13]

That is, the host country levels of welfare will decline continuously if the government quota revenue (i.e., with a positive impact upon welfare) per unit of imports is less than domestic firms profit losses (i.e., with a negative impact upon welfare) per unit of imports.

In the following chapter, based upon an assumed linear demand curve, focus is restricted to the cases of Propositions 2 and 3 since these cases present the possibility of a domestic welfare reduction resultant from partial trade liberalization. This is a result which contradicts that for the traditional trade theory in a perfectly competitive structure. From Lemma 5, note that the host country welfare levels are reduced as a result of increased imports if the actual foreign output market share is sufficiently small. Therefore, it may be expected that welfare will

decrease at a certain range, to be followed by an increase.

From equation (10), in the case of quotas, a first-order condition for the optimization of national welfare with respect to Y is obtained when $dW/dY = 0$, or

(13) $$[n(P_1-c)(dx/dY)] + (P_2-P_w) - (dP_w/dY)Y = 0 .$$

Thus, we have the optimal amount of foreign imports into the domestic market for the optimization of national welfare. Based upon the small country assumption, this condition takes the form

(14) $$[n(P_1-c)(dx/dY)] + (P_2-P_w)] = 0 .$$

Subsequently, it may be assumed that the second-order condition will hold for all possible outputs Y.

In the following chapter, a special case is considered where the demand functions of both foreign and home-produced goods in the domestic market are assumed to be linear.

CHAPTER III

CRITICAL MARKET SHARE SUBJECT TO LINEAR DEMAND FUNCTIONS

To this point in the analysis, focus has been directed at the theoretical question subject to the condition of product differentiation, but without consideration of the applicable question. From Lemma 6, the domestic welfare function is convex in shape with respect to foreign goods.[14] With this result, the welfare level in the host country decreases as domestic markets are opened, at least up to the point where it reaches the lowest point of domestic welfare. Since the welfare function with respect to Y is convex, there is a critical foreign market share below which a condition of no trade yields a higher level of welfare for the host country.

To obtain intuitively analytic results, both demand functions for the goods Y and X are assumed to be linear. In the absence of foreign trade, the host country welfare is W_a, representing the welfare level under autarky. Thus, total welfare W_t following trade liberalization becomes the sum of the autarkic state of welfare and the change in welfare subject to trade liberalization, expressed as

$$W_t = W_a + \int_0^Y \left(\frac{dW}{dY}\right) dY \quad . \tag{15}$$

When the second term of equation (15) is equal to zero, a critical point[15] results in which there is no change in the level of welfare. Substituting the first-order condition from equation (3) into equation (13),

$$dW/dY = -n(dP_1/dX)(1+\delta)(dx/dY)x - [n(dP_2/dX)(dx/dY) + dP_2/dY]Y \tag{16}$$

is obtained. This may then be rewritten as

$$dW/dY = -Knx - HY \quad , \tag{17}$$

where K and H represent, respectively,

$$[(dP_1/dX)(1+\delta)(dx/dY)]$$

and

$$[n(dP_2/dX)(dx/dY) + dP_2/dY] \quad .$$

The minimum[16] welfare level is reached when the foreign good Y is equal to -[Knx/H], where K is positive since we are dealing with an oligopolistic case. From Lemma 1, H becomes negative. Therefore, the output Y for the minimum welfare level is established at some positive range. Combining equations (15) and (17) results in a critical point, referred to as the critical market level since the host country, below this level, will benefit from closing its markets to foreign imports. Following the manipulation[17]

$$\Gamma = n(dx/dY)[n(dP_1/dX)(dx/dY) + dP_1/dY)]$$

and combining equations (15) and (16) gives

$$Y_c = [(-2Knx)/(H+\Gamma)] \quad , \tag{18}$$

where Y_e is the amount of the foreign good Y which results in a welfare level equivalent to the condition of autarky.

Note that the general solution for equation (18) must take place in the interior region, otherwise, there could be no economic meaning to consider. Thus, from Lemma 1, the sign[18] of $(H + \Gamma)$ is strictly negative. Equation (18) can also be expressed in terms of market share Y_s as

$$Y_s=[-2K]/[H+\Gamma-2K] \quad . \tag{19}$$

Therefore, consider:

Proposition 4. Under the VER policy, given that host price effect is stronger than the cross-price effect, as the degree of substitutability between foreign and domestic goods increases, the critical market share increases.

Proof: Based upon the assumptions of linear demand function, a Cournot oligopolistic condition, and symmetric firms, equation (7) may be reduced to

$$dx/dY=-(b/a)/(n+1) < 0 \quad , \tag{20}$$

where b and a represent dP_1/dY and dP_1/dX, respectively. As long as the host price effects are greater than the cross-price effects, equation (20) is negative. Inserting the exogoneous variables a and b into equation (19) and rearranging terms gives

$$Y_s = [2t(n + 1)]/[-t^2(n^2 + 2n) + 2t(n + 1) + (n+1)^2(g/a)] \quad , \tag{21}$$

where $g = dP_2/dY$, $b = dP_1/dY = dP_2/dX$, and $t = b/a$. The differentiation of equation (21) with respect to t and b gives[19]

(22) $$dY_s/dt > 0 .$$

The sign of equation (22) is positive-definite as long as the elasticity of dP_1/dX with respect to (b/a) is greater than the negative sign. Application of the same method with respect to b yields

(23) $$dY_s/db < 0 .$$

Thus, equations (22) and (23) confirm that if the degree of substitutability between domestic and imported goods is increased, critical market share will increase. Equation (17) can then be expressed in terms of market share as

(24) $$Y_m=[-K]/[H-k] .$$

In this case, Y_m is the minimum point the welfare level of the host country will reach at its lowest level. Application of an identical procedure to Y_m and Y_s with respect to dP_2/dY yields

(25) $$dY_m/dg > 0 \quad \text{and} \quad dY_s/dg > 0 .$$

This result implies, subject to product differentiation, that if industry protected by quantitative restrictions produces a closed-market substitute goods in excess of imports, and for which its own price effects are strong, the host country welfare level will improve by small amounts in correspondence to increases in foreign market. This is because the drop in prices resultant from the increased supply of imported goods will be reduced. There-

fore, the consumer surplus will become smaller, and thus affect the host country welfare.

The basic underlying concept for this process is that an increase in imports will cause a contraction in domestic production (i.e., a negative welfare effect), whereas it serves at the same time to decrease domestic prices for imported good (i.e., a positive welfare effect). In addition, through the substitute effect, the increased supply of imported goods will depress the domestic prices of host country products. At the same time, the decline of the price of domestic products will reinforce the negative effect upon host country welfare for reason of profit losses by domestic firms.

Therefore, on the assumption of all other considerations being equal, it is immediately apparent that a higher dP_2/dY in absolute values generates an increase in host country welfare as greater quantities of imported goods are allowed into home markets. All of these price impacts serve to improve the welfare of the domestic consumer. Thus, the net welfare effect is interrelated with supply and demand side effects. For the case of strategic substitutes, if the demand effect is greater than the supply-side effect, domestic country welfare increases due to partial trade liberalization. To resummarize, a liberalization trade policy subject to product differentiation may decrease domestic welfare for a substantially longer range, dependent upon the size of the demand function

slope, conjectural variations, and the number of firms within the host country.

These results are then extended to the case of homogeneous production where with respect to demand, home goods and imports are perfect substitutes. In this case, changes in price with respect to both home goods and imports are identical (i.e., a = b = g). Reworking equations(21) and (22) for these assumptions, the minimum welfare level is reached when the foreign product share of the home market is 50%, regardless of the number of domestic firms. However, since Y_s is (2n+2)/(2n+3),the critical market share Y_s for the condition of Cournot oligopoly is dependent upon the number of the domestic firms.[20] This is precisely the same result obtained by Eldor and Levin (1990) and by Ono (1990).

In one important respect, it is not reasonable to assume that the host government will seek only VER for its commercial policy. To absorb a more broad trade policy, such factors as the quota policy are also taken into account. From Proposition 3 and equation (14), subject to certain manipulation, the critical market share generating a welfare level identical to total prohibition upon trade is expressed as

(26) $Y_{sq} = [-2Knx + (p_2-P_w)]/[H+\Gamma - 2Knx + (P_2-P_w)]$,

where Y_{sq} denotes the foreign product market share of the domestic market under a quota requirement. However, dependent upon the size of the $(P_2 - P_w)$, the sign of equation

(26) is ambiguous. Consider that the host country imposes a reasonable quota amount that does not completely prevent trade with other countries. If the price difference between P_2 and P_w is very high, indicating a high quota, foreign firms cannot survive. Therefore, the numerator of equation (26) is negative if $(P_2 - P_w)$ is sufficiently small, and Y_{sq} has a certain positive value since the denominator is less than zero. Under quota imposition, additional government revenues can be expected, which is not the case with VER.

To this point, the analysis presented has been confined to a theoretical consideration. In the following section, on a priori theoretical grounds, the U.S. automobile industry is reviewed to enhance the intuitive understanding process.

CHAPTER IV

EMPIRICAL OUTCOME OF THE SIMULATED THEORY

Before getting into the US automobile industry, simulation procedure will be carried out under the following specific linear demand functions:

(27) $$P_1 = -4X - 2Y + 10$$

and

(28) $$P_2 = -2X - 8Y + 8 \ .$$

First, a sensitivity analyses is performed for each of the variables. Table III-1 and Figure III-1 show the effects of the changing slope on the critical foreign shares (Y_s) and Y_m under VER.

Table III-1. Simulated data for different variables.

dP_1/dX (a)	-4	-6	-4	-4	-4	-4
$dP_1/dY = dP_2/dX$ (b)	-2	-2	-3	-2	-2	-2
dP_2/dY (g)	-8	-8	-8	-10	-8	-8
n	2	2	2	2	3	2
δ	0	0	0	0	0	-1/2
dx/dY	-1/6	-1/9	-1/4	-1.6	-3/16	-1/5
Y_m(%)	8.30	8.10	13.30	6.66	9.83	5.20
Y_s(%)	17.64	15.25	20.00	12.76	17.61	1.20

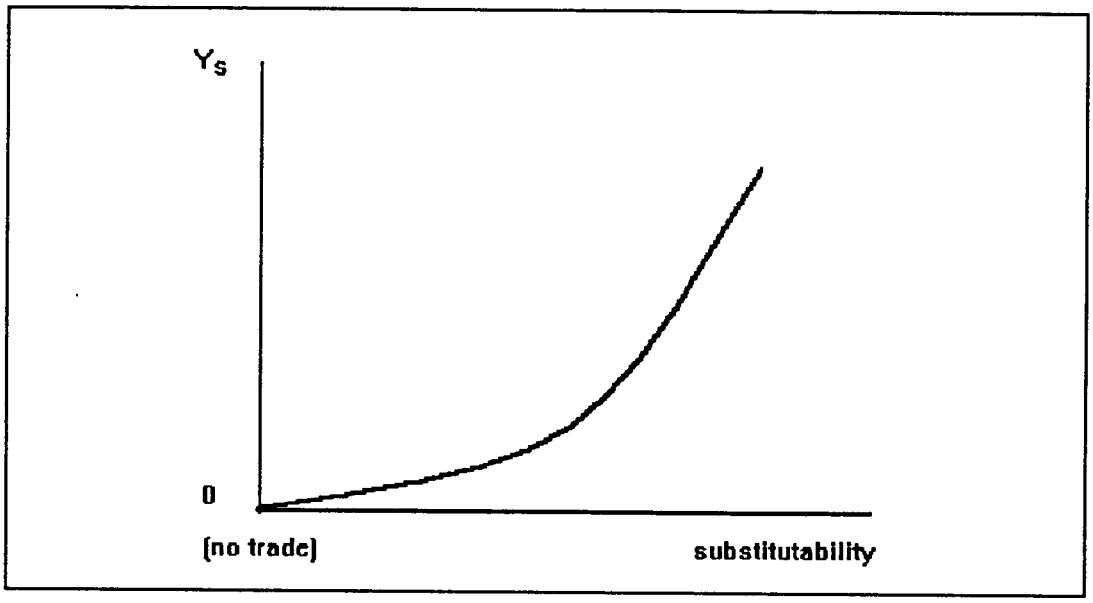

Figure III-1. Critical foreign share for different degrees of substitutability, foreign and domestic goods.

The results indicated in the first and second columns suggest that as price effect upon domestic goods is strong, the critical foreign share must be small. The principal reason for this effect is, subject to trade liberalization, that the domestic price of imported good decreases, providing a positive welfare effect. On the other hand, the increased supply of imported products influences the price of home goods through the substitute effect, providing a negative effect on domestic welfare. Moreover, due to the decreased prices of foreign products, domestic consumers purchase additional foreign goods by reducing their consumption of home products. However, if the host country's domestic price effects are sufficiently strong enough to escape the influence of the foreign price effect (i.e., the

cross-price effect), then the domestic firms can reduce the effect of the change in consumer demand. Thus, output reduction for domestic firms due to increased imports is very small.

Thus, a small welfare reduction is contributed to the domestic economy. As a result, the small foreign market share recovers, reducing domestic welfare to the level of autarky. That is, as long as the domestic price effects dominate the cross-price effects, the goods under consideration cannot be closely substitutable goods. Therefore, foreign imports can have only a marginal effect upon domestic production. A similarly intuitive process applies to the variables considered in the other columns.

One interesting outcome is indicated in the fifth column of Table III-1. Unlike homogeneous case described by Ono (1990), for the condition of product differentiation, as the number of domestic firms is increased, critical market share declines. Under Cournot behavior with homogeneous goods, Ono found that the critical market share was dependent only upon the number of domestic firms, thus producing an exceptionally high foreign market share.

To provide greater realism, data from the U.S. and Japanese automotive industries are presented in Table III-2. Data on the Demand function data[21] are taken from Dixit (1987), who provided inverse demand functions for the years 1979, 1980, and 1983. Conjectural variations were allowed to have the two extreme values 0 (Cournot) and n-1

(collusive). In general, the governments imposed and MFN of 2.9%, which is the most favored nation's tariff rate. For the present analysis, in order to compare critical market shares, both 4% and 2.9% tariff rates were used to indicate the price wedge between the price of imports and world prices (i.e, $(P_2 - P_w)$). In addition, the number of firms indicated in Table III-2 represent the numerical equivalents of the Herfindahl indexes on a company basis. The final results were consistent with general expectations established upon undertaking this project.

Table III-2. Automotive trade variable, U.S. & Japan, three years.

Variables	1979	1980	1983
$a(10^{-4})$	6.758	9.226	9.748
$b(10^{-4})$	2.213	2.701	3.083
$g(10^{-4})$	13.794	12.102	14.558
n	2	2	2
Y_s (Cournot), VER (%)	10.08	13.64	13.05
Y_s (collusive), VER (%)	7.20	10.30	10.01
Y_s (Cournot), 4% price wedge	7.70	10.30	9.90
Y_s (Cournot), 2.9% price wedge	8.20	11.10	10.55
Y_o (Cournot), 4% price wedge	3.80	5.20	5.00
Y_o (Cournot), 2.9% price wedge	4.10	6.50	5.30
Y_s (collusive), 4% price wedge	4.68	7.22	6.80
Y_s (collusive), 2.9% price wedge	5.70	8.10	7.54
Y_o (collusive), 4% price wedge	2.34	3.60	3.40
Y_o (collusive), 2.9% price wedge	2.80	4.00	3.80
Actual Japanese Market Share (%)	16.60	21.20	20.90

For the VER policy given in Table III-2, and as illustrated in Figure III-2a, due to Japanese automobile imports the U.S. domestic welfare increased above the autarky level since the actual Japanese market share in the U.S. was higher than the critical market share. Therefore, further liberalization of the U.S. auto market with respect to Japanese cars will increase the welfare level in the U.S. to an even greater degree. However, in the case of the quota policy shown in Figure III-2b, the U.S. allowed a share for Japanese cars in the domestic U.S. market that was greater than optimal since welfare function with regard to imports under a quota policy is concave upward in a stable economy.

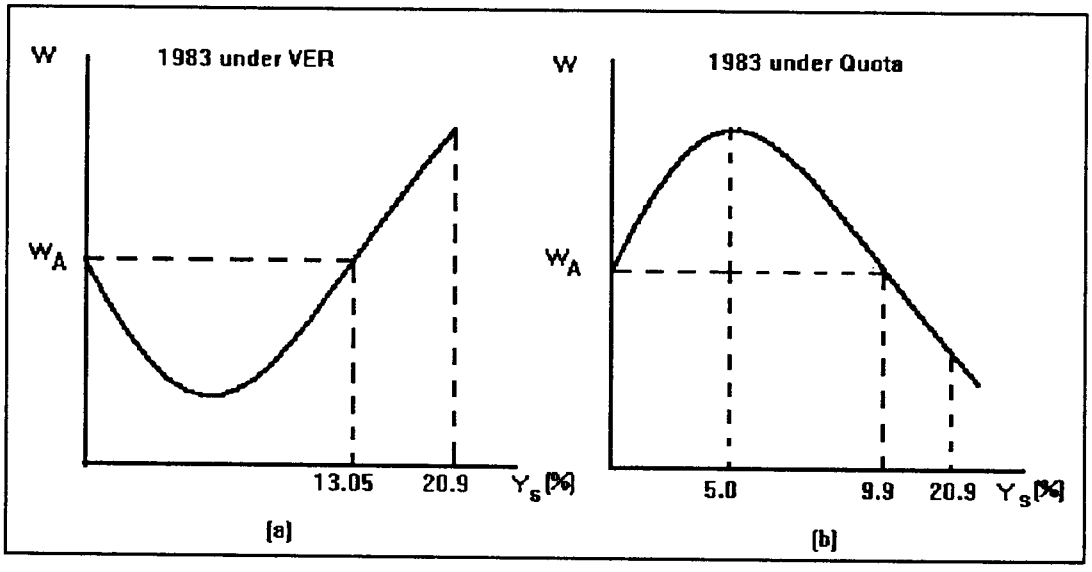

Figure III-2. Policy of quantity restriction, 1983.

With respect to the optimal import share (Y_0) shown in Table III-2, by importing more Japanese cars into the US

market, the net U.S. welfare level declined below the optimal level because the actual Japanese market share was higher than the optimal market share, thus serving to decrease the domestic welfare level. The explanation of this effect is related to quota revenue, which is not a factor in the case of VER trade policy.

Empirically, the arguments presented exist since the accuracy of the available data can be doubted and market behavior is ambiguous. However, it is necessary to accept at least the fact that the potential for perverse welfare effects and opposite results of different policies is likely to result from the trade liberalization under an oligopolistic setting. The high degree of product substitution between imported and domestic goods shown in Figure III-2 will serve to rapidly reverse the downward trending welfare reduction to the degree it is above the level of autarky level for reasonable import market share levels.

CHAPTER V

CONCLUSIONS

For this project, the somewhat paradoxical fact that the benefits of trade liberalization could be perverse under a system of oligopolistic behavior has been demonstrated. Given linear demand function, the expansion of imports serves to lower domestic output if both the domestic and import goods are substitutable. When the demand functions are nonlinear, and even though the two goods are substitutable, it is possible for domestic production to increase due to the increase in imports.

Under the VER policy, if the degree of substitutability between domestic and import goods is sufficiently small, domestic welfare always improves when trade is liberalized. That is, if the domestic and import goods are perfect substitutes, the home country will be better off by closing the domestic market to the foreign country.

In one respect, product differentiation within an imperfect market can create a reasonable foreign market share, which will not be as high as for the homogeneous assumption. When product differentiation in the VER is assumed, the U.S. auto industry must be further liberalized to acquire additional domestic benefits. However, in the case of partial quota liberalization, The U.S. government

should restrict foreign market share to optimize the domestic welfare level. This effect may be related to the general basic concept that welfare levels increase if net consumer surpluses exceed the producer's net excess profits under a broad setting. Thus, imports play a part in the distribution of benefits among groups and exercise an effect upon domestic market power. With respect to future research, the analysis could be extended to deal with a greater number of differentiated products in order to provide improved understanding of critical market share with respect to actual market conduct.

REFERENCES

Bresnahan. 1965. The Estimate of Conjectural Variation. Journal of Econometrics.

Buffie, Edward F., and Pablo Spiller. 1986. Trade liberalization in oligopolistic industries: The quota case. Journal of International Economics 20: 65-81.

Bulow, J.I., J.D. Geanakoplos and P.D. Klemperer. 1985. Multimarket Oligopoly: Strategic substitutes and complements. Journal of Political Economy 93: 488-511.

Chao, Chi-Chur and Eden S. H. Yu. Trade Liberalization and Domestic Oligopoly: A Short- and Long-Run Analysis (Oregon State University Working paper).

Dixit, Avinash K. 1984. International trade policy for oligopolistic industries. Economic Journal (supplement), 1-16.

Dixit, Avinash K. 1986. Comparative statistics for oligopoly. International Economic Review 27(1), February.

Eaton J., and G. Grossman. 1986. Optimal trade and industrial policy under oligopoly. Quarterly Journal of Economics 101, 383-406.

Eldor, Rafael, and Dan Levin. 1986. Trade liberalization and Imperfect competition: A Welfare Analysis (unpublished mimeo manuscript).

Helpman, Elhanan, and Paul Krugman. 1989. Trade Policy and Market Structure. Cambridge: MIT Press.

Motor Vehicle Manufacturers Association of the United States, Inc. 1990. Motor Vehicle Facts and Figures.

Ono, Yoshiyasu. 1990. Foreign penetration and national welfare under oligopoly. Japan and the World Economy 2, 141-154.

Optimal trade and industrial policies for the U.S. automobile industry. 1988. In R. C. Feenstra, ed., Empirical Methods for International Trade.

Rodrik, Daniel. 1988. Imperfect competition, scale economies, and trade policy in developing countries. In Baldwin, Richard, ed., Trade Policy Issues and Empirical Analysis.

APPENDIX

APPENDIX

Endnotes

1. This solves the following consumer problem:

$$E_{\min} = P_1X + P_2Y + Q \ ,$$

subject to W = W(X,Y,Q) where W denotes the consumer utility.

2. In general, its own price effect is greater than the cross-price effect

$$\left|\frac{\partial P_1}{\partial X}\right| > \left|\frac{\partial P_1}{\partial Y}\right| , \qquad \left|\frac{\partial P_2}{\partial Y}\right| > \left|\frac{\partial P_2}{\partial X}\right| .$$

3.

$$\delta_i = \frac{\partial \sum_{j=1}^{n-1} x_j}{\partial x_i} \ ,$$

where δ_i is firm i's conjectural variation with respect to the total output of all rival domestic firms.

4. See Helpman and Krugman, 1988, pp. 5-6 for a definition of perceived marginal revenue.

5. For $\delta_i = -1$, to eliminate price fluctuations, this is perfect competition since the increased output of firm i should result in a decrease of the total output of the rival domestic form by precisely the same amount of the increase in output of firm i. For $\delta_i = n - 1$, as firm i's output is increased, the total output of each rival domestic firm will increase by exactly the same amount. This is therefore termed collusive behavior.

6. Differentiate equation (3) with respect to Y:

$$\left[\frac{dP_1}{dX} + \frac{dP_1}{dX}(1+\delta_i) + \frac{d^2P_1}{dX^2}(1+\delta_i)x_i\right]\frac{dx_i}{dY}$$
$$+ \sum_{j=1}^{n}\left[\frac{dP_1}{dX} + \frac{d^2P_1}{dX^2}(1+\delta_i)x_i\right]\frac{dx_i}{dY}$$
$$= -\left[\frac{dP_1}{dY} + \frac{d^2P_1}{dXdY}(1+\delta_i)x_i\right],$$
$$\sum_{j=1}^{n}\left[\frac{dP_1}{dX}Hx\ \frac{d^2P_1}{dX^2}(1+\delta_j)x_j\right]\frac{dx_i}{dY}$$
$$+ \left[\frac{dP_1}{dX} + \frac{dP_1}{dX}(1+\delta_j) + \frac{d^2P_1}{dX^2}(1+\delta_j)x_j\right]\frac{dx_j}{dY}$$
$$= -\left[\frac{dP_1}{dY} + \frac{d^2P_1}{dXdY}(1+\delta_j)x_j\right].$$

These may be solved by the application of Cramer's rule, where

$$\frac{dx_i}{dy} = \frac{|R|_{nxn}}{\lambda\beta},$$

and where

$$|R| + \begin{vmatrix} r_{1i} & \cdots & r_{1n} \\ \vdots & \ddots & \vdots \\ r_{n1} & \cdots & r_{n2} \end{vmatrix}$$

and the principal diagnonal is

$$r_{ij} = 1 + \frac{\left[\frac{dP_1}{dX}(1+\delta_j)\right]}{\left[\frac{d^2P_1}{dX^2}(1+\delta_j)x_j + \frac{dP_1}{dX}\right]}, \qquad \text{for } j=2,\ldots,n$$

and

$$r_{il} = \frac{\left[\frac{d^2P_1}{dXdY}(1+\delta_i)x_i + \frac{dP_1}{dY}\right]}{\left[\frac{dP_1}{dX} + \frac{d^2P_1}{dX^2}x_i(1+\delta_i)\right]}.$$

The remainder of the elements in the matrix |R| are equal to 1, thus:

and

$$\lambda = 1 + \sum_{i=1}^{n} \frac{\left[\frac{d^2P_1}{dX^2}(1 + \delta_i)x_i + \frac{dP_1}{dX}\right]}{\left[\frac{dP_1}{dX}(1 + \delta_i)\right]}$$

$$\beta = \prod_{i=1}^{n} \frac{\left[\frac{dP_1}{dX}(1 + \delta_i)\right]}{\left[\frac{dP_1}{dX} + \frac{d^2P_1}{dX^2}(1 + \delta_i)x_i\right]} .$$

7. From equation (7), for the linear assumption

$$\frac{d^2P_1}{dx^2} , \frac{d^2P_1}{dx\,dy}$$

are equal to zero, where

$$n\frac{dx}{dY} = \frac{-n}{\left(1 + \frac{n}{1 + \delta}\right)(1 + \delta)} = \frac{-n}{n + 1 + \delta} .$$

Since δ is between -1 and n - 1,

$$-1 < n\frac{dx}{dy} < 0 .$$

8. Refer to footnote 18.

9. If we take the total differentiation of equation (8),

$$X_c\,dP_1 + Y_c\,dP_2 + E_w\,dW = nx\,dP_1 + nP_1\,dx + (P_2 - P_w)\,dY + (dP_2 - dP_w)\,Y + d\theta ,$$

where the subscript c denotes consumption, then, since $d\theta = -cdx$,

$$E_w\frac{dW}{dY} = n(P_1 - c)\frac{dx}{dY} + (P_2 - P_w) - \frac{dP_w}{dY}Y .$$

10. Chao analyzed the short- and long-run welfare impacts upon the home country due to partial quotas and VER liberalization.

11. Refer to footnote 18.

12. From equations (3) and (12),

$$\frac{dW}{dY} = -n\frac{dP_1}{dX}\frac{dx}{dY}(1+\delta)x - \left[n\frac{dP_2}{dX}\frac{dx}{dY} + \frac{dP_2}{dY}\right]Y ,$$

when Y is equal to zero and dw/dY < 0. From the second-order condition,

$$\frac{d^2W}{dY^2} = -n\frac{dP_1}{dX}\left(\frac{dx}{dY}\right)^2(1+\delta)x - \left[n\frac{dP_2}{dX}\frac{dx}{dY} + \frac{dP_2}{dY}\right] > 0 .$$

Thus, the welfare function is convex.

13. From equation (10),

$$\frac{dW}{dY} = (P_1 - c)\left[n\frac{dx}{dY} + \frac{(P_2 - P_w)}{(P_1 - c)}\right] > 0$$

since $-1 < n\, dx/dY < 0$. If $(P_2 - P_w)$ is greater than $(P_1 - c)$, then dW/dY will be positive.

14. If the second-order condition is positive, i.e.,

$$\frac{d^2W}{dY^2} = n\left[n\frac{dP_1}{dX}\frac{dx}{dY} + \frac{dP_1}{dY}\right]\frac{dx}{dY} - \left[n\frac{dP_2}{dX}\frac{dx}{dY} + \frac{dP_2}{dY}\right] > 0 ,$$

then under the linear assumption it is always positive.

15. Ono mentioned this term in his study.

16. From equation (12), this is the optimal level when the first-order condition is satisfied. However, under the linear assumption,

$$\frac{d^2W}{dY^2} < 0 ,$$

therefore the optimal level is the minimum point.

17. From equation (15), to obtain the same level of welfare as the autarky's by following partial trade liberalization, i.e., $W_t = W_A$,

$$\int_0^Y \left(\frac{dW}{dY}\right) dY = 0 ,$$

substitute equation (16) into equation (15),

$$\int_0^Y \left(\frac{dW}{dY}\right) dY = \int_0^Y \left[n(P_1 - c)\frac{dx}{dY}\right] dY$$
$$- \int_0^Y \left\{\left[n\left[\frac{dP_2}{dX}\frac{dx}{dY}\right] + \frac{dP_2}{dY}\right] Y\right\} dY$$
$$\Rightarrow \int_0^Y \left(nP_1\frac{dx}{dY}\right) dY - \int_0^Y \left[(nc)\frac{dx}{dY}\right] dY$$
$$- \int_0^Y Y\left[n\left[\frac{dP_2}{dX}\frac{dx}{dY}\right] + \frac{dP_2}{dY}\right] dY \ .$$

Since demand is linear, dx/dY, dP_2/dX and dP_2/dY are constant. Then, by using

$$\int u'v = uv - \int uv' \ ,$$

$$\int_0^Y \left(\frac{dW}{dY}\right) dY = \left(nP_1\frac{dx}{dY}\right) Y - \frac{Y^2}{2}\left[n\frac{dx}{dY}\left[\frac{dP_1}{dX}\frac{dx}{dY} + \frac{dP_1}{dY}\right]\right]$$
$$- \left(nc\frac{dx}{dY}\right) Y - \frac{Y^2}{2}\left[n\frac{dP_2}{dX}\frac{dx}{dY} + \frac{dP_2}{dY}\right] = 0 \ .$$

Then, rearranging terms,

$$Y\left[\frac{Y}{2}\left\{\left[n\frac{dP_2}{dX}\frac{dx}{dY} + \frac{dP_2}{dY}\right] + n\frac{dx}{dY}\left[n\frac{dP_1}{dX}\frac{dx}{dY} + \frac{dP_1}{dY}\right]\right\} - n(P_1 - c)\frac{dx}{dY}\right] = 0$$

The solutions will be $Y = 0$, or

$$Y = \frac{2n(P_1 - c)\frac{dx}{dY}}{n\frac{dx}{dY}\left[n\frac{dP_1}{dX}\frac{dx}{dY} + \frac{dP_1}{dY}\right] + \left[n\frac{dp_2}{dX}\frac{dx}{dY} + \frac{dP_2}{dY}\right]} \ .$$

Now, substitute equation (3)

$$Y_e = \left[\frac{(-2knx)}{(H + \Gamma)}\right] .$$

18. In a stable economy, this is negative. For further details, see Dixit, 1986.

19. From equation (18), differentiate with respect to t, then

$$\frac{dY_s}{dt} = 2t^2(n+1)(n^2+2n) + 2(n+1)^3(g/a)\left(1 + \frac{da/a}{dt/t}\right).$$

If the elasticity of a with respect to t is greater than -1, then $dY_s/dt > 0$.

20. From equation (19), substitute $dP_1/dX = dP_2/dY = dP_1/dY = dP_2/dX$, and $dx/dY = -1/(n+1)$. It then follows that (2n+2)/2n+3. For homogeneous treatment, see Ono, 1990.

21. For further details regarding this data, see Dixit, 1988.