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**IMPORT QUOTA AND PRODUCT QUALITY:
THE CASE OF THE CANADIAN CLOTHING INDUSTRY**

by

I. PRAKASH SHARMA. M.A.

**A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfilment of
the requirements of the degree of
Doctor of Philosophy**

Department of Economics

Carleton University

Ottawa, Ontario

1992

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acceptance of the thesis

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ABSTRACT

This thesis examines, theoretically and empirically, the effects of an import quota on the quality of both imported products and those produced domestically which compete with imports. The effect on import quality is found to be ambiguous, while the quality of domestically produced import-competing products rises.

Data prepared by Statistics Canada for this thesis were used to compute estimates of the quality of seven clothing product categories manufactured in Canada. Estimates of import quality for the matching seven import categories from five low cost, quota-restrained countries were then calculated.

The quota imposed by Canada in 1977 on such imports from these countries resulted in import quality upgrading in the short run, but the effect on the quality of Canadian manufactured import-competing products was found to be ambiguous.

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CHAPTER ONE

INTRODUCTION

A popular view in the trade literature is that quota restraints result in a higher quality of imported products. Exporters find it profitable to ship higher price products of better quality to the quota-imposing country since the quantity they can sell is restricted by the quota barrier. Thus a quota leads to an upgrading of import quality.

The quality upgrading hypothesis originated with the Alchian and Allen (1969) proposition of 'shipping the good apples out':

If good 1 is the premium quality apple and good 2 the inferior quality apple with local prices p_1 and p_2 , ($p_1 > p_2$), then after adding a fixed amount, t , as the transportation charge, $(p_1+t)/(p_2+t) < (p_1/p_2)$.

Although both prices are higher, good apples have become relatively cheaper and a higher proportion of good apples will be shipped out than consumed locally.

A specific tariff also adds a fixed amount, as did the transportation cost, to the prices of goods of all qualities. A quota charge affects the quality of imports in the same way as does a specific tariff, if a quota licence price, or *quota charge*, is determined competitively. Rodriquez (1979), Falvey (1979), and Santoni and Van Cott (1980) incorporated this idea in a competitive partial equilibrium model. These models produce the Alchian and Allen result: the quality of imports unambiguously increases under a unit tariff or a quota.¹

This thesis extends the theoretical and the empirical research on the quota-quality link in a competitive, partial equilibrium framework. Previous literature used a long-run model with free entry and constant costs to establish the result that a quota increases import quality. One objective of the thesis is to examine the robustness of the quality-upgrading hypothesis to changes in assumptions. This thesis shows that in a model with a fixed number of firms and increasing costs, the effect of a quota on import quality is ambiguous.

¹ A well known piece of evidence in favour of this phenomenon is quality upgrading by Japanese car exporters [Feenstra (1984)].

Another objective of the thesis is to examine the effect of a quota on the quality of domestic goods. Theoretically, the quality of domestic import-competing goods is found to rise unambiguously under a quota regime.²

The thesis also undertakes an empirical analysis of the effect of the quota imposed in 1977 on quality in the Canadian clothing industry. Making use of special data made available by Statistics Canada, the thesis constructs a new measure of quality for imports and domestic products in certain clothing categories.

The thesis is organized as follows. In Chapter two, a theoretical model is set up. In Chapter three, there is an analysis of the effect of a specific tariff on the quality of imports and import-competing goods. Chapter four considers institutional aspects and provides descriptive statistics concerning the Canadian clothing market. In Chapter five, the empirical methodology and empirical results are developed. Conclusions follow in Chapter six.

The remainder of this chapter is structured as follows: the second section gives a brief account of the relevant international trade literature, while in the third section, the theoretical model and empirical methodology employed in this thesis are summarized.

²This result supports the view of Pestieau (1977) and Ahmed (1989), but is contrary to Jenkins' (1985) argument that Canadian clothing manufacturers move down the product quality spectrum.

1.2. A REVIEW OF THE LITERATURE

The literature on commercial policy and product quality starts with Falvey (1979) who examines the issue in a competitive partial equilibrium model where a small economy imports two varieties of a good. The marginal and average cost of each type is assumed constant. The two varieties are close substitutes so income and cross-price effects are assumed absent. A unit tariff or quota charge raises the prices of both varieties by the same absolute amount but, as in the Alchian-Allen proposition, the relative price of the premium variety falls and import quality upgrading takes place. Imports of the higher quality variety increase but imports of the lower quality variety fall more, so that total imports of the product decrease. An *ad valorem* tariff, on the other hand, does not affect the quality composition of imports since the relative price of the two varieties is unchanged.

Santoni and Van Cott (1980) extended the Falvey model to three varieties of imports. They obtained the quality upgrading result with both unit tariff and quota regimes.

Rodriguez (1979) modeled quality as a continuous variable and assumed that the services of different qualities were perfect substitutes. In his model the country imports one quality in the absence of any trade barriers. The marginal and average costs of output are assumed constant but are higher with more quality content. Although the output of the foreign firm is indeterminate, the quality of services it supplies is determined by the condition that price of services and price of quality equal marginal costs. Free entry of foreign firms ensures the equality of marginal and average cost, and that they are the same as the price of services in the home country.

In the Rodriguez model, a unit tariff or a quota charge raises foreign firm's marginal revenue of quality above its marginal cost by increasing the price of services in home market. The foreign firm then increases quality content. An *ad valorem* tariff does not bring forth any quality adjustment because it does not alter the equality of price-marginal cost, and the marginal and average costs of quality.

Mayer (1982) models domestic and foreign production of a quality differentiated product in a general equilibrium framework with quality treated as a continuous variable. However, Mayer analyzes the effect on import quality of imposition of quality standards rather than an import quota.

There is a considerable literature originating with Barro (1974) and Musa and Rosen (1978) on whether a monopolist increases or decreases product quality. The issue is whether the quality of imports supplied by a monopolist improves under different commercial policies.³ In these models the effect of a quota charge is similar to that of a specific tariff. The general result in monopoly models is that specific and *ad valorem* tariff regimes both have ambiguous effects on import quality⁴. The results were similar when extended to cover monopolistic competition⁵ and oligopoly⁶.

The ambiguous import quality result derived in this thesis is consistent with findings from models with imperfectly competitive markets. The unambiguous domestic quality upgrading result derived in this thesis is a result that has not been addressed in previous work.

³ Krishna (1987), Das and Donnenfeld (1987).

⁴ Krishna (1987, 1990), Das and Donnenfeld (1987).

⁵ Krugman (1979), Lancaster (1979).

⁶ Krishna and Itoh (1988), Das and Donnenfeld (1989).

The automobile industry is characterised by imperfectly competitive firms. Empirical work by Feenstra (1984, 1988) examined the effect on import quality of (a) Japanese voluntary export restraints (VERs), and (b) a 25 percent *ad valorem* tariff on truck imports from Japan to the United States. Feenstra used data on automobile characteristics and hedonic regression techniques to analyze quality. Although there was no evidence of quality change in the *ad valorem* tariff case, VERs were associated with an increase in the average quality of Japanese cars.⁷

The footwear market in the United States is a competitive industry. Aw and Roberts (1986, 1988) used the index number approach to examine the quality of U.S. imports of footwear from quota restrained countries. Their work supported the quality upgrading hypothesis.⁸

1.3. FRAMEWORK FOR THE THESIS

In the model formulated in Chapter two, the home country clothing market is supplied by domestic and foreign firms. The analysis is based on a short run partial equilibrium model with perfect competition. An index q , ($q = 0, \dots, Q$), ranks clothing varieties in ascending order of quality.

⁷ Tarr and Morkre (1984), Feenstra (1984), and Anderson (1985) also estimate welfare costs in the U.S. due to the quota system.

⁸ Anderson (1985) also finds support for this hypothesis in the case of U.S. import of cheese.

In the model there are two countries termed "foreign" and "home". In each country firms choose the quantity and quality of the varieties to produce. The production process is such that marginal cost is rising with respect to both quantity and quality.

Consumers budget in two stages. At the first stage, overall utility is maximized by allocating the budget between expenditures on the clothing and other goods' sectors. At the second stage, the clothing sector sub-utility is maximized subject to the clothing sector expenditure. The consumer sub-utility function is additive in the q clothing varieties, with the various varieties treated as perfect substitutes.

In free trade equilibrium, each country produces output of a single quality. In our model, the effects of a specific tariff or a quota on quality and output are qualitatively equivalent.

The direct effect of the specific tariff on the output and quality choice of the foreign firms is negative: the net price received by the foreign firms is lowered, and they react by reducing both quality and output.

Another effect is indirect, influencing the choice of output and quality for both foreign and home firms. The specific tariff increases the price and output of the reference grade, i.e., the lowest quality. Because higher qualities are priced relative to this reference grade, the tariff causes their prices to go up as well. The increase in the price of the reference quality causes a rise in the marginal revenue of firms; they are induced to produce more output and increase quality content. This indirect effect is positive. In particular, it explains the result that domestic firms increase quality when a tariff or quota is imposed on imports.

The quality of imports can increase or decrease or remain unchanged depending on whether the direct and the indirect effects offset or reinforce each other. In contrast to the previous literature, our model does not yield the unambiguous prediction that import quality increases under a quota regime.

For empirical evidence we turn to data from the Canadian clothing market from 1974 to 1986. The Canadian clothing industry is competitive. Clothing imports to Canada from low-cost countries such as Hong Kong, China, the Philippines, South Korea and Taiwan, have been subject to quota restrictions since 1977. Meanwhile, all high-cost countries had unrestrained access to the Canadian clothing market.

Statistics Canada provides quality adjusted price index data for seven product categories which can be matched to import categories. From product price survey data Statistics Canada prepared for this thesis, quality unadjusted price data matched to quality adjusted price data are available for the same seven categories. From Customs data come unit values for seven import product categories which can be matched to varieties of clothing produced in Canada.

The measure of domestic product quality employed here is the ratio of the quality unadjusted price index and the quality adjusted price index. The measure of import quality used is the Canadian quality adjusted price index times import unit value index divided by the Canadian quality unadjusted price index.

Empirical evidence for the seven import product categories from the five major quota restricted countries indicates that the quality-upgrading hypothesis for imports is accepted based on a comparison of import quality during three years periods before and after the imposition of a quota in 1977. For import-competing products, quality changes are marginal and no clear pattern emerges.

These descriptive tests are supplemented by statistical analysis using pooled data. In the regression analysis dummy variables are used to capture the effect of the quota. The results show an increase in the quality of imports following the quota but indicate no significant change in the quality of Canadian production.

The regression analysis is then extended to isolate the effect of the quota on quality from the influence of factors such as real GDP, inflation, and supply trends. Regressions are run for each product category and country using data from 1974 to 1986. No significant effects of these additional variables were found.

The import quality-upgrading hypothesis holds in the Canadian clothing market by the evidence of this thesis. This result extends previous work, which applied to imperfectly competitive markets, to a competitive setting, as is the case in Canada. Little evidence of quality-upgrading by import-competing firms is found.

CHAPTER TWO

PRODUCT QUALITY AND COMMERCIAL POLICY:

THE BASIC MODEL

In this chapter we formulate a model of a competitive market where (a) services provided by different varieties are perfect substitutes, and (b) domestic and foreign firms face rising marginal costs with respect to both quality and output. Assumption (a) allows domestic and foreign firms to produce different qualities in a competitive industry. Assumption (b), a plausible specification in the short-run, leads to some new results derived in the next chapter.

This chapter is organized as follows. The demand side is developed in section 2.1. In section 2.2, the supply side of the model is set up. The model is solved for the free-trade equilibrium in section 2.3.

2.1. THE DEMAND SIDE

Consumers are assumed to have identical utility functions, so the analysis of the demand side of the model can be developed in terms of the utility function of the representative consumer.

To simplify the analysis consumers are assumed to do two-stage budgeting. The first stage utility function is defined over clothing and other goods. The second stage sub-utility function is defined over the Q quality differentiated clothing varieties of the clothing industry.

The first stage utility function is:

$$U = U(u_c, u_y), \quad (2.1)$$

where U is the first stage utility function,

u_c is the second stage utility function for the clothing sector, and

u_y is the second stage utility function for sector Y which represents all goods.

If the utility function (2.1) is separable, the consumer optimization can be analyzed in two steps. In the first stage, the consumer allocates expenditure between clothing and other goods, given the budget constraint and the price of clothing compared to that of other goods. In the second stage, the clothing budget is allocated to different

varieties within the clothing group. This allocation depends only on total clothing expenditure and the prices of the different varieties.¹

Consider the second stage optimization problem with the general form of the clothing sector sub-utility function taken as:

$$u_c = u_c(s_c^0, s_c^1, \dots, s_c^Q) \quad , \quad (2.2)$$

where s_c^q is the service flow obtained by the representative consumer from variety q . This service flow is defined as the quality content in one unit of variety q , denoted $\psi(q)$, times the quantity consumed, denoted x_c^q ; that is, $s_c^q = \psi(q)x_c^q$, $q = 0, \dots, Q$.

The utility function (2.2) is assumed to be additive in its arguments:

$$u_c = s_c = \sum_{q=0}^Q s_c^q = \sum_{q=0}^Q \psi(q)x_c^q, \quad (2.3)$$

where s_c is the total services consumed by the representative consumer. Assuming the relationship between ψ and q is one-to-one, index q is chosen so that the higher is q the higher is $\psi(q)$:

¹ See Deaton and Muellbauer (1980): 124.

$$\psi(j) > \psi(i), \quad \text{for } j > i. \quad (2.4)$$

Following Rodriguez (1979), (2.3) assumes that there is perfect substitution between different product varieties. This assumption allows a number of varieties to be produced in a competitive industry.

Let m be the optimal clothing sector budget allocation from the first stage decision.² At the second stage, the representative consumer chooses the optimal combination of varieties by maximizing (2.3) subject to the constraint:

$$\sum_{q=0}^Q p^q x_c^q = m, \quad (2.5)$$

where p^q is the unit price of q -th variety.³

² In general, the share of m in total expenditure depends on the budget and the prices of the clothing and other goods. If however, (2.1) is represented by the Cobb-Douglas form this share is constant.

³ In section 2.2 below, q is treated as a continuous variable. Optimization by a finite number of different firms (i.e., different cost functions) leads to a finite number of varieties produced. Thus q is taken to be a discrete variable in the present section.

The second stage consumer optimization is:

$$\max_{x_c^q} \mathcal{L} = \sum_{q=0}^Q \psi(q) x_c^q + \lambda (m - \sum_{q=0}^Q p^q x_c^q), \quad (2.6)$$

where λ is the Lagrangian multiplier. The first order conditions are:

$$\begin{aligned} \frac{\partial \mathcal{L}}{\partial x_c^q} &= \psi(q) - \lambda p^q = 0, \quad q = 0, \dots, Q, \\ \frac{\partial \mathcal{L}}{\partial \lambda} &= m - \sum_{q=0}^Q p^q x_c^q = 0. \end{aligned} \quad (2.7)$$

According to (2.7), the following condition must be satisfied for the consumer to be indifferent between any two varieties:

$$\frac{\psi(i)}{p^i} = \frac{\psi(j)}{p^j}, \quad i, j = 0, \dots, Q. \quad (2.8)$$

Equation (2.8) shows that for the representative consumer to buy varieties i and j , p^i/p^j must be equal $\psi(i)/\psi(j)$. Thus, if multiple varieties are sold in the market, their prices must be set in such a way that they satisfy (2.8); that is, the marginal utility per dollar must be the same for each variety.

Normalizing q so ψ for variety 0 (the reference grade) is one, (2.8) becomes:

$$p^q = p^0 \psi(q), \quad q = 0, \dots, Q. \quad (2.9)$$

The price of variety q is linked to the price of the reference variety by the quality content function $\psi(q)$.

Using (2.7) and (2.9) the demand for clothing services by the representative consumer is expressed as:

$$s_c(p^0, m) = \sum_q^Q \psi(q) x_c^q = \frac{m}{p^0}, \quad (2.10)$$

If there are n^c consumers, aggregate demand for services in the domestic market, S_c , can be written as:

$$S_c(p^0, M) = n^c s_c = \frac{M}{p^0}, \quad (2.11)$$

where $M = n^c \cdot m$.

2.2. THE SUPPLY SIDE

In the domestic market, clothing varieties are supplied by home and foreign firms. Each firm can choose to produce any variety q , where q is now treated as a continuous index of quality over the interval $[0, Q]$.

The total cost functions for representative home and foreign firms are given by:

$$C^j = \phi^j(x^j, q^j), \quad j = H, F$$

$$\frac{\partial \phi^j}{\partial x^j} > 0, \quad \frac{\partial \phi^j}{\partial q^j} > 0, \quad (2.12)$$

where x^H and q^H represent outputs and quality produced by a representative home firm and x^F and q^F represent outputs and quality produced by a representative foreign firm. The cost functions are assumed to be increasing in output and quality. Note that ϕ^H and ϕ^F can differ due to factor price and/or technological differences.

2.3. THE FREE-TRADE EQUILIBRIUM

We first consider the free trade situation where foreign firms face no barriers in selling to the home country. The unit price in the home market for any level of q is thus the same for both home and foreign firms. Using (2.9) the profit function of a representative firm in country j under free trade is:

$$\pi^j = p^0 \psi(q^j) x^j - \phi^j(x^j, q^j), \quad j=H, F \quad (2.13)$$

Using subscripts to denote partial derivatives, the first order conditions for profit maximization are:

$$p^0 \psi_q(q^j) x^j - \phi_q^j(x^j, q^j) = 0, \quad j=H, F, \quad (2.14)$$

$$p^0 \psi(q^j) - \phi_x^j(x^j, q^j) = 0, \quad j=H, F \quad (2.15)$$

The second order conditions for profit maximization are assumed to be satisfied.⁴

The two equations, (2.14) and (2.15), can be solved for the two unknowns, q^j and x^j . The first term on the left hand side of (2.14) is the marginal revenue of quality, $MR(q^j)$, while the second term is the marginal cost of quality, $MC(q^j)$. The competitive firm equates $MR(q^j)$ and $MC(q^j)$ to determine its optimal quality. Similarly, the first term on the left hand side of (2.15) is the marginal revenue of quantity, $MR(x^j)$, and the second term is the marginal cost of quantity, $MC(x^j)$. The competitive firm equates $MR(x^j)$ and $MC(x^j)$ to determine its optimal quantity.

⁴ The second order conditions are: (1) $\pi_{q^j q^j}^j = p^0 \psi_{qq}(q^j) \cdot x^j - \phi_{qq}^j(x^j, q^j) < 0$; (2) $\pi_{x^j x^j}^j = -\phi_{xx}^j(x^j, q^j) < 0$; and (3) $\pi_{q^j x^j}^j = \pi_{x^j q^j}^j = [p^0 \psi_{qj}(q^j) - \phi_{qx}^j(x^j, q^j)] > 0$. We assume that (1) and (2) are negative and (3) is positive. For profit maximization we also need to assume that:

$$\pi_{q^j q^j}^j \pi_{x^j x^j}^j - [\pi_{q^j x^j}^j]^2 > 0.$$

The choice of q^j and x^j is illustrated in Figure 1. There the $q^j q^j$ curve is the locus of all (q^j, x^j) combinations that satisfy (2.14), while the $x^j x^j$ curve is the locus of (x^j, q^j) that satisfy (2.15). It is shown in Appendix II.A that both schedules are upward sloping under the assumption that the cross-effects term in the second order conditions is positive. It is also demonstrated that the $x^j x^j$ curve is steeper than $q^j q^j$ curve in the neighbourhood of (q^{j*}, x^{j*}) .

Figure 2.1: The Firm in Free-Trade Equilibrium

The solution to (2.14) and (2.15) is (q^{j*}, x^{j*}) , given by the intersection of $q^j q^j$ and $x^j x^j$ at point E^{j*} in Figure 2.1.

In the Rodriguez model (1979) the firm's output is indeterminate because of the assumption of constant marginal cost. By contrast, in this model, the level of output and quality for the firm is determinate as a result of the assumption that marginal cost increases as quantity or quality rise.

In the analysis of Figure 2.1, p^0 for the representative firm in country j was given. A change in p^0 alters both q^j and x^j .

In Appendix II.B it is shown that an increase in p^0 is associated with an increase in both q^j and x^j :

$$\frac{dq^j}{dp^0} > 0, \quad j=F,H \quad . \quad (2.16)$$

$$\frac{dx^j}{dp^0} > 0, \quad j=F,H \quad . \quad (2.17)$$

The explanation of this result is as follows: any increase in the price of the reference quality raises marginal revenue $MR(q)$ in (2.14) for a given x^j , so firms in each country increase q^j to raise $MC(q)$ to satisfy (2.14). An increase in p^0 shifts the $q^j q^j$ schedule up to $q^{j'} q^{j'}$ as shown in Figure 2.2.

Figure 2.2: Shifts in $x^j x^j$ and $q^j q^j$ due to a Change in p^0

For a given q^j the firm finds that its $MR(x^j)$ has risen due to the increase in p^0 . The firm must now increase x^j such that $MC(x^j)$ gets larger and condition (2.13) holds again. In terms of Figure 2.2, an increase in p^0 for a given value of q^j causes the $x^j x^j$ schedule to shift to the right to $x^{j'} x^{j'}$.

The upward shift in the $q^j q^j$ schedule and the rightward shift in the $x^j x^j$ schedule cause the equilibrium quality and output to rise. Crucial to this result is the condition that the $x^j x^j$ schedule is steeper than the $q^j q^j$ schedule.

It is generally observed that better quality clothing items are produced in high wage countries. This fact is consistent with our results. In our model, even if the technology is the same in home and foreign countries, differences in relative factor prices could cause $\phi^H(\cdot)$ to differ from $\phi^F(\cdot)$. It is possible, as illustrated in Figure 2.3, that the intersection of the $x^H x^H$ and $q^H q^H$ schedules

occurs at a higher level of quality than the intersection of the $x^F x^F$ and $q^F q^F$ schedules.

Figure 2.3: Home Versus Foreign Quality

Once the equilibrium levels of output for each quality level are determined for the representative firm, the supply of services by the representative firm in country j is:

$$s^j = \psi(q^j) X^j, \quad j=F, H \quad . \quad (2.18)$$

The total supply of services in the home market from country j is the number of firms in country j times the supply of services by the representative firm:

$$S^j = \psi(q^j) n^j X^j, \quad j=F, H \quad , \quad (2.19)$$

where n^j is the number of firms in country j . The aggregate supply of services, S , is the sum of the supply from each country:

$$S(p^0) = S^H + S^F = \psi(q^H)n^H X^H + \psi(q^F)n^F X^F \quad . \quad (2.20)$$

From (2.16) and (2.17) q^j and x^j both increase as p^0 increases. The supply function of services in (2.19) and (2.20) this increases with p^0 .

To determine the equilibrium home market price of services for the reference quality, aggregate demand for services (2.11) and aggregate supply of services (2.20) are equated to obtain:

$$p^0 = M / [\psi(q^H)n^H X^H + \psi(q^F)n^F X^F] \quad . \quad (2.21)$$

The determination of the price of the reference quality in the free trade case is illustrated in Figure 2.4. Aggregate demand is given by the S_c schedule, which (from 2.10) is negatively sloped in p^0 and S space. The aggregate supply of services, the $S(S^F + S^H)$ schedule, is upward sloping from (2.20). The intersection of the two schedules determines p^{0*} . Given the price of the reference quality, the price of any higher quality can be derived from (2.9).

Figure 2.4: The Determination of the Reference Quality Price

The demand for services supplied by the j -th country can be easily derived. For example, the demand curve for services supplied by the foreign country is the residual demand, $S_c^F(\cdot)$, after domestic supply has been subtracted from the total home demand:

$$S_c^j(p^0, M) = S_c(p^0, M) - S^i(p^0, M), \quad i, j = F, H; \quad i \neq j. \quad (2.22)$$

The equilibrium level of services for country j is obtained by equating $S_c^j(\cdot)$ and $S^j(\cdot)$:

$$S_c^j(p^0, M) = S^j(p^0) = \psi(q^j) n^j X^j, \quad j = F, H. \quad (2.23)$$

This solution is illustrated in Figure 2.5.

Figure 2.5: The Determination of Home or Foreign Supply of Services

In Figure 2.5, S_c^j is the net demand available to country j in the home market while S^j is country j 's supply of services. The two schedules intersect at E^{j*} . The free-trade equilibrium level of services is S^{j*} at the free-trade price of the reference quality, p^{0*} .

APPENDICES TO CHAPTER TWO

II.A. SLOPES OF $q^j q^j$ AND $x^j x^j$ CURVES

To determine the slope of the $q^j q^j$ curve, we differentiate (2.12) with respect to q^j and x^j :

$$\begin{aligned} d\pi_{q^j}^j = 0 = & \left[p^0 x^j \frac{\partial^2 \psi}{\partial q^{j^2}} - \frac{\partial^2 \phi}{\partial q^{j^2}}(q^j, x^j) \right] dq^j \\ & + \left[p^0 \frac{\partial \psi}{\partial q^j}(q^j) - \frac{\partial \phi^j}{\partial q^j} \frac{\partial q^j}{\partial x^j}(q^j, x^j) \right] dx^j . \end{aligned} \quad (A2.1)$$

We next obtain:

$$\begin{aligned} \left. \frac{dq}{dx^j} \right|_{q^j q^j} &= - \frac{p^0 \frac{\partial \psi}{\partial q^j}(q^j) - \frac{\partial \phi^j}{\partial q^j} \frac{\partial q^j}{\partial x^j}(q^j, x^j)}{p^0 x^j \frac{\partial^2 \psi}{\partial q^{j^2}} - \frac{\partial^2 \phi}{\partial q^{j^2}}(q^j, x^j)} \\ &= - \frac{\left. \pi_{x^j q^j}^j \right\} > 0}{\left. \pi_{q^j q^j}^j \right\} < 0} > 0 . \end{aligned} \quad (A2.2)$$

To determine the slope of the $x^j x^j$ curve, we differentiate (2.13) with respect to q^j and x^j :

$$d\pi_{x^j}^j = 0 = \left[p^0 \frac{\partial \psi}{\partial q^j}(q^j) - \frac{\partial \phi^j}{\partial x^j} \frac{\partial x^j}{\partial q^j}(q^j, x^j) \right] dq^j + \left[- \frac{\partial^2 \phi}{\partial x^{j^2}}(q^j, x^j) \right] dx^j .$$

(A2.3)

We next obtain:

$$\begin{aligned} \left. \frac{dq}{dx^j} \right|_{x^j x^j} &= \frac{\phi_{x^j x^j}(x^j, q^j)}{p^0 \frac{\partial \psi}{\partial q^j}(q^j) - \frac{\partial \phi^j}{\partial x^j} \frac{\partial x^j}{\partial q^j}(q^j, x^j)} > 0 \\ &= \frac{- \left. \pi_{x^j x^j}^j \right\} > 0}{\left. \pi_{q^j x^j}^j \right\} > 0} > 0 . \end{aligned}$$

(A2.4)

Both schedules are positively sloped in q^j - x^j space. But at the intersection of the two curves the slope of the $x^j x^j$ curve is steeper than the $q^j q^j$ curve.

$$\left. \frac{dq}{dx^j} \right|_{x^j x^j} = \frac{\left. \begin{matrix} -\pi^j_{x^j x^j} \\ \pi^j_{q^j x^j} \end{matrix} \right\} > 0}{\left. \begin{matrix} \pi^j_{x^j q^j} \\ \pi^j_{q^j q^j} \end{matrix} \right\} > 0} = - \frac{\left. \begin{matrix} \pi^j_{x^j q^j} \\ \pi^j_{q^j q^j} \end{matrix} \right\} < 0}{\left. \begin{matrix} \pi^j_{x^j x^j} \\ \pi^j_{q^j q^j} \end{matrix} \right\} > 0} = \left. \frac{dq}{dx^j} \right|_{q^j q^j}$$

$$\left. \frac{dq}{dx^j} \right|_{x^j x^j} = \left[\pi^j_{q^j q^j} \right] \left[\pi^j_{x^j x^j} \right] > 0,$$

$$\left. \frac{dq}{dx^j} \right|_{q^j q^j} = \left[\pi^j_{x^j q^j} \right]^2.$$

(A2.5)

The assumption that $|J^j| > 0$ implies that:

$$\left\{ \left[p^0 \psi_{q^j q^j}(q^j) x^j - \phi_{q^j q^j}(x^j, q^j) \right] \left[-\phi_{x^j x^j}(x^j, q^j) \right] \right\} > \left\{ \left[p^0 \psi_{q^j}(q^j) - \phi_{q^j x^j}(x^j, q^j) \right]^2 \right\}$$

$$\left. \frac{dq}{dx^j} \right|_{x^j x^j} = \left[\pi^j_{q^j q^j} \right] \left[\pi^j_{x^j x^j} \right] > \left[\pi^j_{x^j q^j} \right]^2 = \left. \frac{dq}{dx^j} \right|_{q^j q^j}.$$

(A2.6)

The slope of the $x^j x^j$ curve is thus steeper than the $q^j q^j$ curve.

II.B. EFFECTS OF p^0 ON FIRM QUALITY AND OUTPUT

To examine how the representative firm adjusts quality and output to a change in the price of the reference quality, we form the differential of the two first order conditions in (2.12) and (2.13) to obtain:

$$\begin{aligned} d\pi_{q^j}^j = 0 = & \left[\frac{\partial \psi}{\partial q^j}(q^j, x^j) \right] dp^0 \\ & + \left[p^0 x^j \frac{\partial^2 \psi}{\partial q^{j^2}} - \frac{\partial^2 \phi}{\partial q^{j^2}}(q^j, x^j) \right] dq^j \\ & + \left[p^0 \frac{\partial \psi}{\partial q^j}(q^j) - \frac{\partial \phi^j}{\partial q^j} \frac{\partial q^j}{\partial x^j}(q^j, x^j) \right] dx^j. \end{aligned}$$

(A2.7)

Then we compute:

$$\begin{aligned} d\pi_{x^j}^j = 0 = & \left[\psi(q^j) dp^0 \right] + \left[p^0 \frac{\partial \psi}{\partial q^j}(q^j) - \frac{\partial \phi}{\partial x^j} \frac{\partial x^j}{\partial q^j}(q^j, x^j) \right] dq^j \\ & + \left[- \frac{\partial^2 \phi}{\partial x^{j^2}}(q^j, x^j) \right] dx^j. \end{aligned}$$

(A2.8)

Setting $dp^0 \neq 0$ we have:

$$\left[\begin{array}{l} \left[p^0 x^j \frac{\partial^2 \psi}{\partial q^{j^2}} - \frac{\partial^2 \phi}{\partial q^{j^2}}() \right] \left[p^0 \frac{\partial \psi}{\partial q^j}(q^j) - \frac{\partial \phi^j}{\partial q^j} \frac{\partial q^j}{\partial x^j}() \right] \\ \left[p^0 \frac{\partial \psi}{\partial q^j}(q^j) - \frac{\partial \phi^j}{\partial x^j} \frac{\partial x^j}{\partial q^j}() \right] \left[- \frac{\partial^2 \phi}{\partial x^{j^2}}() \right] \end{array} \right]_x \times \left[\begin{array}{l} \frac{dq^j}{dp^0} \\ \frac{dx^j}{dp^0} \end{array} \right] = \left[\begin{array}{l} - \frac{\partial \psi^j}{\partial q^j}() x^j \\ - \psi(q^j) \end{array} \right] .$$

(A2.9)

Solving for dq^j/dp^0 we have:

$$\frac{dq^j}{dp^0} = \frac{1}{|J^j|} \left\{ - \frac{\partial \psi^j}{\partial q^j}() x^j \left[- \frac{\partial^2 \phi}{\partial x^{j^2}}() \right] \right. \\ \left. [- \psi(q^j)] \left[p^0 \frac{\partial \psi}{\partial q^j}(q^j) - \frac{\partial \phi^j}{\partial q^j} \frac{\partial q^j}{\partial x^j}() \right] \right\} > 0 .$$

(A2.10)

Solving for dx^j/dp^0 we get:

$$\frac{dx^j}{dp^0} = \frac{1}{|J^j|} \left\{ \left[p^0 x^j \frac{\partial^2 \psi}{\partial q^{j^2}} - \frac{\partial^2 \phi}{\partial q^{j^2}}() \right] \psi(q^j) \right. \\ \left. - \left[p^0 \frac{\partial \psi}{\partial q^j}(q^j) - \frac{\partial \phi^j}{\partial q^j} \frac{\partial q^j}{\partial x^j}() \right] - \frac{\partial \psi^j}{\partial q^j}() x^j \right\} > 0 .$$

(A2.11)

CHAPTER THREE

EFFECTS OF A QUOTA ON PRODUCT QUALITY:

THEORETICAL ANALYSIS

In this Chapter the model of chapter two is used to analyze the effect of a quota on import quality. Because in this model the effect of a quota and a unit tariff are the same, we focus on the unit tariff case to simplify the discussion.

This chapter is organized as follows. In section 3.1, the foreign firm's equilibrium under a specific tariff regime is analysed. In section 3.2, the home firm's production response to the specific tariff is worked out.

3.1. EQUILIBRIUM UNDER A UNIT-TARIFF (OR QUOTA) ON FOREIGN PRODUCTION

It is well known that in a competitive model the effect of a quota on product quality is analytically equivalent to that of a specific tariff. (The analytical equivalence between a quota and a unit tariff is shown in the Appendix III E.) Under quota restrictions, the cost of obtaining import licences adds a fixed charge per unit of imports. The analysis here is presented in terms of a unit or specific tariff on imports.

In the presence of a per unit tariff the representative foreign firm must take into account the tariff expense by which its sales revenue is reduced. Letting t denote the tariff per unit of imports, the representative foreign firm's profits are:

$$\pi^F = p^0 \psi(q^F) x^F - t x^F - \phi^F(q^F, x^F) \quad . \quad (3.1)$$

The first order conditions are:

$$p^0 \psi_q(q^F) x^F - \phi_q^F(x^F, q^F) = 0 \quad , \quad (3.2)$$

$$p^0 \psi(q^F) - t - \phi_x^F(q^F, x^F) = 0 \quad . \quad (3.3)$$

These conditions for the foreign firm are solved for x^F and q^F . The solution can be written as:

$$x^F = x^F(p^0, t) \quad , \quad (3.4)$$

$$q^F = q^F(p^0, t) \quad . \quad (3.5)$$

We now examine what happens to product quality and the output of the foreign firm once a specific tariff is put in place in the home market.

In our model the effect of a tariff can be decomposed into (a) the direct effect on quality or output of the foreign firm, and (b) the indirect effect due to the tariff causing the price of the reference quality to rise, which induces the foreign firm to change its optimal choice of quality and output.

The overall effect of a unit tariff on the quality and output of the foreign firm is obtained by totally differentiating (3.4) and (3.5):

$$dq^F = \frac{\partial q^F}{\partial t} dt + \frac{\partial q^F}{\partial p^0} \frac{\partial p^0}{\partial t} dt \quad , \quad (3.6)$$

$$dx^F = \frac{\partial x^F}{\partial t} dt + \frac{\partial x^F}{\partial p^0} \frac{\partial p^0}{\partial t} dt \quad . \quad (3.7)$$

The overall quality and output effects are evaluated by first considering the direct effects given by the first terms on the right hand sides of (3.6) and (3.7). As shown in Appendix III.A, the direct effects of the tariff on the output and quality of the foreign firm are:

$$\frac{\partial x^F}{\partial t} < 0 \quad . \quad (3.8)$$

$$\frac{\partial q^F}{\partial t} < 0 \quad . \quad (3.9)$$

These results can be explained with the help of Figure 3.1. Starting from free-trade equilibrium at point E^{F*} with p^0 and q^F held constant, the tariff in (3.3) lowers $MR(x^F)$ relative to $MC(x^F)$ by the amount t . The foreign firm reduces its output level to reduce $MC(x^F)$ so (3.3) is satisfied again. This means that the $x^F x^F$ schedule in Figure 3.1 shifts up and to the left to $x^{Ft} x^{Ft}$. The reduced x^F lowers the foreign firm's $MR(q^F)$. To satisfy (3.2) the foreign firm must also reduce its $MC(q^F)$ by decreasing q^F . In Figure 3.1 this is illustrated by a move from E^{F*} to E^{Ft} along the original $q^F q^F$ schedule. The new equilibrium point for the foreign firm at E^{Ft} shows that both x^F and q^F fall.

Figure 3.1: The Foreign Firm in Equilibrium with a Tariff

The indirect effect of a tariff on the quality and output of the foreign firm is easy to explain. We have shown that for a given p^0 , the tariff causes the foreign firm to reduce the quality and quantity supplied to the home market. The supply of foreign services on the home market will thus shift to the left under a tariff. This is illustrated in Figure 3.2 by the leftward shift of the foreign supply of services schedule from S^F to S^{Ft} . For a given net demand schedule for foreign services, the reference quality price rises to p^{0t} while the level of services falls to S^{Ft} . Thus we obtain the result that a specific tariff causes the price of the reference quality to rise:

$$\frac{\partial p^0}{\partial t} > 0 \quad . \quad (3.10)$$

We can now sign each term in (3.6) to evaluate the overall effect of the tariff on foreign quality. The direct effect is negative from (3.9). The indirect effect is positive because both $(\partial q^F / \partial p^0)$ and $(\partial p^0 / \partial t)$ are positive from (2.14) and (3.10), respectively. The overall effect of a specific tariff on the quality of imports is ambiguous.

Similarly, we can evaluate (3.7) for the overall effect of the tariff on foreign output. The direct effect is negative from (3.8). The indirect effect is positive because both $(\partial x^F / \partial p^0)$ and $(\partial p^0 / \partial t)$ are positive from (2.15) and (3.10), respectively. The overall effect of a specific tariff on quantity of imports, like the overall effect on quality, is ambiguous.

The difference between the ambiguous effect in our model of a tariff on import quality and the unambiguous result obtained by Rodriguez (1979), Falvey (1979), and others can be explained by differing assumptions. In Rodriguez's model, marginal cost is constant in output and increasing in quality. A specific tariff increases the foreign firm's marginal revenue by raising the price of services in the home market. Given the absence of a quantity effect on marginal cost the foreign firm can only increase its marginal cost by increasing quality to satisfy the first order conditions.¹ In our model the specific tariff also has an output effect so the foreign firm need not increase q to satisfy (3.2).

¹ In Rodriguez's (1979) model, total cost, TC , can be expressed as $\phi^F(q^F)x^F$. Then (3.2) becomes to $p^0 \psi_q(q^F) - \phi_q^F(q^F) = 0$, which does not involve x^F .

3.2. THE SPECIFIC TARIFF EFFECT ON HOME PRODUCTION

The only change for the representative domestic firm when imports are subject to a specific tariff is that the price of the reference quality from (3.10) rises relative to the free-trade situation. It follows that the first order conditions for the home firm remain the same as in the free-trade case:

$$p^0 \psi_q(q^H) x^H - \phi_q(x^H, q^H) = 0 \quad , \quad (3.11)$$

$$p^0 \psi(q^H) - \phi_x(x^H, q^H) = 0 \quad . \quad (3.12)$$

As in the free-trade case, these two conditions for the domestic firm are solved for x^H and q^H . By writing the solution in functional form we see that x^H and q^H depend only on p^0 and not on t :

$$x^H = x^H(p^0) \quad , \quad (3.13)$$

$$q^H = q^H(p^0) \quad . \quad (3.14)$$

In Appendix III.C, differentials of (3.13) and (3.14) are computed to examine what happens to output and quality of the home firm, given that imports are subject to a specific tariff. From (2.14) and (2.15) respectively, $\frac{dq^H}{dp^0}$ and $\frac{dx^H}{dp^0}$ are known to be positive. Since the tariff on imports raises

the price of the reference quality, it also increases $MR(q^H)$ in (3.11) for the home firm. To satisfy (3.11) the home firm upgrades quality. A specific tariff increases p^0 and $MR(x^H)$ in (3.12) so the domestic firm produces a larger quantity.

Combining the results from (3.15) and (3.16) we conclude that in the new equilibrium the level of services supplied by home firms will increase as the tariff on imports raises the price of the reference quality. This result is illustrated in Figure 3.2.

From Figure 3.1 it was seen that the specific tariff on imports led to reduced supply of foreign services. It is shown in Appendix III. D that this foreign supply reduction translates into higher demand for home supplied services.

Figure 3.3: Tariff: Home Services and the Reference Quality Price

In Figure 3.3, we begin with the free-trade price for the reference quality p^{0*} , and the free-trade level of home services, S^{H*} . The demand for home services shifts to the right from S_c^H to S_c^{Ht} . For a given domestic supply function $S^H(p^0)$, the excess demand increases the price of the reference quality from p^{0*} to p^{0t} , the same amount as in the foreign country analysis. The supply of home apparel services thus increases from S^{H*} to S^{Ht} .

APPENDICES TO CHAPTER THREE

III.A. THE DIRECT EFFECTS OF A TARRIF ON FOREIGN FIRM QUALITY AND OUTPUT

Under a specific tariff the foreign firm maximizes the following profit function:

$$\pi^F = p^0 \psi(q^F) x^F - t x^F - \phi(q^F, x^F) \quad . \quad (A3.1)$$

The first order conditions are:

$$\pi_{q^F}^F = p^0 \psi_{q^F}(q^F) x^F - \phi_{q^F}(x^F, q^F) = 0 \quad , \quad (A3.2)$$

$$\pi_{x^F}^F = p^0 \psi(q^F) - t - \phi_{x^F}(q^F, x^F) = 0 \quad . \quad (A3.3)$$

The second order conditions are:

$$\pi_{q^F q^F}^F = p^0 \psi_{q^F q^F}(q^F) x^F - \phi_{q^F q^F}(x^F, q^F) < 0 \quad , \quad (A3.4)$$

$$\pi_{x^F x^F}^F = - \phi_{x^F x^F}(x^F, q^F) < 0 \quad , \quad (A3.5)$$

$$\pi_{q x^F}^F = \Pi_{x q^F}^F = [p^0 \psi_F(q^F) - \phi_{q x^F}^F(x^F, q^F)] > 0 . \quad (A3.6)$$

From these conditions we obtain the Jacobian:

$$|J^F| = \pi_{q q^F}^F \pi_{x x^F}^F - \left[\pi_{q x^F}^F \right]^2 > 0 . \quad (A3.7)$$

(A3.2) can be differentiated totally to obtain:

$$\begin{aligned} d\pi_{q^F}^F = 0 = & \left[\frac{\partial \psi}{\partial q^F}(q^F) \cdot x^F \right] dp^0 \\ & + \left[p^0 x^F \frac{\partial^2 \psi}{\partial q^{F2}} - \frac{\partial^2 \phi}{\partial q^{F2}}(q^F, x^F) \right] dq^F \\ & + \left[p^0 \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial q^F} \frac{\partial q^F}{\partial x^F}(q^F, x^F) \right] dx^F . \end{aligned} \quad (A3.8)$$

Totally differentiating (A3.3) yields:

$$\begin{aligned} d\pi_{x^F}^F = 0 = & \psi(q^F) dp^0 - dt \\ & + \left[p^0 \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial x^F} \frac{\partial x^F}{\partial q^F}(q^F, x^F) \right] dq^F \\ & + \left[- \frac{\partial^2 \phi}{\partial x^{F2}}(q^F, x^F) \right] dx^F . \end{aligned} \quad (A3.9)$$

Setting $dp^0 = 0$ and $dt \neq 0$, we have:

$$\begin{bmatrix} \left[p^0 x^F \frac{\partial^2 \psi}{\partial q^F{}^2} - \frac{\partial^2 \phi}{\partial q^F{}^2}(\cdot) \right] \left[p^0 \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi}{\partial q^F} \frac{\partial q^F}{\partial x^F}(\cdot) \right] \\ \left[p^0 \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial x^F} \frac{\partial x^F}{\partial q^F}(\cdot) \right] \left[- \frac{\partial^2 \phi}{\partial x^F{}^2}(\cdot) \right] \end{bmatrix} \begin{bmatrix} \frac{dq^F}{dt} \\ \frac{dx^F}{dt} \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} .$$

(A3.10)

The direct effect of a tariff on the quality and quantity of output of the foreign firm is given by:

$$\begin{aligned} \frac{\partial q^F}{\partial t} &= \frac{1}{|J^F|} \begin{vmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix} & \begin{bmatrix} p^0 \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial q^F} \frac{\partial q^F}{\partial x^F}(\cdot) \end{bmatrix} \\ \begin{bmatrix} 1 \end{bmatrix} & \begin{bmatrix} - \frac{\partial^2 \phi}{\partial x^F{}^2}(\cdot) \end{bmatrix} \end{vmatrix} , \\ &= \frac{1}{|J^F|} \left\{ - \left[p^0 \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial q^F} \frac{\partial q^F}{\partial x^F}(\cdot) \right] \right\} < 0 , \text{ and} \end{aligned}$$

(A3.11)

$$\begin{aligned}
 \frac{\partial x^F}{\partial t} &= \frac{1}{|J^{Ft}|} \begin{vmatrix} \left[p^0 x^F \frac{\partial^2 \psi}{\partial q^{F^2}} - \frac{\partial^2 \phi}{\partial q^{F^2}}(\cdot) \right] & \begin{bmatrix} 0 \end{bmatrix} \\ \left[p^0 \frac{\partial \psi}{\partial q^F}(\cdot) - \frac{\partial \phi^F}{\partial x^F} \frac{\partial x^F}{\partial q^F}(\cdot) \right] & \begin{bmatrix} 1 \end{bmatrix} \end{vmatrix} , \\
 &= \frac{1}{|J^{Ft}|} \left\{ \left[p^0 x^F \frac{\partial^2 \psi}{\partial q^{F^2}} - \frac{\partial^2 \phi}{\partial q^{F^2}}(\cdot) \right] \right\} < 0 .
 \end{aligned}$$

(A3.12)

III.B. THE EFFECT OF A SPECIFIC TARIFF ON p^0

The change in the price of the reference quality is determined by the interaction of the foreign supply and home demand for imports, as well as by the demand and supply of home products. Equating the two sources of supply to the demand for services in the home market, we obtain:

$$S_c = S_c^F + S_c^H = \frac{M}{p^0} \quad ,$$

$$\frac{M}{p^0} = \psi(q^F) x^F + \psi(q^H) x^H \quad , \quad (A3.13)$$

We know that q^j and x^j are each a function of p^0 so the price of the reference quality in the home market is given by:

$$p^0 = M / [\psi(q^F(p^0)) x^F(p^0) + \psi(q^H(p^0)) x^H(p^0)] \quad . \quad (A3.14)$$

Since both foreign quality and quantity are affected by the tariff, the equation in (A3.13) is modified to:

$$S_c = \frac{M}{p^0} = \psi[q^F(p^0, t)] x^F(p^0, t) + \psi[q^H(p^0)] x^H(p^0) \quad ,$$

$$M = p^0 \psi[q^F(p^0, t)] x^F(p^0, t) + p^0 \psi[q^H(p^0)] x^H(p^0) \quad . \quad (A3.15)$$

To analyse the effect of a tariff change on p^0 , we form the differential:

$$\begin{aligned}
 dM = 0 = & \psi[q^F(p^0, t)] x^F(p^0, t) dp^0 + \\
 & + p^0 x^F(p^0, t) \left[\frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial p^0} dp^0 + \frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial t} dt \right] + \\
 & + p^0 \psi[q^F(p^0, t)] \left[\frac{\partial x^F}{\partial p^0} dp^0 + \frac{\partial x^F}{\partial t} dt \right] + \\
 & + \psi[q^H(p^0)] x^H(p^0) dp^0 + p^0 x^H(p^0) \frac{\partial \psi}{\partial q^H} \frac{\partial q^H}{\partial p^0} dp^0 + \\
 & + p^0 \psi[q^H(p^0)] \frac{\partial x^H}{\partial p^0} dp^0 = 0 \quad .
 \end{aligned}$$

(A3.16)

Variables of interest can be factored out to yield:

$$\begin{aligned}
 dp^0 \left\{ \psi[q^F(p^0, t)] x^F(p^0, t) + p^0 x^F(p^0, t) \frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial p^0} + \right. \\
 + p^0 \psi[q^F(p^0, t)] \frac{\partial x^F}{\partial p^0} + \psi[q^H(p^0)] x^H(p^0) + \\
 \left. + p^0 x^H(p^0) \frac{\partial \psi}{\partial q^H} \frac{\partial q^H}{\partial p^0} + p^0 \psi[q^H(p^0)] \frac{\partial x^H}{\partial p^0} \right\} + \\
 dt \left\{ p^0 x^F(p^0, t) \frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial t} + p^0 \psi[q^F(p^0, t)] \frac{\partial x^F}{\partial t} \right\} = 0 \quad .
 \end{aligned}$$

(A3.17)

Finally, we can rearrange and solve to obtain:

$$\frac{dp^0}{dt} = - \frac{\left\{ p^0 x^F(p^0, t) \frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial t} + p^0 \psi[q^F(p^0, t)] \frac{\partial x^F}{\partial t} \right\}}{\left\{ \psi[q^F(p^0, t)] x^F(p^0, t) + p^0 x^F(p^0, t) \frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial p^0} + \right.}$$

$$+ p^0 \psi[q^F(p^0, t)] \frac{\partial x^F}{\partial p^0} + \psi[q^H(p^0)] x^H(p^0) +$$

$$\left. + p^0 x^H(p^0) \frac{\partial \psi}{\partial q^H} \frac{\partial q^H}{\partial p^0} + p^0 \psi[q^H(p^0)] \frac{\partial x^H}{\partial p^0} \right\}} > 0 .$$

(A3.18)

The expression $\frac{dp^0}{dt}$ is positive because each term in the denominator is positive while each term in the numerator is negative. When a tariff is imposed the price of the reference quality rises.

III.C. THE HOME FIRM AND TRADE RESTRICTION:

COMPARATIVE STATICS

Relative to the free-trade price of the reference quality in the home market, p^0 , the price under a tariff or a quota, $p^{0\alpha}$, is always higher. The home firm maximizes profit given by:

$$\pi^{q\alpha} = p^0 \psi(q^H) x^H - \phi(x^H, q^H) \quad . \quad (A3.19)$$

The first order conditions are:

$$\pi_{q^H}^H = p^0 \psi_{q^H}(q^H) x^H - \phi_{q^H}(x^H, q^H) = 0 \quad , \quad (A3.20)$$

$$\pi_{x^H}^H = p^0 \psi(q^H) - \phi_{x^H}(x^H, q^H) = 0 \quad . \quad (A3.21)$$

The second order conditions are:

$$\pi_{q^H q^H}^H = p^0 \psi_{q^H q^H}(q^H) \cdot x^H - \phi_{q^H q^H}(x^H, q^H) < 0 \quad , \quad (A3.22)$$

$$\pi_{x^H x^H}^H = - \phi_{x^H x^H}(x^H, q^H) < 0 \quad , \quad (A3.23)$$

$$\pi_{q^H x^H}^H = \pi_{x^H q^H}^H = [p^0 \psi_{q^H}(q^H) - \phi_{q^H x^H}(x^H, q^H)] > 0. \quad (A3.24)$$

We obtain the following expression for the Jacobian:

$$|J^{\alpha}| = \pi_{q^H}^H \pi_{x^H}^H - \left[\pi_{q^H x^H}^H \right]^2 > 0 \quad . \quad (A3.25)$$

Totally differentiating (A3.20) yields:

$$\begin{aligned} d\pi_{q^H}^H = 0 = & \left[\frac{\partial \psi}{\partial q^H} (q^H) x^H \right] dp^0 \\ & + \left[p^0 x^H \frac{\partial^2 \psi}{\partial q^{H^2}} - \frac{\partial^2 \phi}{\partial q^{H^2}} (q^H, x^H) \right] dq^H \\ & + \left[p^0 \frac{\partial \psi}{\partial q^H} (q^H) - \frac{\partial \phi}{\partial q^H} \frac{\partial q^H}{\partial x^H} (q^H, x^H) \right] dx^H \quad . \end{aligned} \quad (A3.26)$$

Totally differentiating (A3.21) yields:

$$\begin{aligned} d\pi_{x^H}^H = 0 = & \psi(q^H) dp^0 \\ & + \left[p^0 \frac{\partial \psi}{\partial q^H} (q^H) - \frac{\partial \phi^H}{\partial x^H} \frac{\partial x^H}{\partial q^H} (q^H, x^H) \right] dq^H \\ & + \left[- \frac{\partial^2 \phi}{\partial x^{H^2}} (q^H, x^H) \right] dx^H \quad . \end{aligned} \quad (A3.27)$$

Setting $dp^0 \neq 0$, we obtain:

$$\begin{bmatrix} \left[p^0 x^H \frac{\partial^2 \psi}{\partial q^{H^2}} - \frac{\partial \phi^2}{\partial q^{H^2}}(\cdot) \right] & \left[p^0 \frac{\partial \psi}{\partial q^H}(q^H) - \frac{\partial \phi}{\partial q^H} \frac{\partial q^H}{\partial x^H}(\cdot) \right] \\ \left[p^0 \frac{\partial \psi}{\partial q^H}(q^H) - \frac{\partial \phi^H}{\partial x^H} \frac{\partial x^H}{\partial q^H}(\cdot) \right] & \left[- \frac{\partial^2 \phi}{\partial x^{H^2}}(\cdot) \right] \end{bmatrix} \times$$

$$\begin{bmatrix} \frac{dq^H}{dp^0} \\ \frac{dx^H}{dp^0} \end{bmatrix} = \begin{bmatrix} - \left[\frac{\partial \psi}{\partial q^H}(q^H) x^H \right] \\ - \psi(q^H) \end{bmatrix},$$

(A3.28)

$$\begin{aligned} \frac{dq^H}{dp^0} &= \frac{1}{|J^{H\alpha}|} \left| \begin{bmatrix} - \left[\frac{\partial \psi}{\partial q^H}(q^H) x^H \right] \\ - \psi(q^H) \end{bmatrix} \times \right. \\ &\quad \left. \begin{bmatrix} \left[p^0 \frac{\partial \psi}{\partial q^H}(q^H) - \frac{\partial \phi^H}{\partial q^H} \frac{\partial q^H}{\partial x^H}(\cdot) \right] \\ \left[- \frac{\partial^2 \phi}{\partial x^{H^2}}(\cdot) \right] \end{bmatrix} \right| \\ &= \frac{1}{|J^{H\alpha}|} \left\{ \left[\frac{\partial \psi}{\partial q^H}(q^H) x^H \right] \frac{\partial^2 \phi}{\partial x^{H^2}}(\cdot) + \right. \\ &\quad \left. + \psi(q^H) \left[p^0 \frac{\partial \psi}{\partial q^H}(q^H) - \frac{\partial \phi^H}{\partial q^H} \frac{\partial q^H}{\partial x^H}(\cdot) \right] \right\} > 0. \end{aligned}$$

(A3.29)

The effect of a specific tariff on the home firm's output is given by:

$$\begin{aligned} \frac{dx^H}{dp^0} &= \frac{1}{|J^{H\alpha}|} \begin{vmatrix} \left[p^0 x^H \frac{\partial^2 \psi}{\partial q^{H^2}} - \frac{\partial \phi^2}{\partial q^{H^2}}(\cdot) \right] & - \left[\frac{\partial \psi}{\partial q^H}(q^H) x^H \right] \\ \left[p^0 \frac{\partial \psi}{\partial q^H}(q^H) - \frac{\partial \phi^H}{\partial x^H} \frac{\partial x^H}{\partial q^H}(\cdot) \right] & - \psi(q^H) \end{vmatrix} \\ &= \frac{1}{|J^{H\alpha}|} \left\{ - \left[p^0 x^H \frac{\partial^2 \psi}{\partial q^{H^2}} - \frac{\partial \phi^2}{\partial q^{H^2}}(\cdot) \right] \psi(q^H) \right. \\ &\quad \left. + \left[p^0 \frac{\partial \psi}{\partial q^H}(q^H) - \frac{\partial \phi^H}{\partial x^H} \frac{\partial x^H}{\partial q^H}(\cdot) \right] \left[\frac{\partial \psi}{\partial q^H}(q^H) x^H \right] \right\} > 0 . \end{aligned}$$

(A3.30)

III.D. THE EFFECT OF A SPECIFIC TARIFF ON IMPORT DEMAND

From (A3.13) we know that $S_c = S_c^F + S_c^H = \frac{M}{p}$, and from (A3.15) we know, $M = p^0 \psi[q^F(p^0)] x^F(p^0) + p^0 \psi[q^H(p^0)] x^H(p^0)$. Taking the total differential of this last equation, given income and the price of the reference quality, we obtain:

$$dM = 0 = p^0 \{ [x^q \psi_q(q^F) dq^F + \psi() dx^F] + [x^q \psi_q(q^H) dq^H + \psi() dx^H] \} \quad .$$

(A3.31)

Our analysis shows that with a tariff dq^F and dx^F are negative: foreign supply to the home market is reduced. For a given total home market demand for services, the reduction in demand for foreign services means that demand for home produced services shifts to the right (Figure 3.1) for each price of the reference quality. For a given supply schedule of services by the home firm, the price of the reference quality rises as does the level of home produced services. To satisfy (A3.31) both dq^H and dx^H must be positive.

III.E. THE TARIFF AND IMPORT QUOTA EQUIVALENCE

The analysis in Chapter three treated the effects of a specific tariff as qualitatively the same as those of a quota. This equivalence result holds true in our model.

In maximising profits the foreign firm takes into account that if $\bar{x}^F \leq x^{\theta F}$, where $\bar{x}^F$ is the quantity it produces and $x^{\theta F}$ is quota entitlement, it could sell the unutilized portion and obtain additional revenue equal to $\rho(x^{\theta F} - \bar{x}^F)$. When the quota constraint is binding, the foreign firm optimizes:

$$\mathcal{L}^{\bar{x}} = p^0 \psi(q^F) \bar{x}^F - \phi(x^F, q^F) + \rho(x^{\theta F} - \bar{x}^F) . \quad (\text{A3.32})$$

To the extent that the output of the foreign firm is below the maximum permitted by the quota license, the following first order conditions apply:

$$\mathcal{L}_{q^F}^{\bar{x}} = p^0 \psi_{q^F}(q^F) x^F - \phi_{q^F}(x^F, q^F) = 0 , \quad (\text{A3.33})$$

$$\mathcal{L}_x^{\bar{x}} = p^0 \psi(q^F) - \rho - \phi_x(q^F, x^F) = 0 . \quad (\text{A3.34})$$

Comparing (A3.34) with (A3.3), we find that if the quota charge, ρ , is the same as the specific tariff rate, t , there is no difference in the first order conditions for the case of a quota and the situation with a specific tariff. However, if the firm is using all its licensed allocation the applicable version of $\mathcal{L}_{x^F}^{F\bar{x}}$ is:

$$\mathcal{L}_{x^F}^{F\bar{x}} = 0 \quad . \quad (\text{A3.35a})$$

The second order conditions are:

$$\pi_{q^F q^F}^F = p^0 \psi_{q^F q^F}(q^F) x^F - \phi_{q^F q^F}(x^F, q^F) < 0 \quad , \quad (\text{A3.36})$$

$$\pi_{x^F x^F}^F = - \phi_{x^F x^F}(x^F, q^F) < 0 \quad , \quad (\text{A3.37})$$

$$\pi_{q^F x^F}^F = \pi_{x^F q^F}^F = [p^0 \psi_{q^F}(q^F) - \phi_{q^F x^F}(x^F, q^F)] > 0 \quad . \quad (\text{A3.38})$$

These conditions yield:

$$|J^{F\bar{x}}| = \pi_{q^F q^F}^F \pi_{x^F x^F}^F - \left[\pi_{q^F x^F}^F \right]^2 > 0 \quad . \quad (\text{A3.39})$$

Totally differentiating (A2.59) yields:

$$\begin{aligned}
 d\mathcal{L}_{q^F}^{\bar{F}x} = 0 = & \left[\frac{\partial \psi}{\partial q^F} (q^F) x^F \right] dp^0 \\
 & + \left[p^0 x^F \frac{\partial^2 \psi}{\partial q^{F^2}} - \frac{\partial^2 \phi}{\partial q^{F^2}} (q^F, x^F) \right] dq^F \\
 & + \left[p^0 \frac{\partial \psi}{\partial q^F} (q^F) - \frac{\partial \phi^F}{\partial q^F} \frac{\partial q^F}{\partial x^F} (q^F, x^F) \right] dx^F .
 \end{aligned}
 \tag{A3.40}$$

Differentiating totally (A2.60) we obtain:

$$\begin{aligned}
 d\mathcal{L}_x^{\bar{F}x} = 0 = & \psi(q^F) dp^0 - dp \\
 & + \left[p^0 \frac{\partial \psi}{\partial q^F} (q^F) - \frac{\partial \phi^F}{\partial x^F} \frac{\partial x^F}{\partial q^F} (q^F, x^F) \right] dq^F \\
 & + \left[- \frac{\partial^2 \phi}{\partial x^{F^2}} (q^F, x^F) \right] dx^F .
 \end{aligned}
 \tag{A3.41}$$

Setting $dp^0 = 0$ and $dp \neq 0$, we get:

$$\begin{aligned}
 & \left[\begin{array}{l} \left[p^0 x^F \frac{\partial^2 \psi}{\partial q^{F^2}} - \frac{\partial^2 \phi}{\partial q^{F^2}} () \right] \left[p^0 \frac{\partial \psi}{\partial q^F} (q^F) - \frac{\partial \phi^F}{\partial q^F} \frac{\partial q^F}{\partial x^F} () \right] \\ \left[p^0 \frac{\partial \psi}{\partial q^F} (q^F) - \frac{\partial \phi^F}{\partial x^F} \frac{\partial x^F}{\partial q^F} () \right] \left[- \frac{\partial^2 \phi}{\partial x^{F^2}} () \right] \end{array} \right]_x \\
 & \left[\begin{array}{l} \frac{dq^F}{dp} \\ \frac{dx^F}{dp} \end{array} \right] = \left[\begin{array}{l} 0 \\ 1 \end{array} \right] .
 \end{aligned}
 \tag{A3.42}$$

The solution for the direct quality effect of a tariff on the foreign firm is given by:

$$\begin{aligned} \frac{dq^F}{d\rho} &= \frac{1}{|J^F \bar{x}|} \begin{vmatrix} \begin{bmatrix} 0 \end{bmatrix} & \begin{bmatrix} p^0 \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial q^F} \frac{\partial q^F}{\partial x^F}(\cdot) \end{bmatrix} \\ \begin{bmatrix} 1 \end{bmatrix} & \begin{bmatrix} - \frac{\partial^2 \phi}{\partial x^{F^2}}(\cdot) \end{bmatrix} \end{vmatrix} \\ &= - \frac{\begin{bmatrix} p^0 \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial q^F} \frac{\partial q^F}{\partial \bar{x}^F}(\cdot) \end{bmatrix} > 0}{|J^F \bar{x}|} < 0, \end{aligned} \quad (A3.43)$$

$$\begin{aligned} \frac{dx^F}{d\rho} &= \frac{1}{|J^F \bar{x}|} \begin{vmatrix} \begin{bmatrix} p^0 x^F \frac{\partial^2 \psi}{\partial q^{F^2}} - \frac{\partial^2 \phi}{\partial q^{F^2}}(\cdot) \end{bmatrix} & \begin{bmatrix} 0 \end{bmatrix} \\ \begin{bmatrix} p^0 \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial x^F} \frac{\partial x^F}{\partial q^F}(\cdot) \end{bmatrix} & \begin{bmatrix} 1 \end{bmatrix} \end{vmatrix} \\ &= \frac{1}{|J^F \bar{x}|} \left\{ \begin{bmatrix} p^0 x^F \frac{\partial^2 \psi}{\partial q^{F^2}} - \frac{\partial^2 \phi}{\partial q^{F^2}}(\cdot) \end{bmatrix} \right\} < 0. \end{aligned} \quad (A3.44)$$

The effect of the quota charge on foreign quality and output is exactly the same as that of a specific tariff.

III.F. ANALYSIS OF A PROPORTIONAL TARIFF

Let τ denote an *ad valorem* tariff rate that the home government imposes on imports coming from the foreign country. The *ad valorem* tariff has the effect of raising p^0 , the price of the reference quality in the home market. The profit function of the foreign firm is:

$$\pi^F = p^0(1 - \tau) \psi(q^F) x^F - \phi(q^F, x^F) \quad . \quad (A3.45)$$

The first order conditions are:

$$\pi_{q^F}^F = p^0(1 - \tau) \psi_{q^F}(q^F) x^F - \phi_{q^F}(x^F, q^F) = 0 \quad , \quad (A3.46)$$

$$\pi_{x^F}^F = p^0(1 - \tau) \psi(q^F) - \phi_{x^F}(q^F, x^F) = 0 \quad . \quad (A3.47)$$

The second order conditions are:

$$\pi_{q^F q^F}^F = p^0 \psi_{q^F q^F}(q^F) x^F - \phi_{q^F q^F}(x^F, q^F) < 0 \quad , \quad (A3.48)$$

$$\pi_{x^F x^F}^F = - \phi_{x^F x^F}(x^F, q^F) < 0 \quad , \quad (A3.49)$$

$$\pi_{q^F x^F}^F = \pi_{x^F q^F}^F = [p^0 \psi_{q^F}(q^F) - \phi_{q^F x^F}(x^F, q^F)] > 0 \quad . \quad (A3.50)$$

From these conditions we obtain:

$$|J^{F\tau}| = \pi_{q^F q^F}^F \pi_{x^F x^F}^F - \left[\pi_{q^F x^F}^F \right]^2 > 0 \quad . \quad (A3.51)$$

As in the specific tariff case, the quality and quantity effects arise through two channels: the direct *ad valorem* tariff effect on the quality and quantity of the foreign firm, and the indirect effect due to the change in the market price of the reference quality.

$$dq^F = \frac{\partial q^F}{\partial \tau} d\tau + \frac{\partial q^F}{\partial p^0} \frac{\partial p^0}{\partial \tau} d\tau \quad , \quad (A3.52)$$

$$dx^F = \frac{\partial x^F}{\partial \tau} d\tau + \frac{\partial x^F}{\partial p^0} \frac{\partial p^0}{\partial \tau} d\tau \quad . \quad (A3.54)$$

As in the specific tariff case, we can calculate the direct effect:

$$\begin{aligned} d\pi_{q^F}^F = 0 = & \left[(1 - \tau) \frac{\partial \psi}{\partial q^F} (q^F) x^F \right] dp^0 \\ & - \left[p^0 \frac{\partial \psi}{\partial q^F} (q^F) x^F \right] d\tau \\ & + \left[p^0 (1 - \tau) x^F \frac{\partial^2 \psi}{\partial q^{F2}} - \frac{\partial^2 \phi}{\partial q^{F2}} (q^F, x^F) \right] dq^F \\ & + \left[p^0 (1 - \tau) \frac{\partial \psi}{\partial q^F} (q^F) - \frac{\partial \phi^F}{\partial q^F} \frac{\partial q^F}{\partial x^F} (q^F, x^F) \right] dx^F \quad . \end{aligned} \quad (A3.55)$$

$$\begin{aligned}
d\pi_{x^F}^F = 0 &= [(1 - \tau)\psi(q^F)] dp^0 - [p^0 \psi(q^F)] d\tau \\
&+ \left[p^0 (1 - \tau) \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial x^F} \frac{\partial x^F}{\partial q^F}(q^F, x^F) \right] dq^F \\
&+ \left[- \frac{\partial^2 \phi}{\partial x^{F^2}}(q^F, x^F) \right] dx^F .
\end{aligned}$$

(A3.56)

Setting $dp^0 = 0$ and $d\tau \neq 0$, we obtain:

$$\left[\begin{array}{l} \left[p^0 (1-\tau) x^F \frac{\partial^2 \psi}{\partial q^{F^2}} - \frac{\partial \phi^2}{\partial q^{F^2}}() \right] \left[p^0 (1-\tau) \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial q^F} \frac{\partial q^F}{\partial x^F}() \right] \\ \left[p^0 (1-\tau) \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial x^F} \frac{\partial x^F}{\partial q^F}() \right] \left[- \frac{\partial^2 \phi}{\partial x^{F^2}}() \right] \end{array} \right]_x$$

$$\left[\begin{array}{l} \frac{dq^F}{d\tau} \\ \frac{dx^F}{d\tau} \end{array} \right] = \left[\begin{array}{l} \left[p^0 \frac{\partial \psi}{\partial q^F}(q^F) x^F \right] \\ [p \psi(q^F)] \end{array} \right] .$$

(A3.57)

The solution for the direct quality effect of the tariff on the foreign firm is given by:

$$\frac{dq^F}{d\tau} = \frac{1}{|J^F\tau|} \begin{vmatrix} \left[p^0 \frac{\partial \psi}{\partial q^F}(q^F) x^F \right] \left[p^0(1-\tau) \frac{\partial \psi}{\partial q^F}(\cdot) - \frac{\partial \phi^F}{\partial q^F} \frac{\partial q^F}{\partial x^F}(\cdot) \right] \\ [p^0 \psi(q^F)] \left[- \frac{\partial^2 \phi}{\partial x^{F2}}(\cdot) \right] \end{vmatrix},$$

$$= - \frac{\frac{\partial^2 \phi}{\partial x^{F2}}(\cdot) \left[p^0 \frac{\partial \psi}{\partial q^F}(\cdot) x^F \right] - [p^0 \psi(\cdot)] \left[p^0(1-\tau) \frac{\partial \psi}{\partial q^F}(\cdot) - \frac{\partial \phi^F}{\partial q^F} \frac{\partial q^F}{\partial x^F}(\cdot) \right]}{|J^F\tau|} < 0.$$

(A2.82)

Solving for the direct quantity effect of the specific tariff on the foreign firm yields:

$$\frac{dx^F}{d\tau} = \frac{1}{|J^F\tau|} \begin{vmatrix} \left[p^0(1-\tau) x^F \frac{\partial^2 \psi}{\partial q^{F2}} - \frac{\partial^2 \phi}{\partial q^{F2}}(\cdot) \right] \left[p^0 \frac{\partial \psi}{\partial q^F}(q^F) x^F \right] \\ \left[p^0(1-\tau) \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial x^F} \frac{\partial x^F}{\partial q^F}(\cdot) \right] [p^0 \psi(q^F)] \end{vmatrix},$$

$$= \frac{1}{|J^F\tau|} \left\{ [p^0 \psi(\cdot)] \left[p^0(1-\tau) x^F \frac{\partial^2 \psi}{\partial q^{F2}} - \frac{\partial^2 \phi}{\partial q^{F2}}(\cdot) \right] - \left[p^0 \frac{\partial \psi}{\partial q^F}(q^F) x^F \right] \left[p^0(1-\tau) \frac{\partial \psi}{\partial q^F}(q^F) - \frac{\partial \phi^F}{\partial x^F} \frac{\partial x^F}{\partial q^F}(\cdot) \right] \right\} < 0.$$

(A3.58)

As in the case of a specific tariff, the direct effect of a proportional tariff on both the quality and output of the foreign firm is negative.

To evaluate the effect of the proportional tariff on the price of the reference quality in the home market, we begin with the equilibrium condition in the home market:

$$M = p^0 \psi[q^F(p^0, \tau)] x^F(p^0, \tau) + p^0 \psi[q^H(p^0)] x^H(p^0) \quad (A3.59)$$

To analyse the effect of a change in *ad valorem* tariff on p^0 , we form the differential:

$$\begin{aligned} dM^X = 0 = & \psi[q^F(p^0, \tau)] x^F(p^0, \tau) dp^0 \\ & + p^0 x^F(p^0, \tau) \left[\frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial p^0} dp^0 + \frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial \tau} d\tau \right] \\ & + p^0 \psi[q^F(p^0, \tau)] \left[\frac{\partial x^F}{\partial p^0} dp^0 + \frac{\partial x^F}{\partial \tau} d\tau \right] \\ & + \psi[q^H(p^0)] x^H(p^0) dp^0 + p^0 x^H(p^0) \frac{\partial \psi}{\partial q^H} \frac{\partial q^H}{\partial p^0} dp^0 \\ & + p^0 \psi[q^H(p^0)] \frac{\partial x^H}{\partial p^0} dp^0 = 0 \quad . \end{aligned} \quad (A3.60)$$

Factoring out variables of interest, we obtain:

$$\begin{aligned} dp^0 \left\{ \psi[q^F(p^0, \tau)] x^F(p^0, \tau) + p^0 x^F(p^0, \tau) \frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial p^0} \right. \\ \left. + p^0 \psi[q^F(p^0, \tau)] \frac{\partial x^F}{\partial p^0} + \psi[q^H(p^0)] x^H(p^0) \right. \\ \left. + p^0 x^H(p^0) \frac{\partial \psi}{\partial q^H} \frac{\partial q^H}{\partial p^0} + p^0 \psi[q^H(p^0)] \frac{\partial x^H}{\partial p^0} \right\} \\ + d\tau \left\{ p^0 x^F(p^0, \tau) \frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial \tau} + p^0 \psi[q^F(p^0, \tau)] \frac{\partial x^F}{\partial \tau} \right\} = 0 \quad . \end{aligned}$$

Finally, we rearrange and solve to obtain:

$$\frac{dp^0}{d\tau} = - \frac{\left\{ p^0 x^F(p^0, \tau) \frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial \tau} + p^0 \psi[q^F(p^0, \tau)] \frac{\partial x^F}{\partial \tau} \right\}}{\left\{ \psi[q^F(p^0, \tau)] x^F(p^0, \tau) + p^0 x^F(p^0, \tau) \frac{\partial \psi}{\partial q^F} \frac{\partial q^F}{\partial p^0} \right.}$$

$$+ p^0 \psi[q^F(p^0, \tau)] \frac{\partial x^F}{\partial p^0} + \psi[q^H(p^0)] x^H(p^0)$$

$$\left. + p^0 x^H(p^0) \frac{\partial \psi}{\partial q^H} \frac{\partial q^H}{\partial p^0} + p^0 \psi[q^H(p^0)] \frac{\partial x^H}{\partial p^0} \right\}} > 0 .$$

(A3.62)

The expression $\frac{dp^0}{d\tau}$ is positive because each term in the denominator is positive while each term in the numerator is negative. An increase in the tariff raises the price of the reference quality.

We want to evaluate the indirect effect of the proportional tariff on the quality and output of the foreign firm. We know that $\frac{dq^F}{dp^0}$ and $\frac{dx^F}{dp^0}$ are positive. As in the analysis of a specific tariff, we find that the signs of (A3.52) and (A3.53) are ambiguous. Changes in foreign quality and/or quantity following the imposition of a proportional tariff depends on whether the direct or the indirect effect dominates.

CHAPTER FOUR

THE CANADIAN CLOTHING INDUSTRY

Canada has a long history of tariff protection for clothing and textile production. In 1950s these industries faced increasing import competition from low cost countries so the Canadian government negotiated voluntary export restraints with countries like Japan. In 1960s imports from countries like Hong Kong, Taiwan, and South Korea increased. In 1970 the federal government formulated the Canadian Textile Policy with the aim of encouraging product-line specialization. By mid the 1970s imports from low cost producers were displacing Canadian manufacturing in both clothing and textiles.¹

¹ See, Mahon (1984): 50-57, and 96-109.

The Textile and Clothing Board (1977) recommended import quotas on a broad range of products to allow the clothing industry to modernize its production and management techniques. In early 1977, the government introduced quotas on clothing imports from low and high cost countries, but restrictions on high cost countries were withdrawn a year later.

The number of low cost developing countries subject to quota restrictions has grown steadily since 1977. When imports of apparel items from a low cost country became substantial, it was asked to limit its exports to Canada. Currently clothing imports to Canada from twenty-seven low-cost countries are subject to quota restrictions.

In section 4.1 of this chapter some features of Canadian and international apparel manufacturing and marketing are discussed. In section 4.2, the nature of the quota regime and its effect on the Canadian apparel market is described. In section 4.3, Canadian clothing market data on imports and domestic manufacturing are presented and discussed.

4.1. APPAREL MANUFACTURING

Clothing manufacturing is located primarily in the provinces of Ontario and Quebec. During 1981-1987, 60 percent of total labour employment in clothing were employed in Ontario and 26.5 percent in Quebec².

The share of clothing in overall Canadian consumption spending fell for a decade, until this trend reversed in 1985. In constant dollars, the share of clothing expenditures in total consumer expenditures on goods and services was 5.5 percent in 1981 but 5.77 percent in 1986³. Value added in the clothing industry increased from \$2.7 billion in 1984 to \$2.8 billion in 1985⁴.

Historically two-thirds of the Canadian clothing industry consisted of small scale operations. In 1985 smaller businesses made up 74 percent of all clothing establishments, shipping 32 percent of domestic clothing production. By contrast, the textile industry is dominated by large enterprises.

² Textile and Clothing Board, 1987, Table 12.

³ Textile and Clothing Board, 1987, Tables A-20 and A-21.

⁴ Statistics Canada, Catalogue No. 34-252.

At the end of the 1980s there appeared a trend toward larger firms in the Canadian clothing industry. Capital intensity in the clothing industry had been low relative to the textile industry, a fact attributed in the literature⁵ to small firm size and the labour intensive nature of manufacturing garments.

The manufacturing process in the clothing sector begins with the design of garments, based on forecasts of consumer demand, fashion, and style. The design is then made into patterns, which are used to cut the fabric purchased from textile mills. The cut fabric is then sewn or fused into garments, which are tagged and shipped through distribution channels to retail outlets. Many apparel manufacturers perform only some of these functions, sub-contracting parts of the production overseas or in Canada.

Apparel production equipment in Canada is similar to that of other countries. Because of the rapid diffusion of technology in competitive international markets, a technological advantage is difficult to maintain over time⁶.

⁵ Mahon (1984): 122.

⁶ Ahmad (1989): 29-30.

Within the garment industry, the labour skills required differ. The first step is designing the product. Once designers identify a new trend in clothing style, the task of cutting and stitching prototype clothing for models at fashion shows begins. Popular items are much sought after, but in a year or two the product cycle runs its course and the product becomes standardized. At this stage costs are reduced by using standard fabrics and producing the apparel item in large volumes.

Garment designing and cutting require specialized skills. These activities add value to the product and are carried out primarily in high-cost developed countries. Standardized products are contracted out to manufacturers in the low-cost developing countries. Such production involves mostly sewing, which is much less skilled than the design of a garment.⁷

In manufacturing clothing, producers can switch production lines from low quality to higher quality items fairly quickly. It is not unusual for a clothing producer to manufacture different product lines in successive years. Difficulty in reswitching product lines is primarily due to communication problems rather than production technology.

⁷ This is discussed in Lardner (1988) and Dagg (1990).

The activity of importing apparel involves the intermediation of trading houses overseas and importing firms in Canada before the product is passed on to the Canadian retailer. Canadian retailers and wholesale importers choose the fashions made for them by foreign producers.

Except for macroeconomic conditions, the demand and supply of basic standardized apparel items are not subject to drastic changes. Wholesale importers can place orders and be confident of selling out during the season. Standardized apparel items are usually sold in discount stores, which are first in placing import orders for the coming season. Retail department and chain stores are the next to place orders for goods of intermediate quality. Boutiques and specialty stores dealing in higher quality lines have to stay in close touch with the fashions of the season.

Due to flexibility in the manufacture of clothing, garment producers can respond quickly to any change in profitable opportunities as commercial policy shifts. Retail sales do not exhibit the same adaptability.

4.2. QUOTA RESTRICTIONS IN THE CANADIAN APPAREL MARKET

The tariff rate on Canadian clothing imports has averaged 25 per cent for the past two decades. Because tariff protection was not sufficient to counter the flow of imports from developing countries, Canadian authorities resorted to voluntary export restraints on several clothing items from 1970 to 1977. This system was not successful in restraining imports and was discarded in 1976 when a more restrictive form of quota was instituted.

From 1975 to 1976 imports of knitted and clothing items increased by 43 percent⁸. A large part of this growth was the reaction of both exporters and importers to the belief that the new form of quota would be based on recent historical performance. This anticipation was proved correct when a global quota system was imposed in 1977 on imports of clothing items from all clothing exporting countries whether high or low cost.

⁸ Jenkins, (1980).

In June 1978, the federal government announced that this quota system would be abolished in favour of a system of bilateral agreements between Canada and the most important of the low cost exporting countries. Initially, agreements were signed with the seven largest exporting countries, but by early 1980 fourteen bilateral agreements had been reached, and by December 1991 restraints applied to twenty-seven countries, namely:

Bangla Desh	Brazil	Bulgaria	China, P.R.
Czechoslovakia	Hong Kong	Hungary	India
Indonesia	Korea, North	Korea, South	Macau
Malaysia	Maldives	Mauritius	Pakistan
Philippines	Poland	Romania	Singapore
Sri Lanka	Taiwan	Thailand	Turkey
Vietnam			

No quotas were imposed on the clothing imported from the U.S. or high cost European producers. The move from a system of global to bilateral quotas did not involve any alteration of the tariff regime applying to such imports. However, in conjunction with the imposition of the global quota in 1977 the effective rate of tariff applicable to imports from Taiwan and South Korea was increased.

Some key characteristics of the Canadian clothing market are shown in Table 4.1.

Table 4.1: Apparent Canadian Market: All Clothing Subject to Restraint Measures

	1975	1979	1980	1981	1982	1983	1984	1985	1986
Share of market held by:									
Domestic Shipments	65	68	73	69	67	62	59	59	57
Imports	35	32	27	31	33	38	41	41	43
of which 'Low Cost' countries }	29	28	24	27	30	34	37	37	38

Source: TCB, 1987, Table A-18.

The market for clothing, in units of apparel, increased by 5 percent in both 1985 and 1986. Nonetheless, the market share of domestic clothing producers continued to decline in 1986, but at a slower rate than in previous years. The Canadian clothing industry was not successful in increasing productivity as productivity declined due to an expanded labour force.⁹

In value terms the share of clothing imports from the four major exporting countries (Hong Kong, South Korea, Taiwan and China) declined by 1.1 percent in 1986 to 57.6 percent. Over the period 1982 to 1986, the market share of

⁹ Textile and Clothing Board (1987), Tables 6-8.

Hong Kong declined from 22.5 percent to 18.8 percent while that of South Korea fell from 19.5 percent to 15.4 percent, as did that of Taiwan from 15.8 percent to 14.6 percent. The market share of China increased from 6.5 percent to 8.8 percent. Among industrialized countries, the United States continues to lose ground. Its share of the Canadian clothing import market dropped by 1.0 percent in 1986 to 5.7 percent.

From 1982 to 1986, Canada negotiated 25 bilateral restraint arrangements. Between 1981 and 1984, the share of the Canadian market held by domestic clothing producers declined from 69 percent to 59 percent. The recovery following the 1982 recession benefitted importers rather than domestic producers. In July 1986, the government announced a new policy to provide a more stable climate for the textile and clothing industries.¹⁰

The Canadian bilateral restraint arrangements from January 1987 to December 1991 permitted an annual average growth rate of imports of 3.2 percent, and were more restrictive than the arrangements for the 1982-1986 period when import growth averaged 3.6 percent. Import growth from the four major exporters was held to 1.8 percent while exports of other restrained countries to Canada grew at a rate of 5.6 percent.¹¹

¹⁰ Textile and Clothing Board Inquiry Reports (1985, 1987).

¹¹ Textile and Clothing Board (1987).

The key element in the operation of the system of bilateral quotas is that the exporting country now has administrative control over those who obtain licences to sell to Canadian importers. The export licences are issued by a special branch of the Ministry of Trade in each of these countries and are allocated to producers or exporters on the basis of past performance.

Canadian importers must find a manufacturer who has been either issued licences by firm's government to export the item or is able to purchase licences from another firm that has been issued some and is willing to sell. Licences for items where the demand is expected to be greater than the number specified by the quota ceiling quickly attain a market premium (a "quota charge") as importers bid against each other for the available quota. The quota charge is determined as a residual as are all types of economic rents. As a result, foreign exporters receive windfall income.

Quota rents and utilization rates over time can be illustrated following Jenkins (1980). The quota for a category of garments is specified for a period of one year. The export licences are used when the ordered goods are shipped and quota utilization counted in the year goods are delivered. However, licences are purchased at the time when the order is made which may be many months earlier.

To see this point, assume that Canadian firms are placing import orders for the fall season next year. Suppose that the importers of standardized clothing items place their orders in November and December this year, while the importers of more fashionable items place their orders in late January and early February. The nature of the market is such that the bulk of the transactions are carried out in the early part of the year. If the demand for an item is strong, there might be repeat orders for fashionable categories.

At the time the importer of standardized items needs to complete manufacturing agreements (in order to meet his delivery dates to retailers) there is little information available as to what the scarcity value of the quota licenses will be later in the year. If a manufacturer builds a quota charge of \$2 a dozen into a sale made in January, but runs out of quota space so that the firm cannot complete a transaction coming to it in July which would have paid it \$10 a dozen, the firm will have lost through its decision to sell early. At the same time if the firm asks too high a price for the quota early in the year and turns away buyers and thus ends up with a surplus of quota space at the end of the year, it will also have lost.

Most items under the bilateral quota have a positive probability of ending up in a situation near the end of the year where there is no quota space available despite a strong demand for the good. If this is the case, then early in the year when most of the orders are being placed the quota licenses for an item will have a positive expected value. Thus, importers will be charged a positive amount for the right to export to Canada even though at the end of the year surplus quota space is available.

The administration of the quota by the authorities in the exporting countries may lead to high charges for export licences and at the same time surplus quota space. Usually a part of the total quota is not allocated by the governments of the exporting countries in the early part of the year when most of the buying is done. Hence, quota space may be scarce during this period when it is needed, but become available later on when there may be less demand for it. These actions may be carried out by the exporting government if it thinks it has some influence over the prices in the importer's domestic market and thus can extract some monopoly rents for its firm with quota space. As imported garments have dominated the market for lower priced clothes in Canada, there may be validity in this view.

Because Canada negotiated bilateral quota agreements with most actual and potential exporting countries, these quotas effectively prevent importers from moving to new countries which have lower cost sources of supply. Therefore, if the traditional exporting countries are not able to maintain real productivity growth in the textile and clothing sectors equal to or greater than in other industries, their real supply costs for clothing will rise. If they rise faster than the increase in the costs of domestic producers in the importing country, then we would expect to see quota charges falling through time. In this case a falling value for the quota in the exporting country does not mean that Canadians are paying less for imports, but rather that the costs of production in the exporting country are absorbing a larger portion of the quota's scarcity rent.

4.3. THE DATA

To test the hypotheses concerning import quality and Canadian quality, we use disaggregated data for clothing product categories because quota controls are specified for narrowly defined product groups. Control groups are at two or most three digit levels.

Some of the control groups examined in this thesis were: "Dresses (women's, girls')" (42.1), "Skirts (women's, girls')" (42.2), "Full-fashioned Collar Shirts and Other Shirts (men's and boys')" (39.5), "Outer Jackets (excluding leather)" (46.1), "Overcoats, Topcoats (excluding leather) and Rainwear (textile)" (46.2), "Sweaters, Pullovers and Cardigans (men's, boys')" (50.1), "Sweaters, Pullovers and Cardigans (women's, girls)" (50.2), and "Sportscoats, Blazers and Fine Suits, (men's and boys')" (47).

Annual customs data on the total value and quantity of imports are obtained from Statistics Canada catalogue 65-203. We have compiled a data base from 1974 to 1987 for eleven import categories from four of Canada's major suppliers of clothing imports: Hong Kong, the Peoples Republic of China, South Korea, and Taiwan.

The data on Canadian product categories come from two sources. Annual total value and unit data are obtained from catalogue 31-211. Data on annual price indexes for various Canadian clothing product categories were made available by the Prices Division of Statistics Canada.

The price index data for five product categories were prepared specifically for this thesis by the Prices Division. Using these data we were able to compute quality indices for imports and for import-competing products manufactured in Canada.

Import unit value data were calculated from the yearly total value (net of tariff duties) and the quantity of imports. The Prices Division data on adjusted and unadjusted price indices are based on a monthly survey of Canadian manufacturing enterprises. The quality adjustment is made by asking how much additional cost the firm incurred over the last year by adding features to an already existing product. The incremental cost is subtracted from the unadjusted price as a proxy for quality improvement.

We consulted the Clothing Industry Division in the Ministry of Industry, Science and Technology to achieve an accurate matching of the import product categories to the Canadian product categories for the two types of Canadian data. For proper matching we had to combine several categories for both import and Canadian data:

1. The men's sweater category was obtained by combining sweaters, cardigans, men's and boys' sweaters, knitted wool, (784-40), acrylic, (784-43), and man-made fibres (784-46). The import category for Canada which corresponds is "Sweaters, knitted, men's" (7815) which is based on quality adjusted and quality unadjusted price indices obtained from Statistics Canada.

2. The women's sweater and knit blouses category was obtained by combining women's and girls' sweaters and cardigans, knitted wool, (784-41), acrylic, (784-44), and man-made fibres (784-47); and knitted blouses (784-14). The corresponding import category for Canada was "Knitted Sweaters, Blouses, tops, women" (7836).
3. Suit imports (783-69) correspond to Canadian suit categories men's suits, (781-41), women, misses, girls' suits (782-4) and men's sport suits (781-43).
4. Import data on foundation garments (789-21) corresponds to that category for Canada (7855).
5. The import categories "underwear made from woven fabrics" (781-19) and "underwear, nes" (781-49) were combined so as to correspond with men's (7817) and women's (7838) underwear data for Canada.
6. The import category "overcoats and topcoats men's and boys' (783-20) correspond to "coats, overcoats, men's" (7811) for the quality adjusted price index series and (781-3122) for total value and unit data for Canada.
7. Import data for shirts in the categories cotton (783-41), polyester (783-44), man-made fibre (783-45), and nes (783-47) correspond to the Canadian total value/unit data (7816).
8. The import category "outdoor jackets" (783-16) corresponds to the Canadian category "short coats" [(781-311) and (781-321)].

9. The import category of non-knit blouses was made up of cotton (783-12), and nes blouses (783-14), and corresponds to Canadian categories: women's (782-512), girls' (782-522), and children's (783-33) blouses.
10. Imports of non-knitted dresses of cotton (783-23), man-made fibre (783-24), and nes (783-25) correspond to the categories of dresses women and misses' (782-511), children (783-311), and girls' (782-521).
11. The import category "skirts, not-knitted" (783-49) corresponds to the Canadian category "skirts" (782-61).

To compute data on Canadian product quality, we need both the quality adjusted and unadjusted series. Based on quality adjusted and unadjusted price index series for products for the base year 1986, we computed price indexes for all import and Canadian product categories using 1974 as the base year.

In Chapter five is presented the empirical methodology to test the quality upgrading hypotheses of Chapter three using the data described above.

CHAPTER FIVE

IMPACT OF QUOTA ON PRODUCT QUALITY: EMPIRICAL ANALYSIS

In the clothing industry it is difficult to obtain data on relevant characteristics of imported and domestically produced apparel to allow the application of the hedonic price technique used by Feenstra (1984, 1988). We therefore developed an alternative measure of quality change based on special data on quality adjustment used by Statistics Canada to prepare price indexes for clothing products. This measure also uses the restrictions on utility function assumed in Chapter 2 and is thus closely related to the theoretical framework of this thesis.

For broad product groups, some researchers have used unit value data for subgroups to measure import quality. For example, Aw and Roberts (1986, 1988) used this approach to measure import quality change in footwear.¹ However, the quota on Canadian clothing imports is specified in terms of narrowly defined categories. To estimate quality change for such narrowly defined categories, the alternative measure developed in this thesis is useful.

The discussion in this chapter is as follows: in section 5.1, we explain the methodology for measuring quality change in imports and import competing products, while in section 5.2, the results are presented and discussed.

5.1. OUR MEASURE OF PRODUCT QUALITY

The home price of a variety, p^{qj} , is equal to the price of the reference quality, p^0 , times the quality index $\psi(q^j)$ from (2.7). Using a slightly different notation with time subscripts, this result can be restated as:

$$p_t^j = p_t^0 \psi(j_t), \quad j=H, F, \quad (5.1)$$

where j_t is the variety produced in period t by firms in country j and p_t^j is the unit value (the quality unadjusted price) in period t for country j .

¹Rodrik (1989) used unit value data to compare South Korean and Taiwanese product quality.

From (5.1) the quality of the variety produced by country j in time period t is:

$$\psi(j_t) = \frac{p_t^j}{p_t^0} \quad . \quad (5.2)$$

As (5.2) shows, $\psi(j_t)$ equals the ratio of p_t^j and p_t^0 . Although data on p_t^j were readily available for home and foreign countries, p_t^0 represents the price of an unobservable reference quality. For the home country Canada, we have quality adjusted price index data. We first show how these data were used to estimate $\psi(H_t)$. We then exploit relation (5.2) to estimate $\psi(F_t)$, using estimates of $\psi(H_t)$ and data on p_t^F and p_t^H .

Let $\bar{p}_t^H$ denote the quality adjusted price of the variety produced at home in period t . According to the method used by Statistics Canada this quality adjusted price can be expressed in terms of relation (5.1) as:

$$\bar{p}_t^H = p_t^0 \psi(H_{t-1}) \quad . \quad (5.3)$$

Thus, $\bar{p}_t^H$ represents the t -period price of the quality produced in period $t-1$. In each period the price is adjusted for quality change only between the current and the previous period.²

² Statistics Canada often measures the price change between periods t and $t-1$ (of $t-1$ quality), using estimates of cost changes between the same period.

Letting $\theta_t^H = \frac{P_t^H}{\bar{P}_t^H}$ and using (5.3) and (5.1), we

obtain:

$$\theta_t^H = \frac{\psi(H_t)}{\psi(H_{t-1})} \quad (5.4)$$

The ratio of the quality unadjusted and quality adjusted price indices expresses quality change in a product category from period to period. Using (5.4), $\psi(H_t)$ can be expressed as:

$$\psi(H_t) = \psi(H_0) \prod_{i=0}^{t-1} \theta_{t-i}^H \quad (5.5)$$

The home quality index in period t is the quality index in the base period 0 times the product of past ratios of quality unadjusted and quality adjusted unit values. To estimate these ratios we made use of special data on quality adjusted prices prepared for this thesis by Statistics Canada. We can thus directly obtain estimates of $\psi(H_t)$. The base year for all indexes in the present work is 1974, with the base year quality index $\psi(H_0)$ set equal to 100.³

³ Because Statistics Canada data is quality adjusted and unadjusted prices indexes, the estimates we compute are in the index number format. The quality unadjusted unit value index of the variety produced in period t in country j is I_t^j , where $[I_t^j = (p_t^j/p_{74}^j)]$; while the home variety quality adjusted unit value index in period t is $\bar{I}_t^H$, where $[\bar{I}_t^H = (\bar{p}_t^H/\bar{p}_{74}^H)]$. The home quality computation corresponding to

$$(5.5) \text{ is } \psi(H_t) = \psi(H_{74}) \prod_{i=74}^{t-1} \left[\frac{I_{t-i}^H}{\bar{I}_{t-i}^H} \right].$$

After getting a measure of $\psi(H_t)$, (5.1) is used to obtain:

$$\psi(F_t) = \psi(H_t) \frac{P_t^F}{P_t^H} \quad . \quad (5.6)$$

According to (5.6), the foreign quality index in period t is equal to the index of domestic quality in the same period times the ratio of unit values of foreign and home varieties. Once we have estimates for home quality estimates of foreign quality are obtained from unit value data on imports and domestic products. This procedure for estimating $\psi(F_t)$ uses the assumption of perfect substitution between varieties which underlies (5.1).

5.2. RESULTS

The effect of a quota on the quality of imports operates through both direct and indirect channels. The direct effect causes foreign firms to lower quality following the imposition of a quota while the indirect effect leads them to increase quality content. It is an empirical issue whether the direct effect dominates and quality is reduced, or the indirect effect dominates and the upgrading of import quality takes place. The popular view would expect the net effect to be positive.

The effect of an import quota on the quality of domestic varieties is the (positive) indirect effect working through

the cost function. The magnitude of this effect can be large or small, depending on the cost function. Comparing the effects on domestic and import quality, it is possible that the indirect effect on import quality not only exceeds the direct effect on import quality but also exceeds the effect on domestic quality. In this case, the net effect on import quality can be larger than the effect on domestic quality. The reason for such ambiguous results is that the magnitude of these effects depends on the cost functions in each country which usually differ.

The empirical work in this thesis focuses on the short run. The advantage of short-run assessment is that the effects of a quota can be isolated from other influences on quality. We compare average quality over the three years before and the three years after the imposition of the Canadian quota in June 1977. Since 1977 is a transitional year, it is not included in the comparison. The analysis in Table 5.1 compares the 1975-1977 and 1978-1980 periods.

The short run effects of the quota on the quality of home products and imports is shown in Table 5.1 for five quota restrained countries and seven product groups. These product groups represent categories for which we were able to obtain quality adjusted prices ($\bar{p}_t^H$) and were able to match Canadian and import data. The quality of Canadian products [$\psi(K_t)$] is calculated according to (5.5) using estimates of the θ^H 's.

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Estimation of the θ^H 's require data on both quality adjusted and unadjusted prices. While the Prices Division of Statistics Canada made quality adjusted price data available for all seven categories, it provided comparable quality unadjusted price data for only three categories: Men's sweaters; Underwears; and Foundation garments. For the remaining four categories: Shirts; Overcoats, shortcoats, and topcoats; Women's sweaters, knit blouses, tops; and Suits, the unadjusted price indexes were computed from unit value data obtained from the Clothing Products Division of Statistics Canada.

In Table 5.1 we consider the five major quota restrained exporters of apparel to Canada: Hong Kong (*HK*), the Peoples' Republic of China (*CH*), South Korea (*SK*), the Philippines (*Ph*), and Taiwan (*TW*). For the product category foundation garment, *PH* and *HK* are the major import suppliers; *CH*, *SK*, and *TW* are therefore dropped. For other product categories *Ph* is not a major supplier and is eliminated. To compute $\psi(j_t)$, for $j = Hk, Ch, Sk, Tw, Ph$, we first got unit values from Customs data. These unit values were then used to compute quality unadjusted import price (p_t^j) indexes.

In Table 5.1 the pre-quota row shows three year averages for the 1975-77 period, while the post-quota row shows three year averages for the 1978-80 period. To test the quality upgrading hypotheses, we examined the ratio of the post-quota and pre-quota averages. (A value for the ratio greater than 1.00 lends support to the quality-upgrading hypothesis.)

Evidence from Table 5.1 suggests an upgrading of quality in the short-run in most import categories for most countries. There is a marked improvement in the quality of imports from Hong Kong, Taiwan and Philippines; the post/pre quota quality ratios for all products were higher than unity. In the case of South Korea the ratio is less than unity for the category "underwear", but is higher for all other product categories. For the People's Republic of China the ratio is lower than unity for "shirts" and "underweares" and higher than one for the other four categories. The empirical evidence thus favours the view that a quota leads an upgrading of import quality.

The evidence of Table 5.1 on the effect of an import quota on the Canadian quality of import-competing products is mixed and marginal. There appears to be no quality effect in the "men's sweaters" category while there is marginal quality upgrading of "underwear" and "foundation garments". There is a marginal decline in the quality of Canadian products in "women's sweaters, knit blouses, tops", "shirts", and "suits" categories. However, a significant quality upgrading did occur in the "overcoats, topcoats" category.

Table 5.1 Short Run Effect of Quota on Import Quality

Product Category	Country	Hong Kong	China	South Korea	Taiwan	Canada
Shirts	Pre Quota	98.51	96.66	93.16	94.57	105.65
	Post Quota	120.32	86.16	131.22	140.34	101.20
	Post/Pre	1.22	0.89	1.41	1.48	0.96
Overcoats shortcoats topcoats	Pre Quota	89.16	77.76	209.92	107.65	93.05
	Post Quota	267.58	205.00	397.56	118.73	107.80
	Post/PreQ	3.00	2.64	1.89	1.10	1.16
Suits	Pre Quota	79.58	92.65	100.48	74.81	105.16
	Post Quota	87.42	121.93	218.61	119.52	99.13
	Post/PreQ	1.10	1.32	2.18	1.60	0.94
Women's Sweaters knit Blouses tops	Pre Quota	84.65	69.54	86.98	97.16	108.03
	Post Quota	130.59	83.92	134.84	222.45	103.25
	Post/PreQ	1.54	1.21	1.55	2.29	0.96
Men's Sweaters	Pre Quota	94.07	83.57	104.76	91.83	99.90
	Post Quota	153.64	92.14	220.13	179.59	100.03
	Post/PreQ	1.63	1.10	2.10	1.96	1.00
Under- wears	Pre Quota	104.03	76.09	317.54	88.19	98.67
	Post Quota	126.75	74.95	299.88	166.79	100.05
	Post/PreQ	1.22	0.98	0.94	1.89	1.02
Foundation Garments (Girdles, brassieres, corsets)	Pre Quota	98.78	Philippines 120.14		-	99.33
	Post Quota	131.22	263.29		-	100.32
	Post/PreQ	1.33	2.19		-	1.01

In summary, the Candian quota on clothing imports appears to have led to higher import quality but only a marginal change in the quality of Canadian import competing products.

Measurement errors may well make it difficult to estimate the true effect of quota on Canadian quality. We next undertook statistical tests which take measurement errors into account.

To explore whether the post/pre quota quality differences presented in Table 5.1 are statistically significant, we estimated a pooled regression with dummy variables. Let set $\mathcal{I}$ represent *Can*, *Hk*, *Ch*, *Sk*, and *Ph* and set $\mathcal{J}$ all countries in set $\mathcal{I}$ plus Taiwan (*Tw*). Let set $\mathcal{V}$ represent the categories: Overcoats and topcoats, (*Ct*), Suits (*St*), Men's sweaters (*Ms*), Underwear (*Uw*), Shirts (*Sh*), and Foundation garments (*Fg*); and let set $\mathcal{U}$ be the products in set $\mathcal{V}$ plus Women's knit blouses, sweaters, tops (*Bl*). The regression equation is:

$$X_i^{u,j} = \alpha + \tau Q + \sum_I \beta_i D_i + \sum_I \gamma_i D_i Q + \sum_V \delta_v D_v + \sum_V \eta_v D_v Q + \epsilon_i, \quad (5.7)$$

$$t = 0, 1,$$

$$i \in \mathcal{I}, j \in \mathcal{J}, u \in \mathcal{U}, v \in \mathcal{V},$$

where $X_i^{u,j}$ represents the average quality for product u in country j in the pre-quota ($t = 0$) and post-quota ($t = 1$) period; Q is a quota dummy variable equal to 0 for $t = 0$ and equal to 1 for $t = 1$; D_i and D_v are country and industry dummy variables; and ϵ_i is the error term.

We included a constant and dropped *Tw* and *B1* from the regression so that τ estimates the effect of quota for *B1* in *Tw*. The effect of the quota for other cells can be calculated using appropriate country, product and interaction dummy variables:

τ captures the effect of the quota in the excluded country and the excluded industry,

$\tau + \eta_v$ is the effect of the quota on industry *v* in the excluded country,

$\tau + \gamma_i$ is the effect of the quota on the excluded industry in country *i*,

$\tau + \gamma_i + \eta_i$ is the effect of the quota on industry *v* in country *i*.

The pooled equation (5.7) provides additional degrees of freedom but requires the assumption that the distribution of the error term is the same for all products and countries. The results are presented in Table 5.2.

In Table 5.2, the estimate of τ is positive and significant at 5 percent level. The estimated γ_i 's, except for *Can* and *Ph*, are not significantly different from the effect of the quota on *B1* from *Tw*. All estimated η_i 's, except *Ct*, are negative but not significant. The results support the hypothesis that the quota had a significant positive effect on quality in all countries except Canada.

**Table 5.2: Short run Quality Effects of Quota,
Pooled Regression Analysis.**

Parameter:	α	β_{Hk}	β_{Ch}	β_{Sk}	β_{Can}	β_{Ph}
Estimate:	^{**} 76.87	0.24	-9.42	^{**} 59.68	11.51	26.84
St. Error:	19.60	19.24	19.59	19.59	19.24	44.89
Parameter:	τ	γ_{HK}	γ_{Ch}	γ_{Sk}	γ_{Can}	γ_{Ph}
Estimate:	^{**} 63.04	-9.74	-33.79	14.27	^{**} -57.28	^{**} 93.04
St. Error:	27.20	27.21	27.71	27.21	27.21	63.48
Parameter:	δ_{ct}	δ_{St}	δ_{Ms}	δ_{Uw}	δ_{Sh}	δ_{Fg}
Estimate:	26.23	1.27	5.08	[*] 47.63	8.44	16.42
St. Error:	21.46	21.46	21.46	21.46	21.46	21.46
Parameter:	η_{ct}	η_{St}	η_{Ms}	η_{Uw}	η_{Sh}	η_{Fg}
Estimate:	[*] 58.09	-7.00	-24.90	-23.93	-27.60	-12.93
St. Error:	30.35	30.35	30.35	30.35	30.35	41.56

Notes: * significant at 10 per cent level.

** significant at 5 per cent level.

$\bar{R}^2 = 0.38$, $R^2 = 0.46$, Number of Observations = 198.

In the case of Canada, the negative quality effect measured by the estimated γ_{can} cancels out the estimated τ effect; thus, we cannot reject the hypothesis of no quality improvement in import-competing Canadian clothing products.

Using the results in Table 5.2 we can generally accept the hypothesis of import quality upgrading at the 5 percent level of significance.

In the three years prior to and three years after the imposition of the quota in Canada, it is possible that factors other than the quota may have affected the results of Tables 5.1 and 5.2. Such factors could come through the demand or the supply side to affect quality in the Canadian clothing market via p^0 . To explore such a possibility we used the following regression model, including other determinants of quality and using data for the (longer) period from 1974 to 1986:

$$\Delta \log X_t^{uj} = \alpha^{uj} + \tau^{uj} Q + \beta_1^{uj} \Delta \log P_t + \beta_2^{uj} \Delta \log y_t + \epsilon_t^{uj},$$

$$j \in J, u \in U,$$

$$t = 1975, \dots, 1986,$$

(5.8)

where P_t is the *GDP* price deflator, and y_t is real *GDP* in Canada. Q is the quota dummy variable equal to 1 in 1977-1980 and 0 otherwise. The variables P_t and y_t are included to capture the effect of demand on p^0 . Because the effect of these variables on quality could differ between countries, we estimated equation 5.8 separately for each country j ($\in \mathcal{J}$) and each industry i ($\in \mathcal{I}$). In (5.8), α^{uj} represents the effect of a change in supply trends. The demand for clothing quality in Canada depends on the general price level (approximated by the *GDP* price deflator, P_t), and on real income as (measured by real *GDP* in Canada, y_t).⁴

The variables of the regression model are presented in the form of first differences to avoid serial correlation in the error terms. The double log specification of the model is easy to interpret since the estimates of the coefficients represent elasticities.

According to the quality upgrading hypothesis the quota should have a permanent effect on quality. As the quality variable in the regression model is specified in first differences, Q will have a positive effect only during the adjustment period following the imposition of quota.

⁴ In one regression we combined the P_t and y_t explanatory variables, but the estimated coefficients were different and therefore P_t and y_t were used separately.

A statistically significant estimate for β_i^{uj} in (5.8) implies an additional effect on X_i^{uj} that was ignored in the estimates of Table 5.1. The details of the results are in presented in Tables A5.1 to A5.7 in the Appendix to this Chapter. In most cases the variables P and y were insignificant leading one to doubt as to the importance of demand factors during 1977-1980.

In Table 5.3, estimates are presented of the effect of the quota, $\hat{\tau}^{uj}$, for each industry and country. The estimated coefficients are all positive but are significant at 5 per cent level only for Taiwanese shirts, Chinese coats, Taiwanese and Hong Kong suits, Hong Kong foundation garments. In the case of Canada there is no clear-cut and significant effect of the quota. A major limitation of our analysis is the low degrees of freedom. The estimated standard errors of the point estimators are often high relative to the estimated coefficients, so many coefficients are not significant.

The general thrust of the results in Table 5.3 is little different from those in Table 5.2: the quota had a positive and significant effect on some countries but had no discernible effect on Canadian quality.

**Table 5.3 Long Run Quota Effects on Product Quality:
Estimates of τ^{uj}**

Product Category	Country	Hong Kong	China	South Korea	Taiwan	Canada
Shirts	$\hat{\tau}^{uj}$	0.07	0.04	0.06	0.14*	-0.07
	Stand. Err.	0.04	0.14	0.10	0.04	0.06
Overcoats shortcoats topcoats	$\hat{\tau}^{uj}$	0.29	0.55**	0.32	-0.25	0.04
	Stand. Err.	0.22	0.18	0.20	0.38	0.25
Suits	$\hat{\tau}^{uj}$	0.23**	0.17	0.27*	0.44**	-0.09
	Stand. Err.	0.09	0.26	0.12	0.17	0.05
Women's Sweaters knit Blouses	$\hat{\tau}^{uj}$	0.31	0.29	0.32	0.33	-0.10
	Stand. Err.	0.31	0.29	0.34	0.28	0.19
Men's Sweaters	$\hat{\tau}^{uj}$	0.15	0.09	0.10	0.17	-0.05
	Stand. Err.	0.10	0.12	0.10	0.38	0.11
Under- wears	$\hat{\tau}^{uj}$	0.08	0.16	0.17	0.26	0.01
	Stand. Err.	0.10	0.13	0.14	0.23	.006
Foundation Garments (Girdles, brassieres, corsets)	$\hat{\tau}^{uj}$	0.12**	Philippines -0.01		-	0.007
	Stand. Err.	0.22	0.30		-	0.011

Notes:

* significant at 10 % and ** significant at 5 % level.

Sample from 1974-1986.

APPENDIX TO CHAPTER FIVE

Here we present in detail the results of separately estimating equation (5.8) for each industry u and each country j .

$$\Delta \log X_t^{uj} = \alpha^{uj} + \tau^{uj} Q + \beta_1^{uj} \Delta \log P_t + \beta_2^{uj} \Delta \log y_t + \epsilon_t^{uj}$$

$$j \in \mathcal{J}, u \in \mathcal{U},$$

$$t = 1975, \dots, 1986.$$

(5.8)

The results are presented for each product category in the Tables A5.1 to A5.7. Other supply side factors, represented by the estimated intercept term coefficients, are not significant for any country, except for imports of foundation garments from Hong Kong. The other demand side determinants, proxied by P_t and y_t , are insignificant with wrong sign. The fit of the regression, measured by R^2 , is poor for China, Taiwan and Canada, although in a few cases the fit is acceptable.

Table A5.1: Product: Women's knit blouses, sweaters, tops.
Long run effects of price and income on quality,
and the effect of quota: Regression Analysis.

	Const.	Q ₇₇₋₈₀	P	Y	R ²
Canada	-0.30 (0.29)	-0.10 (0.19)	3.08 (3.34)	4.10 (3.87)	0.16
HongKong	0.42 (.48)	0.31 (.31)	-4.21 (5.42)	-7.29 (6.28)	0.20
China	0.53 (.46)	0.29 (.29)	-6.29 (5.22)	-6.90 (6.04)	0.23
S. Korea	0.44 (.52)	0.32 (.34)	-4.95 (5.88)	-6.30 (6.81)	0.17
Taiwan	0.60 (.44)	0.33 (.28)	-6.40 (4.94)	-6.41 (5.72)	0.26

Table A5.2: Product: Foundation garments.
Long run effects of price and income on quality
and the effect of quota: Regression Analysis.

	Const.	Q ₇₇₋₈₀	P	Y	R ²
Canada	.007 (.017)	.007 (.011)	-0.09 (0.20)	-0.07 (0.23)	0.05
HongKong	-0.35** (.35)	0.12** (.22)	2.85** (3.95)	3.21** (4.58)	0.92
Philippines	-0.37 (.48)	-.01 (.30)	3.66 (5.38)	4.86 (6.23)	0.09

Notes:

* significant at 10 % and ** significant at 5 % level.

Standard errors are in parentheses; sample from 1974-1986.

Table A5.3: Product: Overcoats, short- and top coats.
Long run effects of price and income on quality
and the effect of quota: Regression Analysis.

	Const.	Q ₇₇₋₈₀	P	Y	R ²
Canada	0.10 (0.38)	0.04 (0.25)	-1.77 (4.35)	0.29 (5.04)	0.03
HongKong	0.57 (.35)	0.29 (.22)	-4.85 (3.95)	-7.72 (4.58)	0.34
China	-0.10 (.28)	0.50** (.18)	-0.64 (3.17)	1.29 (3.68)	0.51
S. Korea	-0.33 (.32)	0.32 (.20)	0.02 (3.57)	1.54 (4.13)	0.37
Taiwan	-0.73 (.60)	-0.25 (.38)	5.64 (6.73)	13.42 (7.80)	0.28

Notes: * significant at 10 per cent level.

** significant at 5 per cent level.

Number of observations = 12.

Standard errors are in parentheses.

Table A5.4: Product: Men's sweaters.

Long run effects of price and income on quality
and the effect of quota: Regression Analysis.

	Const.	Q ₇₇₋₈₀	P	Y	R ²
Canada	-0.10 (0.17)	-0.05 (0.11)	1.62 (1.88)	0.45 (2.18)	0.09
HongKong	-0.04 (.16)	0.15 (.10)	-1.32 (1.81)	2.72 (2.10)	0.38
China	0.04 (.19)	0.09 (.12)	-1.06 (2.20)	-0.31 (2.55)	0.07
S. Korea	0.01 (.16)	0.10 (.10)	-1.00 (1.77)	1.92 (2.05)	0.25
Taiwan	-0.82 (.60)	0.17 (.38)	6.41 (6.70)	6.79 (7.75)	0.19

Notes: * significant at 10 per cent level.

** significant at 5 per cent level.

Standard errors are in parentheses.

Number of observations = 12.

Table A5.5: Product: Shirts.

Long run effects of price and income on quality
and the effect of quota: Regression Analysis.

	Const.	Q_{77-80}	P	Y	R^2
Canada	-0.19 (0.09)	-0.07 (0.06)	1.52 (1.05)	3.19** (1.21)	0.49
HongKong	-0.08 (.07)	0.07 (.04)	0.20 (0.79)	1.90* (0.92)	0.48
China	0.03 (.21)	0.04 (.14)	-1.07 (2.43)	0.72 (2.81)	0.05
S. Korea	-0.20 (.15)	0.06 (.10)	0.64 (1.73)	5.22 (2.00)	0.49
Taiwan	-0.04 (.06)	0.14** (.04)	-0.86 (0.74)	2.81** (0.86)	0.77

Notes: * significant at 10 per cent level.

** significant at 5 per cent level.

Standard errors are in parentheses.

Number of observations = 12.

Table A5.6: Product: Suits.

Long run effects of price and income on quality
and the effect of quota: Regression Analysis.

	Const.	Q_{77-80}	P	Y	R^2
Canada	-0.08 (0.08)	-0.09 (0.05)	0.89 (0.95)	1.97 (1.10)	0.41
HongKong	0.08 (.14)	0.23** (.09)	-3.84** (1.55)	1.72 (1.80)	0.63
China	0.09 (.40)	0.17 (.26)	-1.17 (4.54)	-1.62 (5.26)	0.05
S. Korea	-0.23 (.19)	0.27* (.12)	0.31 (2.20)	3.83 (2.55)	0.50
Taiwan	0.40 (.26)	0.44** (.17)	-5.70* (2.93)	-4.63 (3.39)	0.52

Notes: * significant at 10 per cent level.

** significant at 5 per cent level.

Standard errors are in parentheses.

Number of observations = 12.

Table A5.7: Product: Underwear.

Long run effects of price and income on quality
and the effect of quota: Regression Analysis.

	Const.	Q ₇₇₋₈₀	P	Y	R ²
Canada	0.006 (0.01)	0.01 (.006)	-0.15 (0.11)	0.02 (0.13)	0.33
HongKong	0.02 (.15)	0.08 (.10)	-0.86 (1.72)	1.09 (2.00)	0.14
China	0.10 (.19)	0.16 (.13)	-4.52* (2.20)	3.18 (2.54)	0.53
S. Korea	0.13 (.20)	0.17 (.14)	-4.75* (2.28)	3.05 (2.59)	0.53
Taiwan	0.40 (.36)	0.26 (.23)	-4.66 (4.12)	-3.39 (4.77)	0.20

Notes: * significant at 10 per cent level.

** significant at 5 per cent level.

Standard errors are in parentheses.

Number of observations = 12.

CHAPTER SIX

CONCLUSIONS

This thesis deals with the effect of a quota on product quality in a competitive model, an issue analyzed by Falvey (1979), Rodriguez (1979), Mayer (1982), Anderson (1985) and Feenstra (1988). These models, using the assumption of constant marginal cost, obtain the result that the effect of a quota on import quality is unambiguously positive. This thesis allows for increasing (but different) marginal cost in each country and also considers the effect of a quota on the quality of domestically produced import-competing varieties.

Following Swan (1972) and Rodriguez (1979), quality is defined as the level of services a product provides. This general concept can easily be linked to the view of quality as a bundle of characteristics, used by Feenstra (1988) and others.

With a quota, foreign firms sell fewer units in the home country, causing a higher price of product service. Under the assumption of constant costs, this in price increase induces foreign firms to upgrade quality.

In our model with increasing marginal costs an import quota has two opposing effects. The quota reduces the foreign firms' marginal revenue, given a price of the services of the product, producing a negative effect on the firms' output and quality. On the other hand, the quota reduces the volume of imports and drives up the price of product service in the home market. This increase in price provides an incentive for foreign firms to raise quality.

In contrast to the previous literature, there are two opposing effects of a quota on import quality in the model of this thesis. Theoretically either effect could dominates.

For home firms, the effect of a quota operates only through the price of product service. The increase in price in the home market translates into higher marginal revenue for the home firms and induces them to increase quality. The model in this thesis predicts that the quality of import-competing domestically manufactured products rises unambiguously after the imposition of a quota on imports.

The analysis in this thesis suggests that whether the quota improves import quality or not is an empirical issue which can only be decided on the basis of an industry by industry and product by product analysis of the data. Empirical work by Feenstra (1984), Aw and Roberts (1988), and Anderson (1985), supported the view that a quota is associated with an upgrading of import quality. Our empirical work examines whether the quality upgrading effect holds in the Canadian clothing market.

The clothing and textile setting is a difficult area in international trade negotiations between developing and developed countries. Developing countries seek unrestricted access to clothing markets in developed countries. Protection in developed countries was intended to provide time for the consolidation of manufacturing in specialty and upscale niches in the clothing market.

Clothing is a competitive industry and the data available are much different than for industries such as automobiles. In the case of automobiles, data on characteristics such as horse-power, leg-room, seating capacity, engine size are available. Feenstra (1984) was able to use hedonic regression methods to measure import quality using data on characteristics. No corresponding characteristics data for apparel items are available. The model developed in this thesis is especially suitable for industries where data on characteristics are not available, yet inferences about product quality are required.

In Canada quota restraints were imposed in May 1977 on imports of clothing products from several low-cost countries. The quota protection was in addition to an average tariff of 25 percent. The quota was negotiated bilaterally by Canada with the exporting country. Quota licences were allocated by authorities in the foreign countries. Quota restrictions applied to narrowly defined product categories. In 1992, twenty-seven countries have clothing and textile agreements with Canada. Despite quota protection, the Canadian clothing manufacturers are going through a time of readjustment and retrenchment. It is thus interesting to examine the effect of the quota on the quality of import-competing products manufactured in Canada.

To test the model developed in this thesis we formulated a measure of the quality of import-competing products manufactured in Canada. This measure makes use of the quality adjusted price survey data for Canadian products as well as data on quality unadjusted price indices and unit value data on imports.

Unit value import data were used to create a measure of import quality. It is well known that unit value data can exhibit considerable noise. Measurement errors were kept to a minimum by establishing a close correspondence between Canadian import-competing product groups and import categories.

Using special data from Statistics Canada, quality change was measured as the ratio of quality unadjusted and quality adjusted prices for seven import-competing categories manufactured in Canada. The estimates for the Canadian product quality were then used to calculate estimates of import quality from Canada's five major low-cost import supplying countries: Hong Kong, People's Republic of China, South Korea, Taiwan, and the Philippines. Import quality is equal to the quality unadjusted price ratio of foreign and Canadian products times the Canadian quality of the corresponding product category.

Next, three year average quality levels, before the quota (1974-76) and after the quota (1978-80), were compared and the ratio of post-quota and pre-quota average quality calculated for each product from each country.

A marginal change was found in the Canadian quality of the seven import-competing categories after the introduction of the quota. For some products the post/pre-quota quality ratio is greater than one indicating that quality rose. For other product categories the ratio was slightly less than one indicating quality declined marginally. In one category quality did not change. There was no discernible pattern of quality change for the Canadian import-competing sector.

The effect of the quota on import quality is positive for all countries in most of the product categories since post/pre-quota quality ratios are greater than unity. Evidence from the Canadian clothing market lends support to the import quality upgrading hypothesis.

This evidence was supplemented by exploring a simple stochastic model based on data, pooled over product categories and countries. In the regression analysis dummy variables were introduced to capture country and product effects as well as quota-country and quota-product interactions. It was found that the quota has a statistically significant positive effect on the quality of imports, a confirmation of earlier results.

To check whether other determinants of quality could be influencing the results, regressions were run using data for 1974-1986 on real Canadian GDP, the GDP price deflator and a quota period dummy variable for each product and country. No systematic effect on the estimates of Canadian real GDP or GDP implicit price deflator was found.

In summary, the theoretical model predicts an ambiguous effect of a quota on the quality of imports and domestic import-competing products. Empirical support for the import quality upgrading hypothesis was obtained, but there was no clear cut effect on the quality of import-competing products.

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